Minerals yearbook 1936. Year 1935 1936

Kiessling, O. E.; Hughes, H. Herbert
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UNITED STATES DEPARTMENT OF THE INTERIOR
HAROLD L. ICKES, Secretary
BUREAU OF MINES
JOHN W. FINCH, Director

MINERALS YEARBOOK

1936

Compiled under the supervision of
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Mineral Resources and Economics Division

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1936

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FOREWORD

The primary function of the Minerals Yearbook is to provide in convenient form a comprehensive and accurate record of economic developments and trends in the mining industry of the United States for the information and use of producers and consumers of mineral commodities and of the general public. This annual record is based upon the fundamental statistics of production and marketing of minerals, supplied under a program of voluntary cooperation of industry with Government, which has produced results of expanding scope and increasing usefulness over a long period of years. Without the cooperation of the mineral industry the periodic accounts of its progress would be impracticable, and without the aid of such industrial annals the effective planning of policies and future operations of producers and consumers would lack effective guidance.

The factual data regarding the operations of the mineral industry of the United States in 1935 are presented and interpreted in this edition of Minerals Yearbook. The record is one of encouraging progress and promising trend, and it is submitted in the belief that it will prove of current interest and lasting value to both the mineral industry and the public which it universally serves.

The demand for Minerals Yearbook has grown rapidly in recent years, and in 1935 more than 9,000 copies were distributed. The 1936 edition is for sale by the Superintendent of Documents, Government Printing Office, Washington, D. C., at a price that is reasonably low. The Government Printing Office is an entirely separate organization, and no money is received by the Bureau of Mines from the sale of this or any other of its publications.

JOHN W. FINCH, *Director*.

JUNE 15, 1936.

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ILLUSTRATIONS

ACKNOWLEDGMENTS

This report marks the seventieth year of periodic surveys of mineral production by the Federal Government and the fifty-sixth year of the continuous annual record.[1] Like its predecessors, Minerals Yearbook 1936 has been made possible by the voluntary cooperation of those interested in the mineral industry. Throughout the United States and its Territories in the early months of each year mine owners, superintendents, plant managers, and accountants prepare statements for the Bureau of Mines covering mineral production and development during the past calendar year. It is the effort of these men—who frequently and cheerfully return to their accounts to settle some doubtful point—that makes possible the foundation of fact upon which the record of the mineral industry now stands. It is a pleasure to acknowledge the generous support of the thousands of individual producers, distributors, and consumers and of many public officials and agencies who have supplied information.

Primary returns from producers are supplemented by information from other sources, and the collection of coal statistics is a good illustration of such aid from both private and Government agencies. In addition to the 17 State geologists mentioned later, cooperative arrangements are maintained for the collection of coal data with the mine inspectors of 20 States, with 14 local associations of coal operators, with 5 railroad traffic organizations, and with 1 large trade association.

In preparing reports covering petroleum, natural gas, and related products, the Bureau draws upon the American Petroleum Institute, the American Gas Association, the National Gas Products Association, the Natural Gasoline Association of America, the Asphalt Institute, the Bureau of Railway Economics, the American Institute of Mining and Metallurgical Engineers, and other organizations. Many useful data are also obtained from the Oil and Gas Journal, the National Petroleum News, and the Oil Price Handbook.

Statistics for nonmetals other than fuels depend almost entirely upon the voluntary cooperation of literally thousands of individual operators. In addition, numerous company executives and other individuals give their time freely in helping to adjust problems that must be solved to maintain continuity and comparability of the figures. Also, the Bureau has been particularly fortunate in having the full cooperation of many of the trade associations in planning and executing its statistical program. Among these associations are the National Sand and Gravel Association, National Crushed Stone Association, National Lime Association, Gypsum Association, the Cement Institute, and the Granite Manufacturers Association.

In the collection of data on metals the nonferrous smelters throughout the country supply invaluable assistance, and the Bureau of the

[1] Minerals Yearbook, 1932–33, p. iii.

Mint cooperates in the compilation of production statistics of the precious metals. Here, also, the Bureau is indebted to various trade organizations. The Lake Superior Iron Ore Association assists in the compilation of statistics on iron ore production, the American Iron and Steel Institute cooperates in the Bureau's work on pig iron, steel, and ferro-alloys, and the Institute of Scrap Iron and Steel, Inc., aids the study of scrap-iron and steel consumption. The Bureau also benefits from the advice and cooperation of the American Zinc Institute, the Lead Industries Association, the Copper Institute, the American Bureau of Metal Statistics, and the American Manganese Producers' Association.

In addition to information supplied by the Bureau of the Mint, already noted, the Yearbook program draws upon the resources of other Government agencies. Unless otherwise noted, all tables of exports and imports were compiled from the records of the Bureau of Foreign and Domestic Commerce. Members of the United States Geological Survey contributed special reports on the geology of certain minerals, and the records of the Interstate Commerce Commission supplied valuable information. It will be readily seen that as the demand for minerals follows the progress of agriculture, trade, and industry, most Federal agencies contribute to the volume either directly or indirectly.

Under a cooperative arrangement between the Bureau of the Census and the Bureau of Mines, the 1935 figures included in this volume were collected through a consolidated schedule for each branch of the mining industry that incorporated the questions of both Bureaus. This arrangement was made upon the advice of the Central Statistical Board [2] in order to eliminate duplicate requests to business men for statistical information and to provide for the most efficient conduct of the survey. The Bureau of Mines undertook the responsibility of directing the canvass, although the cost of the work was borne by both agencies. That the industry appreciated the efforts made to reduce the labor of reporting is indicated from the following editorial comment quoted from the Engineering and Mining Journal: [3]

> Questionnaires to the mining industry this year combined the regular inquiry of the Census Bureau and that of the Bureau of Mines. This was intended to simplify and speed up the two statistical studies and to aid the industry in preparing quick returns, requiring only one, and not the customary two, separate reports. Unfortunate confusion followed because some who received the questionnaires thought that the officials of the Bureau of Mines were going into new fields. * * * As a matter of fact, no new information was sought by either Bureau. Those who have understood otherwise can put their fears aside and make a combined return. This will be regarded as confidential, just as always. It will merely result in more accurate and technically dependable reports. The most important advantage to be anticipated is that all returns will be inspected by competent experienced persons acquainted with mining statistics. * * * Prompt and full cooperation in replies is well-deserved.

State agencies play an important role in the annual canvass of minerals, and special acknowledgments are due State officials who have assisted in the collection of returns and who supplied information in their files. Help has been received from Walter B. Jones, State geologist, University, Ala.; Walter W. Bradley, State mineralogist,

[2] The Central Statistical Board was made a regular Federal agency under terms of the act of July 25, 1935 (49 Stat. 498). Previous to this date the board operated under the authority of executive orders (Executive Order 6225, July 27, 1933, and Executive Order 6700, May 4, 1934). Under both executive and legislative authority the Central Statistical Board has been directed to plan and promote the improvement, coordination, and economical operation of the statistical services of the Federal Government.

[3] Engineering and Mining Journal, vol. 137, no. 4, April 1936, p. 204.

San Francisco, Calif.; Herman Gunter, assistant supervisor of geological department, State board of conservation, Tallahassee, Fla.; Richard W. Smith, State geologist, Atlanta, Ga.; M. M. Leighton, chief of State geological survey division, and Walter H. Voskuil, mineral economist, 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, and H. S. McQueen, assistant State geologist, Rolla, Mo.; H. B. Kummel, State geologist, and Meredith E. Johnson, assistant State geologist, Trenton, N. J.; Charles C. Adams, director of New York State Museum, D. H. Newland, State geologist, and C. A. Hartnagel, assistant State geologist, Albany, N. Y.; H. J. Bryson, State geologist, Raleigh, N. C.; E. P. Rothrock, State geologist, Vermillion, S. Dak.; E. H. Sellards, director of bureau of economic geology, Austin, Tex.; Arthur Bevan, State geologist, University, Va.; Harold E. Culver, supervisor of division of geology, department of conservation and development, Pullman, Wash.; and E. F. Bean, State geologist, Madison, Wis.

In addition to supervising the preparation of graphic material, Max Abel served as editorial associate. M. B. Clark directed statistical presentation, and C. W. Justice assisted in many phases of the Yearbook program. M. E. Winslow supplied helpful suggestions for improvement of the individual chapters and directed the review of the separate contributions in collaboration with A. B. Brown, E. C. Reid, and E. R. Templeton. Y. S. Leong made important contributions to the first chapter and gave many helpful suggestions for the improvement of the figures on metals.

O. E. Kiessling.
H. H. Hughes.

June 15, 1936.

PART I. SURVEY OF THE MINERAL INDUSTRIES

REVIEW OF THE MINERAL INDUSTRY [1]

By F. J. McCarthy, Jr., O. E. Kiessling, and H. H. Hughes

SUMMARY OUTLINE

The mining industry, as well as other types of business activity, continued during 1935 the vigorous recovery evident in 1934. Mining, manufacturing, construction, trade, transportation, finance, and agriculture all shared in the advance that was particularly important during the latter part of the year. The improvement was well-sustained and of a general nature in contrast to the previous 2 years, when the revival was somewhat scattered. Output as well as prices advanced for almost all minerals as well as for most other commodities. Pay rolls moved to higher levels in the mining and associated industries as well as in manufacturing. Employment advanced in the industries associated with mining and in all manufacturing industries but dropped slightly in the mineral-extraction group. Stocks of minerals on hand, particularly stocks of base metals, followed the general downward trend of all raw-material stocks, although bituminous-coal stocks in the hands of consumers increased due to the greater need for coal as business became more active. In the mineral and associated industries a new all-time record was established for

[1] Figures for 1935 are preliminary; detailed data with final revisions will be released later.

gasoline consumption, and notable advances were made in crude oil production, consumption of base metals, iron and steel output, and gold and silver production. In other industries all-time records were established for electric power production, wool and rayon production, output of cigarettes, and sale of electric refrigerators. Substantial advances were made in the amount of money in circulation, automobile registrations, machine-tool orders, retail sales, stock and bond prices, and building construction. This general improvement was reflected in increased foreign trade and in better 1935 earnings statements of most mining companies, as well as of the majority of companies engaged in other types of business.

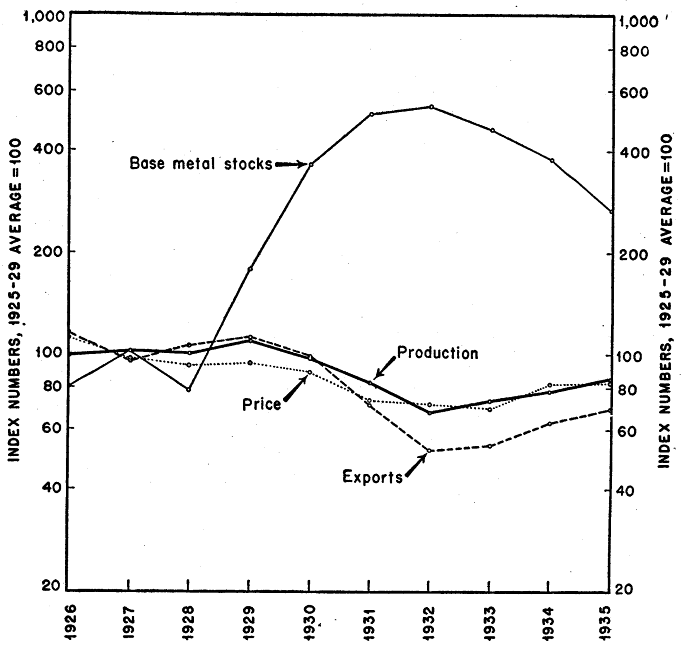

FIGURE 1.—Trends in quantity of mineral production, quantity of mineral exports, prices of all minerals, and quantity of base-metal stocks, 1926–35.

An outstanding development that was important to the minerals industry as well as to business generally in 1935 was the substantial improvement during the latter part of the year in the durable goods industries, which had been lagging during the depression. The necessity for modernization of equipment, the 44-percent increase in automobile production, and the rapid growth in private building construction were important influences in the advance of the heavy goods industries. Factors that affected the capital goods industries were likewise fundamental in the improvement of most branches of mining.

Another important development during 1935 was the invalidation of the National Industrial Recovery Act, which was declared unconstitutional by the United States Supreme Court on May 27. Immediately after the Court's decision there was some apprehension as to the movement of prices and production of almost all products, but most fears regarding the future were quickly dispelled and shortly afterward prices of many products, particularly metals, stiffened, and from then until the end of the year business improved.

The importance of minerals to present-day civilization was shown very pointedly in connection with sanctions that played an important role in international diplomacy during 1935, as some of the world powers attempted to check the Italian-Ethiopian conflict. The strategic value of minerals was demonstrated by the major place they occupied on the list of raw materials banned or proposed to be banned as exports to Italy by the majority of member countries of the League of Nations. Of the 17 commodities on the banned list, 15 were mineral products. Although petroleum was not banned it was considered so strategic that the imposing countries hesitated to add that commodity to the list for fear of precipitating a greater international crisis than already existed. This was the first time in the history of

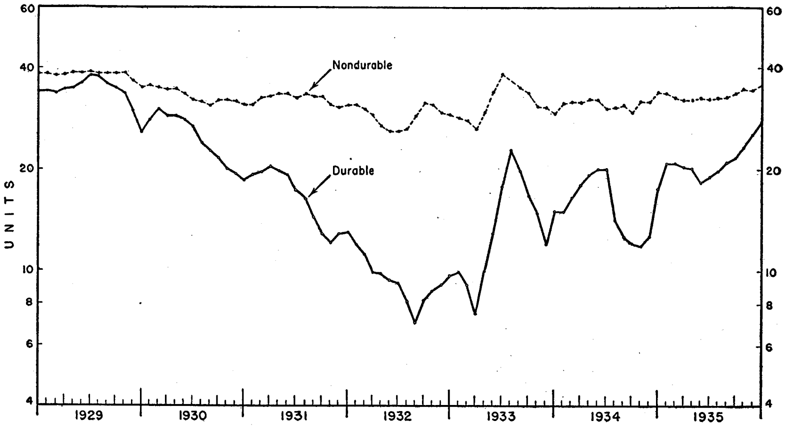

FIGURE 2.—Production of durable manufactures compared with nondurable manufactures, in comparable units and adjusted for seasonal variation, 1929–35. Data compiled by Federal Reserve Board from figures included in its index of manufactures.

the world when a large group of nations attempted such a large-scale application of economic sanctions against another nation to maintain peace, and the important place of minerals in those sanctions forecasts an even more dominant role in the future of international diplomacy.

PRODUCTION

The influence of general business revival affected almost every branch of the minerals industry during 1935, with the result that the physical volume of mineral production continued the increase that had been under way since 1932. Of particular importance was the pick-up in the durable goods industries that was relatively much greater than the gain for nondurable products. The heavy goods group had advanced hesitatingly since the early part of 1933 but made continuous progress from May 1935 until the end of the year, when activity for this group was approximately at a point comparable with that in the early part of 1930. The greater proportionate recovery from the bottom of the depression by the durable as compared with the nondurable goods industries was largely the result of increased automobile production, revival of private ship building, expanded railroad buying, increased building construction, higher activity in iron and steel manufacture, and the need for replacing heavy machinery. Unsettled political conditions in Europe likewise helped the sales of some strategic raw materials.

Mineral production.—The Bureau of Mines index of physical volume of mineral production advanced to 93 in 1935 (preliminary figures) from a low point of 74 in 1932 (1923–25=100), and most of the important individual minerals followed this upward trend. The base metals—copper, lead, and zinc—particularly copper, showed substantial increases in output as a result of better demand from the electrical goods, construction, automobile, and iron and steel industries. Some of the utility companies, which ordinarily are heavy buyers of copper, are reported to have purchased relatively

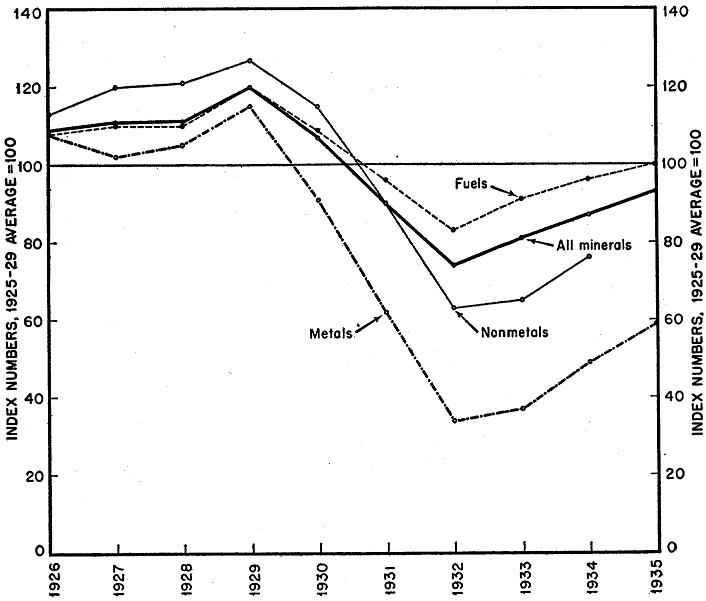

FIGURE 3.—Trends in the physical volume of production of all minerals, metals, fuels, and nonmetals, 1926–35.

small amounts due to legal uncertainties in that industry. Iron-ore production increased about 6,000,000 tons over 1934, largely as a result of the greater demand for iron and steel products from the automobile industry. The gain in iron and steel, together with its influence on many other types of heavy industry, was likewise important in the 3-percent advance of bituminous-coal production. Crude petroleum production, which amounted to almost 1,000,000,000 barrels in 1935, was the largest yield in the United States for any year except 1929. The larger output reflected an all-time record for gasoline consumption in 1935 and an increased demand for almost all other refinery products in both the foreign and domestic markets. The monetary metals likewise made gains, as the output of silver increased about one-third over 1934 in response to higher prices paid by the United States Treasury for domestic newly mined metal. The Treasury price of $35 per ounce for gold, as well as the influence of the higher purchasing power of the dollar during the period of depressed commodity prices, encouraged larger gold production.

Cement and anthracite output, however, dropped somewhat during 1935. Private building, although increasing, could not pick up the slack in cement demand that followed virtual completion of some large cement-consuming public works projects, such as Boulder Dam and those in the Tennessee Valley, and cement production dropped

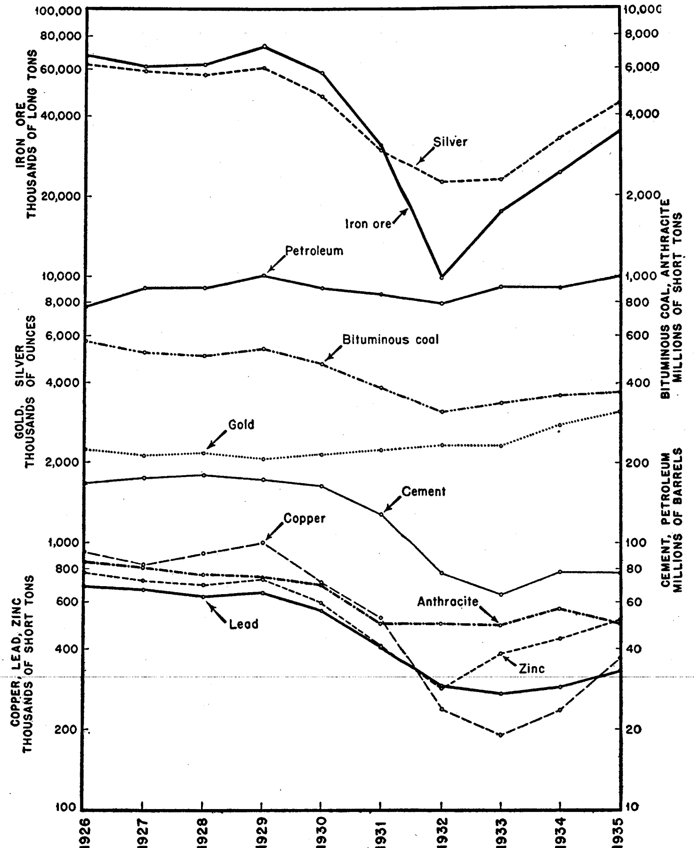

FIGURE 4.—Production trends of important minerals, 1926–35.

about 1,000,000 barrels. The intense competition of substitute fuels in the market previously dominated by anthracite, as well as the increased production of unrecorded bootleg coal, were factors in the 11-percent decline of anthracite production.

Manufacturing production.—Comparing the trend of mineral production with that of all manufactures, it will be noted that minerals and manufactures followed each other fairly closely, although during the depression minerals did not drop as low as manufactures (fig. 5). This was due largely to the relative inelasticity of demand for some of the mineral fuels, particularly the derivatives of petroleum, for which consumer demand did not decrease as much, relatively, as for most other products. Mineral production maintained a fairly high rate of output during the early part of 1935, declined during July and August, and then, along with the increased activity of manufactures, moved upward during the last quarter, when both manufactures and minerals went above their 1923–25 averages.

Construction.—The construction industry experienced severe losses during the depression, but there were encouraging developments during 1935. According to the Federal Reserve Board, building activity (which had been 135 percent of the 1923–25 average in 1928) dropped to 25 percent of the same average in 1933; during 1935,

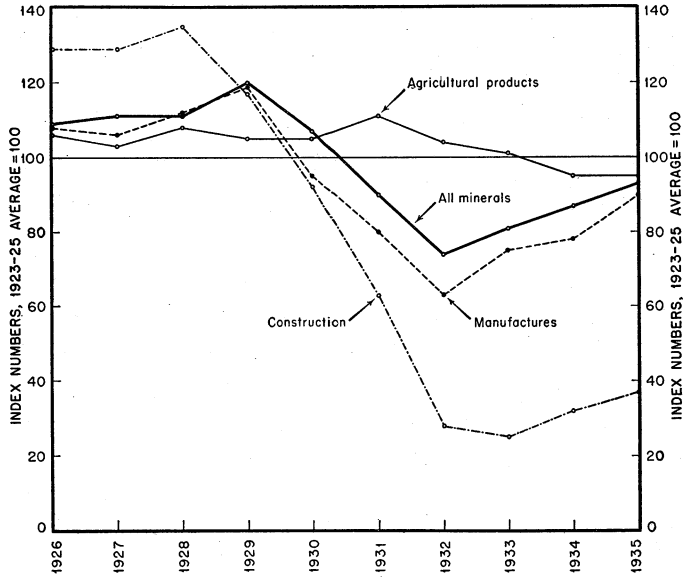

FIGURE 5.—Comparison of the trends of the physical volume of production for minerals, manufactures, agricultural products, and the value of construction contracts awarded, 1926–35. Manufactures and construction indexes from Federal Reserve Board data, and agricultural index from United States Department of Agriculture.

however, there was an increase from 26 percent of the 1923–25 average in March to 67 percent in December. It should be noted, however, that the Federal Reserve Board index is based on the value of contracts awarded as reported by the F. W. Dodge Corporation; thus the actual physical volume of construction undoubtedly did not decrease as much as the drop in the index, due in part to decreased costs of construction. Residential building revived rapidly in 1935 under the helpful influences of better credit conditions and rentals, while Federal funds continued to be a large factor in maintaining nonresidential construction.

Automobile and iron and steel production.—For a number of years trends in the automobile and iron and steel industries have been closely related, for the former is the latter's largest current customer (see fig. 7). Mineral production was relatively lower during the boom peak than the output of automobiles or of iron and steel, but minerals fared much better than either automobiles or iron and steel in the period 1930–34. In 1935 relative activity at iron and steel plants lagged behind mineral and automobile production. The better demand for iron and steel by the automotive trade was one of the first signs that the depression was waning, as automobile manufacturers quickly adjusted their programs to the changing character of the market; the result was substantial recovery, and by 1935 the index of automobile output (1923–25 average=100) stood at 101 compared with 35 in 1932 and 135 in 1929. The early introduction of 1936 models during 1935 was important in increasing sales in 1935, although the new practice apparently resulted in a slight recession

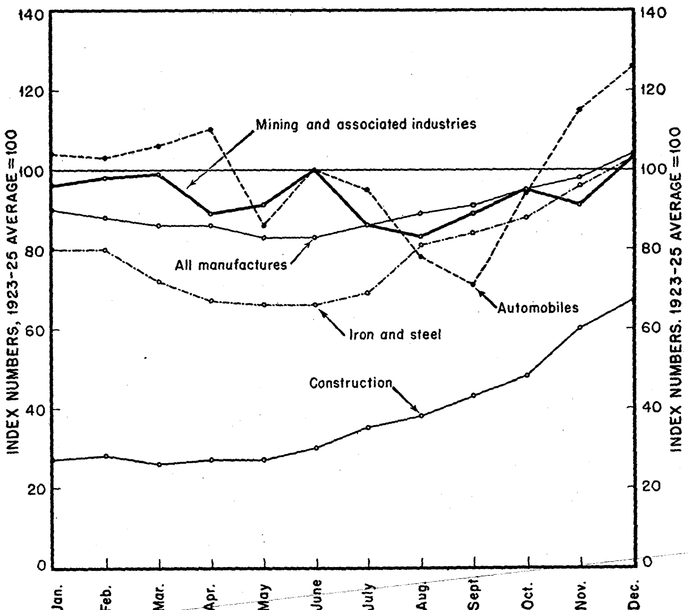

FIGURE 6.—Comparison of trends of physical volume of production for minerals, all manufactures, iron and steel, automobiles, and the value of construction contracts awarded in the United States in 1935, by months. All data from Federal Reserve Board. Minerals index adjusted to Bureau of Mines annual index of mineral production. All indexes adjusted for seasonal variation.

in demand during the early part of 1936. Most close observers of business trends agree that the remarkable recovery in the automobile industry had a widespread effect on all business and was a very important factor in the general business revival.

Agricultural production.—The downward trend of minerals and manufactures from 1929 to 1932 and the upward trend from 1933 to 1935 was almost the antithesis of agricultural production. The index for farm production increased from 105 in 1929 to 111 in 1931; in 1932 the index dropped to 104 and continued downward to 95 in 1934 and remained at this figure in 1935. The advance in output until 1931 was principally the result of larger livestock production and the effort of farmers to offset decreased prices by greater quantity production. The control measures sponsored by the Agricultural Adjustment Administration in its effort to assist the general welfare of the farming class, the drought, and the natural adjustment of farmers to depression conditions were the principal factors in the downward movement of agricultural production in the past 4 years. Based on the 1923–25 averages, agricultural, mineral, and manufacturing production approximated each other more closely during 1935 than in any year since 1930, and it will be recalled that one goal of various farm agencies has been to attain a better equilibrium between agriculture and industry.

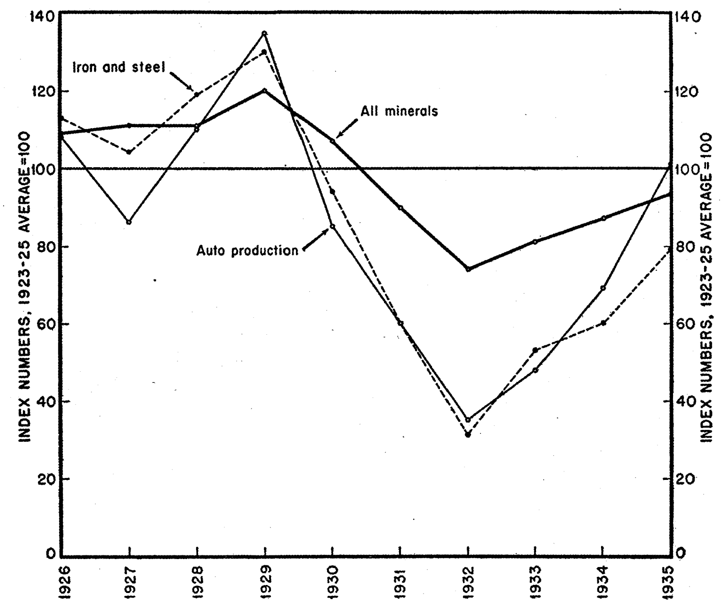

FIGURE 7.—Comparison of trends of physical volume of production for minerals, iron and steel, and automobiles, 1926–35. Iron and steel and automobile indexes compiled by Federal Reserve Board.

PRICES

Mineral prices.—Mineral prices increased during 1935 as a result of greater consumer demand and better adjustment of stocks in relation to consumption. Expanding credit, increased gold production, investment of funds in tangible commodities, and increased demand for war materials were additional factors in bettering the price structure in 1935. The price rise, however, was not as pronounced during 1935 as it was during the previous year, when improvement in mineral prices accompanied the activities of the National Recovery Administration. Following legal decisions in regard to the N. R. A. the price structure in almost all lines was temporarily unsettled due to uncertainty over the effect of the Supreme Court decision. Prices firmed shortly, however, and by the end of the year were above the 1934 average as a result of expanding industrial activity, particularly in the heavy goods industries.

Prices and index numbers of prices for the principal mineral commodities of the United States, 1932–35

Commodity	Average prices				Index numbers (1925–29 average=100)			
	1932	1933	1934	1935	1932	1933	1934	1935
Metals:								
Copper [1] cents per pound	6.3	6.4	8.0	8.3	43	43	54	56
Lead [1] do	3.0	3.7	3.7	4.0	43	53	53	57
Zinc [1] do	3.0	4.2	4.3	4.4	44	62	63	65
Gold [2] dollars per ounce	20.67	25.56	34.95	35.00	100	124	169	169
Silver [3] cents per ounce	28.2	35.0	64.6	71.9	47	58	107	119
Pig iron [1] dollars per long ton	14.80	14.86	16.73	16.91	80	80	90	91
Aluminum [1] cents per pound	19.5	19.0	19.0	18.5	81	79	79	76
Total metals, weighted average					67	70	81	83
Fuels:								
Petroleum [4] dollars per barrel	.87	.67	1.00	[5] 1.00	60	47	69	[5] 69
Natural gas [6] cents per M cubic feet	24.7	23.7	22.3	[5] 22.6	111	106	100	[5] 101
Bituminous coal [7] dollars per short ton	1.31	1.34	1.75	[8] 1.90	67	69	90	[5] 97
Anthracite [7] do	4.46	4.17	4.27	[5] 4.07	84	78	80	[5] 76
Total fuels, weighted average					71	65	81	[5] 83
Nonmetals:								
Sulphur [9] dollars per long ton	18.00	18.00	18.00	18.00	102	102	102	102
Portland cement [10] dollars per barrel	1.01	1.33	1.54	[5] 1.51	62	82	94	[5] 93
Lime [11] dollars per short ton	6.28	6.28	7.16	[5] 7.25	73	73	82	[5] 84
Sand and gravel [11] do	.48	.49	.53	[5] .53	80	82	88	[5] 88
Building stone [11] dollars per cubic foot	1.21	1.33	.95	[5] .71	97	106	76	[5] 57
Roofing slate [11] dollars per square	7.43	6.32	7.54	[5] 6.57	69	59	70	[5] 61
Gypsum [12] dollars per short ton	2.09	1.92	1.89	(13)	89	82	81	(13)
Crushed stone [11] do	.90	.86	.93	[5] .90	87	83	89	[5] 87
Salt [11] do	3.11	2.93	3.00	[5] 2.78	93	88	90	[5] 83
Total nonmetals, weighted average					76	84	90	[5] 87
Total minerals, weighted average					71	69	82	[5] 83

[1] The copper, lead, zinc, pig-iron, and aluminum prices are weighted averages, for each year, of all grades of primary metal sold by producers.
[2] The gold price for 1931–32 is $20.671835 per ounce, the Treasury legal coinage value for fine gold from Jan. 18, 1835, to Jan. 31, 1934; the price for 1933 is $25.56; for 1934, $34.95; and for 1935, $35 per ounce, the average weighted yearly U. S. Government prices.
[3] The silver price in 1931–33 is the average New York price for bar silver; in 1934 and 1935, the Treasury weighted average buying price for newly mined silver.
[4] Bureau of Mines average value at well.
[5] Subject to revision.
[6] Bureau of Mines average value at points of consumption.
[7] Bureau of Mines average value at mine.
[8] Average sales realization of all commercial operations reporting to N. R. A. from divisions I and II for January 1935. Final figures for entire year 1935 and for all districts and operations, including captive mines, not yet available. The figure is therefore not fully comparable with 1934.
[9] Average quoted price f. o. b. mine.
[10] Bureau of Mines average factory value.
[11] Bureau of Mines average value at plant or point of shipment.
[12] Bureau of Mines average value of crude, at point of shipment.
[13] Data not yet available but will be released later.

Mineral prices rose to an average of 83, or 1 point above 1934 (1925–29 average=100), according to preliminary figures based on actual data submitted by producers. Copper prices increased about 4 percent over 1934 and averaged 8.3 cents in 1935. The price of copper during the code had been stabilized at about 9 cents but dropped to about 8 cents after invalidation of the code. A further break may have been prevented when one of the leading groups of copper producers indicated that it would compete with any price cut and would intensify production unless cooperation could be obtained, according to observations in the 1935 Metal Report of Brandeis, Goldschmidt & Co., Ltd. Probably the most important factor affecting the market, however, was the advance in the international price that stimulated the domestic price; thus by the end of the year copper was selling in the domestic market at 9¼ cents, and heavy sustained buying was evident.

Lead prices started rising in the early part of 1935, and except for a minor disturbance at the time of the N. R. A. decision continued the advance throughout the year, closing December at about 4½ cents. The increased demand for lead, caused partly by the demand for war materials and partly by the gains in the battery and pigments

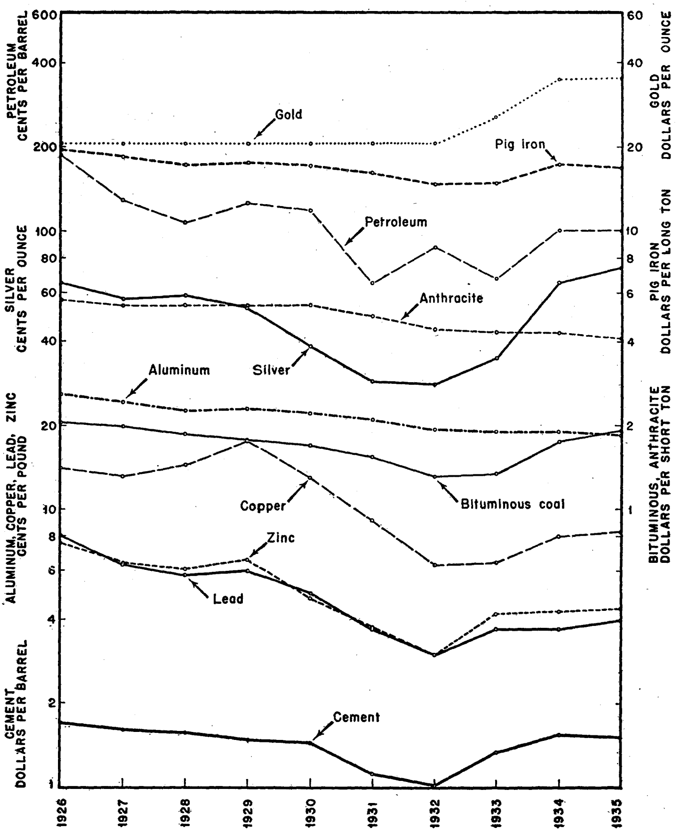

FIGURE 8.—Price trends of important minerals in the United States, 1926–35.

industries, was sufficient to offset the depressing factor of large stocks, and the 1935 average price for all grades increased about 8 percent over 1934. According to trade reports lead purchases were moving directly into manufacture and, so far as could be ascertained, the increase in price was influenced but little by speculative buying.

Zinc prices rose fairly consistently throughout 1935—from 3.71 cents per pound in February to 4.85 cents at the end of the year—but the yearly average was only slightly above that for 1934. The steady increase throughout 1935 reflected a better stock situation, as well as expanding industrial operations, particularly in the galvanizing industry, which had reached an average operating basis of 75 percent, with some plants running close to 100 percent capacity.

Silver was important in the news during 1935. The Treasury price for domestic newly mined silver was raised twice during 1935—from 64.64 to 71.11 cents an ounce on April 10 and again on April 24 to 77.57 cents. The open-market price increased rapidly during the first part of 1935—from 55 cents to 81 cents on April 26—a gain that was reported in the press as due to United States Treasury purchases and to speculation on the London exchange. During the latter part of the year the heavy selling of silver by oriental countries and the adoption of a policy by the United States Treasury of purchasing

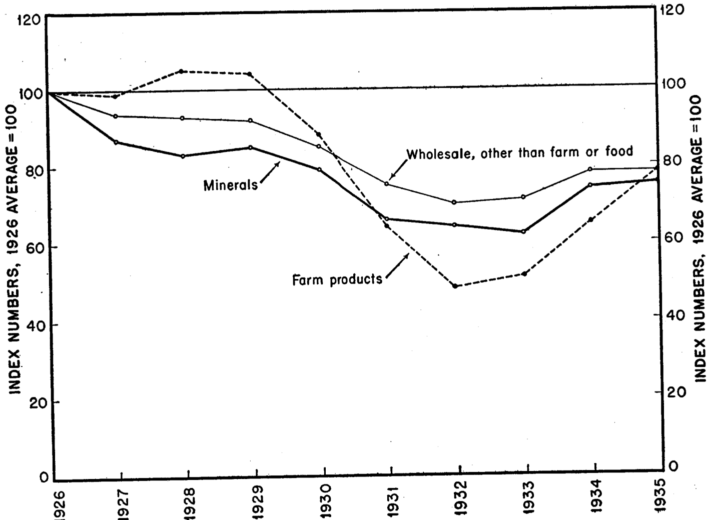

FIGURE 9.—Trends in the prices of minerals and of farm products, and in all wholesale prices other than farm products and foods in the United States, 1926-35. Wholesale and farm prices from Bureau of Labor Statistics.

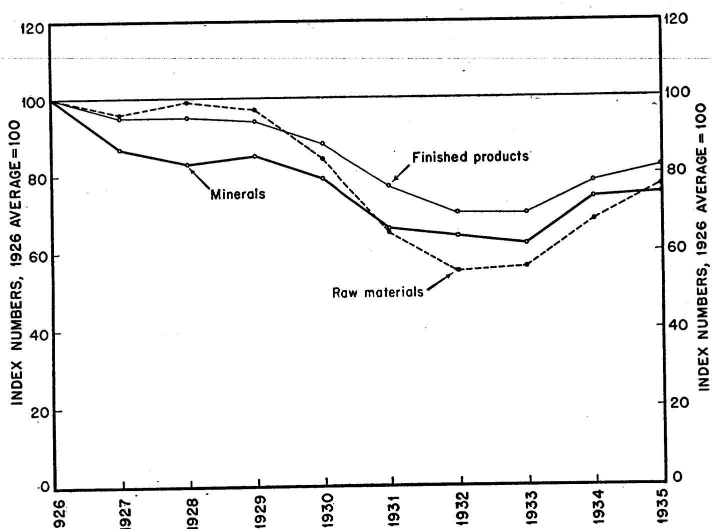

FIGURE 10.—Trends in the prices of minerals, raw materials, and finished products in the United States, 1926-35. Prices of raw materials and finished products from Bureau of Labor Statistics.

silver in many world markets apparently inaugurated a downward trend in the open-market price, which dropped to 49¾ cents at the end of 1935. The gold price continued at $35 per ounce throughout the year. The higher prices for the monetary metals in relation to the purchasing power of most currencies made the mining of these metals more profitable and stimulated production throughout the world.

The average crude petroleum price at the wells remained virtually unchanged compared with the previous year, although prices for many refined products were slightly higher. Gasoline prices particularly were well maintained as a result of the all-time record demand for motor fuel.

Bituminous-coal prices during the first part of 1935 were stabilized to a certain degree by the code, but sales were reported at less than code prices after termination of the N. R. A. However, the demand for coal by expanding industrial activity resulted in an advance in the Bureau of Labor Statistics average wholesale price of composite mine run from $4.18 per ton in April 1935 to $4.34 in December. Also, according to the Bureau of Labor Statistics, anthracite composite wholesale prices averaged about the same in 1935 as in the previous year.

The average price for cement showed a small drop to $1.51 per barrel in 1935 as demand declined slightly, while the price of aluminum continued the gentle downward tendency that had been evident for a number of years.

Wholesale and farm products prices.—All wholesale prices rose at a more rapid rate than minerals from 1934 to 1935, due almost entirely to the sharp rise in farm products and foods. The higher prices of farm products and foods was partly a reflection of crop curtailment and the generally increased purchasing power of all classes. For the first time since 1930 prices of farm products were higher in 1935 than all wholesale prices other than farm products and foods. Omitting the farm products and foods from the average wholesale price, the Bureau of Labor Statistics index declined slightly, from 78.4 in 1934 to 77.9 in 1935. Prices in general advanced more rapidly than production in 1934 when the N. R. A. codes were in effect, but in 1935 the prices of most commodities, except farm products and foods, did not rise as rapidly as production. Raw material prices in 1935 continued to pick up at a more rapid rate than the prices of finished products, a phenomenon that some students hold is characteristic of economic recovery.

STOCKS

The greater consumption of raw materials and the gradual adjustment of business to current conditions resulted in the movement of mineral stocks—particularly those of the base metals—to a better position relative to demand in 1935 than at any time during the past several years. An improved balance in supply and demand was likewise apparent for many commodities other than minerals, as was shown by the decline of 22 percent in the index of stocks of all raw materials reported by the Bureau of Foreign and Domestic Commerce.

Probably the most important adjustment of stocks took place in the base-metals group. The apparent increased consumption of copper resulted in the reduction of refined copper stocks to 175,000 tons, the lowest quantity since 1929. The greater demand for zinc, particularly during the latter part of the year from the iron and steel industry, and the decreased production during the 2-month strike in the Tri-State district, combined with the fact that competition with secondary zinc is relatively unimportant, were factors in the reduction of zinc stocks to about 91,000 tons or a little more than a 2-month supply based on

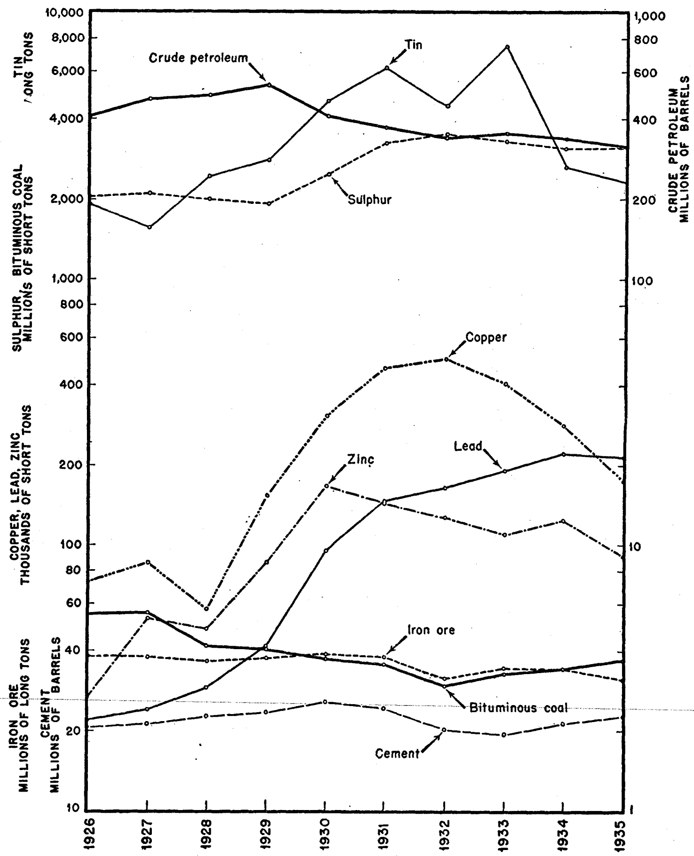

FIGURE 11.—Trends in mineral stocks in the United States, 1926–35.

1935 requirements. Lead stocks, which had increased continuously for at least a decade before 1935 and which reached the unusual figure of about 224,000 tons in 1934, showed a small but significant decline of about 8,000 tons in 1935. The increased amount of secondary lead from batteries coming back into the market, as well as the increased price of silver which tended to stimulate the production of silver-lead ores, were factors that contributed to the accumulation of high lead stocks.

Tin stocks in the United States were very low during 1935, particularly in view of the increased demand for tin by fabricators. In October 1935 the visible supply in the United States, according to the American Metal Market, was only 1,389 long tons, the lowest amount for any month in over 9 years; at the end of the year the reserve was only 2,312 tons. In spite of the small stocks, tin prices in 1935 were maintained at about the same level as 1934, averaging 50.39 cents per pound in 1935 compared with 52.16 cents the previous year. As stocks fell and the demand for tin increased, larger quotas were granted foreign tin producers during the last part of 1935 by the International Tin Committee.

In the nonmetallic group, crude petroleum stocks continued the general downward trend that has characterized the industry since 1929. Except for California the supply of petroleum in 1935 was fairly well controlled. The record-breaking gasoline demand plus the greater consumption of most refinery products were the important factors in reducing crude petroleum stocks.

Consumers' stocks of bituminous coal increased about 2,500,000 tons in 1935, due very largely to a higher rate of industrial activity.

Cement stocks likewise increased about 1,500,000 barrels, due to decreased consumption. Cement production declined slightly, and private construction required more cement than in the previous year, but these factors were more than offset by smaller requirements at some of the large Government projects nearing completion, such as Boulder Dam and those in the Tennessee Valley.

INCOME OF MINING COMPANIES

Larger production and better prices were reflected in higher earnings for most mining companies during 1935. Improved earnings statements were shown by most of the important nonferrous metal companies and oil producing and refining organizations, while the iron and steel industry attained a net income after 4 years of operating at a loss. The coal industry, however, did not follow the 3-year upward trend in earnings that affected most branches of mining, while the asphalt and cement industries were practically able to meet expenses but did not report a profit. These generalizations are, of course, based upon group averages of available data for typical companies and do not reflect the balance sheets of individual corporations or the records of companies not included in the group averages.

Percentage of net income or loss on invested capital of companies operating in various branches of the mining industry and in all industry, 1927–35 [1]

Industry	Number of companies	1927	1928	1929	1930	1931	1932	1933	1934	[2] 1935
Coal	8	−0.4	1.4	1.5	0.7	−0.2	−2.2	−2.3	0.0	−2.0
Oil producing and refining	26	4.7	8.8	8.8	3.9	−.9	1.1	1.5	2.7	4.1
Iron and steel	18	4.0	5.0	8.4	4.2	−.1	−3.6	−1.8	−.6	.7
Nonferrous metals:										
Copper, lead, and zinc	13	6.7	12.5	14.4	2.9	−.4	−3.6	−.1	1.6	3.8
Miscellaneous	8	7.1	9.1	10.0	4.8	1.0	−1.6	2.2	3.5	5.6
Total nonferrous metals	21	6.9	11.1	12.6	3.7	.2	−2.7	.8	2.4	4.6
Asphalt and cement	6	7.6	7.1	6.3	5.4	.1	−3.5	−2.2	−.2	.0
Total minerals	79	4.6	7.6	8.8	3.9	−.5	−.9	.3	1.5	2.9
All industrial	413	8.0	10.0	10.6	5.9	2.3	.3	2.5	3.8	[3] 5.5

[1] Figures compiled from data published by Standard Statistics Co. Net income represents amount available after depreciation and fixed charges. Total invested capital includes funded debt, common and preferred stock, capital reserves, and surplus.

[2] Estimated by the Bureau of Mines on the basis of data on individual companies published by Standard Statistics Co.

[3] Estimate based on the percent increase in the earnings of 909 companies from 1934 to 1935, as shown by Federal Reserve Bank of New York.

Income for mining compared with earnings in general industry.—According to preliminary figures for individual companies published by Standard Statistics Co., the percentage of net income on invested capital of 79 large mining companies continued to remain below that for 413 large industrial companies in 1935, although the net income of the industrial companies did not increase from 1934 to 1935 at as rapid a rate as that shown by the mining group. Earnings by the industrial companies were 5.5 percent in 1935 and 3.8 in 1934 compared with 2.9 percent in 1935 and 1.5 in 1934 by the mining companies.

The rise in general business activity in 1935, particularly during the fourth quarter, was reflected in better sales and resulted in higher profits in almost all lines of business. The 3-month advance in the production schedules of the automobile manufacturers had the effect of increasing production in many branches of industry, such as iron and steel, nonferrous metals, machinery, automobile accessories, tires, leather and fabric upholstery, electrical equipment, and paints and lacquers, while higher farm prices resulted in better demand for manufactured products from the agricultural areas. Increased building construction likewise helped many industries. Freight-car loadings increased over 2 percent in 1935 compared with 1934, but measured in net ton-miles the volume of traffic increased somewhat more than the number of cars loaded, as indicated in an increase in freight revenue of 6 percent in 1935 over 1934.

The net earnings of some lines of business, however, declined in 1935; this applied particularly to the fabricators of agricultural products, such as cotton goods, baking, dairy products, meat packing, tobacco, and miscellaneous fruit products. Manufacturers of railway equipment were unable to contribute very much to the increased profits of all industry, although the low level of maintenance expenditures during recent years indicates that there is probably an accumulated demand for that type of equipment.

Limitations of data.—An analysis of the earnings of the 79 mining companies as well as the 413 industrial companies over a period of years is of interest chiefly as an indicator of principal trends. It should be carefully noted that the average rates of return on invested capital for such a limited number of companies indicate merely such trends and do not provide an accurate measure of the net return for an entire industry that usually shows a lower level of earnings than the leading companies. Also, the percentage of net income or loss on invested capital over a period of years, particularly during the depression period, is not exactly comparable due to changes in the capital structure; for example, the invested capital of 79 mining companies declined from $13,355,000,000 in 1929 to $11,644,000,000 in 1934. All that has been said regarding the limitations of the available data on earnings for the "all industrial" and "mineral" groups applies in even greater degree when the size of the statistical sample is reduced by grouping the 79 mineral-producing companies under the major divisions of mining. Here again, however, the comparisons are interesting because the record covers a period of years.

Income of mining companies, by groups.—As will be seen from the accompanying table and graph, the coal industry has been unable to make a satisfactory income on invested capital for many years. The losses of eight large coal companies amounted to about 2 percent of invested capital in 1935 compared with a negligible gain in 1934.

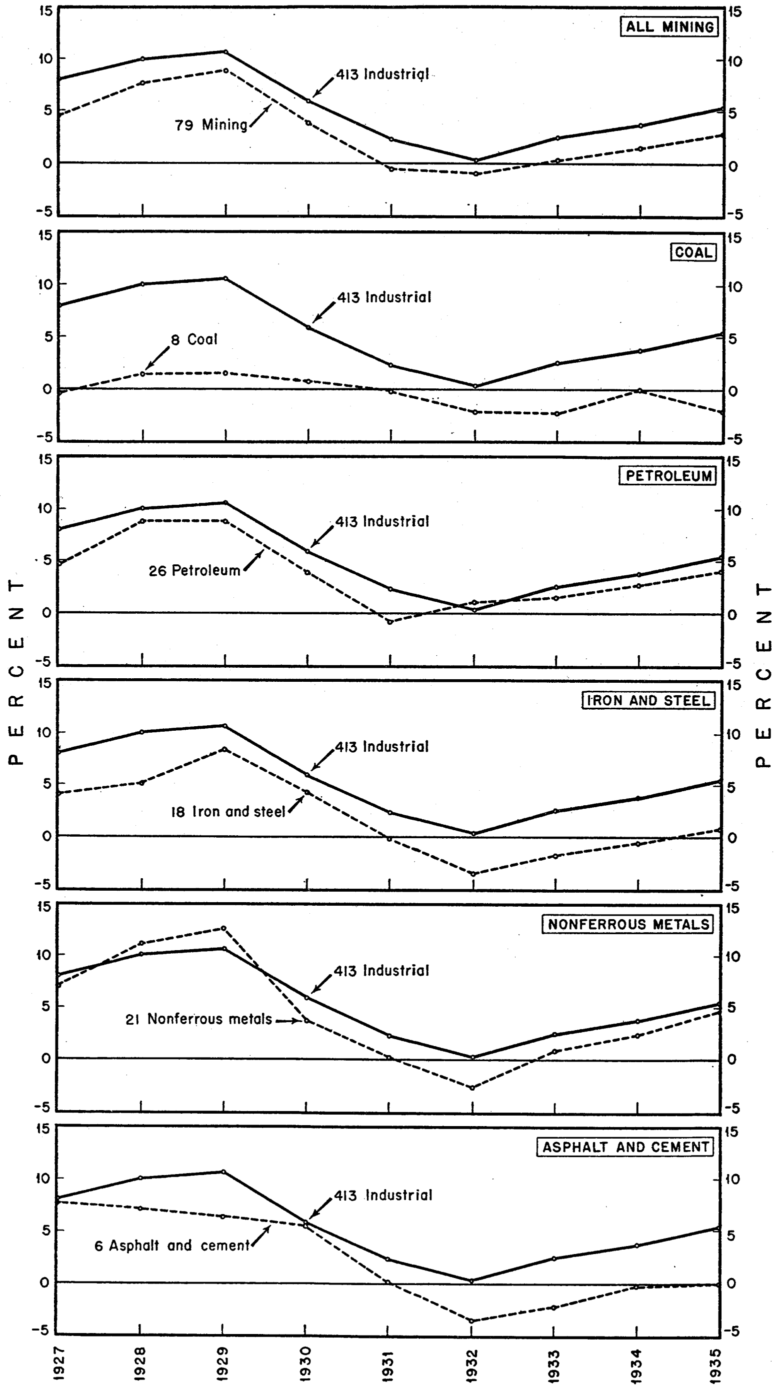

FIGURE 12.—Percentage of net income or loss on invested capital of 413 industrial companies compared with 79 mining companies, including 8 coal companies, 26 oil producing and refining companies, 18 iron and steel companies, 21 nonferrous-metal companies, and 6 asphalt and cement companies, 1927–35. Based on data published by Standard Statistics Co.

There were varying losses during 1931, 1932, and 1933, while the net income during the years of relative prosperity in 1928, 1929, and 1930 were less than 2 percent of invested capital. The heavy funded debt of many large coal companies, the intense competitive situation in the industry, and the shrinkage of markets due to inroads of substitute fuels and to progress in fuel economy largely account for the depressed financial condition of the coal industry.

In the petroleum industry the net income on invested capital for 26 companies, which in general has followed the trend of income in all industry, was 4.1 percent in 1935 compared with 2.7 in 1934. The return on invested capital in the oil industry has increased continuously since 1932 as a result of better demand for petroleum products, particularly gasoline, and the ability of the industry to balance supply and demand more successfully.

In the metals branch of the industry the earnings of the iron and steel companies were at low ebb from 1931 through 1934. In 1935, however, the pick-up in automobile demand as well as the increased purchases of iron and steel products by other industries enabled the 18 iron and steel companies included in the analysis to show a net income for the first time since 1930.

As a result of the increased demand for nonferrous metals in 1935, particularly from the heavy goods industries, and with increased prices and widespread reduction of stocks, the 21 large nonferrous metal companies covered by the survey showed the highest average rate of income on invested capital for any major branch of the mining industry during the year; recorded net income was 4.6 percent compared with 2.4 percent in 1934. Higher gold and silver prices benefited many of the nonferrous metal companies.

Increased activity in residential and commercial construction was unable to absorb the cement output that had previously been consumed by some of the large public-works projects on which construction was tapering off, such as Boulder Dam and those in the Tennessee Valley. Thus, cement output dropped slightly, stocks increased a fraction, and the cement companies could show only a very small change in net income from 1934 to 1935. Cement prices changed little, and the large capacity of the industry as well as competition on the eastern seaboard from foreign producers were unfavorable factors in the market.

FEDERAL LEGISLATION, UNITED STATES SUPREME COURT DECISIONS, AND GOVERNMENT ACTIVITIES AFFECTING MINERALS

Federal legislation.—The most publicized legislation in 1935 affecting minerals was the Bituminous Coal Conservation Act of 1935 (Public Law 402—74th Cong., 49 Stat. 991), known as the Guffey Act. This act, passed to stabilize the industry and to improve labor conditions, provided for the establishment of the National Bituminous Coal Commission. This Commission was authorized to devise a code as a working agreement under which producers accepting the terms of the act would operate. To encourage adherence to the code, a tax of 15 percent on all bituminous shipments was specified, with a drawback of 90 percent of the tax for those who accepted the code. The act also empowered the Commission, operating through 23 administrative district boards, to regulate the procedure for the establishment of minimum prices and to authorize maximum prices for the protection of consumers. Voluntary organization by producers of agencies for marketing of coal was permitted, and certain unfair trade practices were outlawed. The Commission was also directed to investigate the necessity for and the methods of production control and to report its findings to Congress. In addition, the Commission was required to investigate the economic and safe operation of mines, the relief and rehabilitation of unemployed or partly unemployed mine workers, and the possibility of lower distribution costs. Under the act labor difficulties were to be adjudicated by a Bituminous Coal Labor Board, and employees were guaranteed the right of collective bargaining and the right to select their own check weighman; provision was also made for the establishment of maximum hours and minimum wages.

On May 18, 1936, the United States Supreme Court declared the Bituminous Coal Conservation Act unconstitutional. New legislation for the bituminous coal industry is, however, being considered by Congress as this review is written.

On February 22, 1935, the Connally Act (Public Law, 14, 74th Cong., 49 Stat. 30) was passed to remedy the defects found by the United States Supreme Court in the Panama and Amazon cases, which held that section 9 (*c*) of the National Industrial Recovery Act, commonly known as the hot-oil section, was invalid because it constituted an unlawful delegation of legislative power to the President. Under the Connally Act, which expires on June 16, 1937, Congress itself prohibited the shipment in interstate and foreign commerce of petroleum and the products of such petroleum produced in excess of the amount permitted by or contrary to regulations of State law.

Public Resolution 64 (74th Cong., 49 Stat. 939) provided for the consent of Congress to the interstate oil compact—an agreement among six oil-producing States (Texas, Oklahoma, Kansas, Colorado, New Mexico, and Illinois) regarding conservation of oil and gas and prevention of avoidable waste thereof—instituted in Dallas, Tex., on February 16, 1935. Congress likewise consented to adherence to the compact by any other oil-producing State that may later become a party thereto; it expires September 1, 1937.

Section 14 of an act to extend the functions of the Reconstruction Finance Corporation for 2 years (Public Law 1, 74th Cong., 49 Stat. 1) provided that—

> the corporation is authorized * * * to make loans upon sufficient security to recognized and established corporations, individuals, and partnerships engaged in the business of mining, milling, or smelting ores. The Reconstruction Finance Corporation is authorized * * * also to make loans to corporations, individuals, and partnerships engaged in the development of a quartz ledge, or vein, or other ore body, or placer deposit, containing gold, silver, or tin, or gold and silver, when, in the opinion of the Reconstruction Finance Corporation, there is sufficient reason to believe that, through the use of such loan * * * there will be developed a sufficient quantity of ore, or placer deposits of a sufficient value to pay a profit upon mining operations: *Provided*, That not to exceed $20,000 shall be loaned to any corporation, individual, or partnership, for such development purposes: *Provided further*, That there shall not be allocated or made available for such development loans a sum in excess of $10,000,000.

Public Law 602 (74th Cong., 49 Stat. 337) provided for the suspension of annual assessment work on mining claims for the year ending July 1, 1936. This was the fifth consecutive year that such suspension has been permitted. For the first 3 years Alaska was included, but in the last 2 years that Territory was excluded from the provisions of the act.

Under the Revenue Act of 1934 the import and excise taxes on coal, petroleum, and copper were extended for 2 years to expire on June 30, 1937.

The Faddis-Barbour tin bill (Public Law 448, 74th Cong.) was enacted into law in February 1936. It declared that the policy of Congress and purpose of the act were to preserve and develop domestic sources of tin, to restrain the depletion of domestic reserves of tin-bearing materials, and to abate the present costly and dangerous dependent position of the United States with respect to resources of tin. The bill also prohibited the export of tin-plate scrap, except under license issued by the President of the United States, such prohibition to take effect 60 days after enactment of the measure.

Other Federal legislation, which was of a more general nature but indirectly affected the minerals industry, included the Work-Relief Act, which appropriated $4,880,000,000 for work projects to give work to the unemployed; the National Labor Relations Act, which set up a board to settle labor controversies, to encourage and guarantee collective bargaining, and to protect the right of workers to organize for the purpose of negotiating the terms and conditions of their employment; the Federal Social Security Act, providing for old-age pensions, annuities, unemployment insurance, and aid to the blind, crippled, widows, and orphans; the Revenue Act of 1935, which provided for corporation taxes ranging from 12½ percent on net incomes under $2,000 to 15 percent on net incomes over $40,000, for a capital stock tax of $1.40 per $1,000 valuation, for a tax of 10 percent on intercorporation dividends, and for tax-free liquidation of subsidiary corporations; and the Public Utility Act of 1935, which gave broad discretionary powers to the Securities and Exchange Commission regarding dissolution of certain holding companies after January 1, 1938.

United States Supreme Court decisions affecting minerals.—The first United States Supreme Court decision affecting minerals in 1935 was delivered on January 7, in the case of Amazon Petroleum Corporation versus Ryan (see Panama Refining Co. *v.* Ryan, 293 U. S. 388; 55 S. Ct. 241), in which the Court invalidated section 9 (c) of the National Industrial Recovery Act, commonly known as the hot-oil section. The Court declared that this section constituted an unlawful delegation of legislative power to the President, and to remedy this defect Congress passed the Connally Act, as already noted.

In the case of *Schechter Poultry Corporation* v. *United States* (295 U. S. 495; 55 S. Ct. 837; 97 A. L. R. 947), the Supreme Court declared the National Industrial Recovery Act unconstitutional as it constituted an unlawful delegation of legislative power to the President. In consequence of this decision, all codes of fair competition were invalidated, including those for various divisions of the mining industry.

On May 18, 1936, in the case of *James Walter Carter, petitioner,* v. *Carter Coal Co., George L. Carter, as Vice President and a director of said company, et al.* (80 U. S., L. Ed. 749), the Supreme Court declared the Bituminous Coal Conservation Act unconstitutional due to the view of the majority opinion that the tax of 15 percent on production with 13½-percent refund for compliance to the code was a penalty tax, that the labor provisions were considered to be matters of State jurisdiction, and that the various parts of the act were considered inseparable from one another and hence the invalidity of one indicated invalidity of the entire act. The Court left open for future consideration the constitutional question involved in the price-fixing provision; for although this section was invalidated on account of the declared inseparability from other provisions of the act, the Court did not say that in itself it was unconstitutional.

Federal Government investigations affecting minerals.—An important congressional investigation during 1935 was the inquiry into the extent to which the United States depends upon foreign sources for its supply of tin. After extensive study a report was issued by the subcommittee of the House Committee on Foreign Affairs which recommended: (1) The establishment and declaration of a general policy with regard to certain materials essential to industry and to national defence, in which our national resources are not sufficient or not sufficiently developed; (2) the creation of a special agency of the Government with powers and duties appropriate to the carrying out that policy; (3) the relief of the tin situation by certain specific applications of the declared policy, namely, (*a*) to discourage the importation of metallic tin and encourage the importation of tin ores for the purpose of establishing an American tin-smelting industry, (*b*) to cause to be made a systematic and exhaustive search and survey for tin ores in the United States, (*c*) to cause to be made a comprehensive and systematic research for substitutes of tin, (*d*) to provide for some prohibition of the exportation of tin-bearing scrap from time to time under certain conditions. These recommendations doubtless had bearing upon consideration of the Faddis-Barbour bill, passed in 1936, prohibiting the export of tin-plate scrap.

The Federal Trade Commission made an extensive investigation of "economic, corporate and financial phases of the natural-gas producing, pipe-line, and utility industries", and recommended in a voluminous report that the production and interstate movement of natural gas be regulated to prevent waste and unfair marketing practices.

Fair trade practice agreements.—After activities of the National Recovery Administration ceased with invalidation of its enabling act, the Federal Trade Commission was authorized by Executive order to accept voluntary codes from industry termed "fair trade practice agreements", including labor and fair trade provisions, but subject to the antitrust laws. Only nine such applications had been filed with the Federal Trade Commission by the end of 1935, of which the asbestos manufacturing and the rock and slag wool manufacturing codes were concerned with mineral products.

BRIEF SUMMARY OF INDIVIDUAL MINERAL INDUSTRIES

Copper.—The copper industry was in a better position in 1935 than for several years. Demand apparently increased at a more rapid rate than production, and stocks of refined copper declined to 175,000 short tons—a sharp reduction over 3 years from the 502,000 tons on hand at the end of 1932. Prices also improved, so that earnings of most companies tended to rise and dividends were resumed on a small scale.

Under the N. R. A. the price of copper had been more or less stabilized around 9 cents, but after the Schechter decision the quotation dropped temporarily to 8 cents due to uncertainty over the immediate future of the market. The rise in the price that soon followed was attributed by the Standard Statistics Co. to improved consumer demand, coupled with low fabricators' stocks, and to the resumption of speculative buying.

In spite of such unfavorable factors as large domestic supplies of secondary metals, as well as competition from other metals, the copper industry—particularly during the latter part of the year—moved ahead as a result of greater demand from the heavy goods industries. Increased automobile production, larger demand for electrical equipment, and expanded construction activities were the principal factors in the larger copper sales in 1935.

The inflow of foreign copper, particularly from Canada, increased while exports of copper dropped as purchases by France and Germany declined. The drop in sales to those countries was partly offset, however, by increased demand resulting from expanded activity in the British building and electrical trades and from armament needs that accompanied the political tension during the Italian-Ethiopian conflict. These factors were also partly responsible for increased world copper production, which apparently advanced outside the United States at a more rapid rate than consumption and resulted in an increase in stocks in the rest of the world. The drop in stocks in this country was greater than the increase elsewhere, so that world total declined. The rise in foreign copper stocks prompted a conference of world copper producers in New York during the early part of 1935, when an agreement was made looking to a curtailment of 20 to 30 percent in the world copper production.

Lead.—The consumption, production, and price of lead in 1935 increased over 1934. Stocks of refined pig lead, which had been growing constantly for almost a decade through 1934, decreased about 8,000 short tons in 1935, and about 216,000 tons were on hand at the end of the year. The adjustment of lead stocks in relation to demand was less pronounced, however, than in the case of copper or zinc in 1935. The maintenance of production without an appreciable withdrawal of stocks was probably due to some extent to the fact that lead and lead-zinc ores of the Western States contain silver, the price for which increased substantially in 1934 and 1935. The large demand for battery lead as a result of increased automobile production and the increased use of lead for pigments were important factors in helping the lead market during 1935. The relatively small increase in the use of lead in cable coverings, however, was a retarding influence.

Zinc.—The zinc market improved considerably in 1935 over the previous year. Production and prices continued the upward trend shown since 1933, and stocks dropped to 91,000 short tons, placing stocks 27 percent below 1934 and 46 percent under 1930. As a result, the zinc industry was probably in a better position in 1935 than any of the base-metals group. The principal influences that affected the zinc market were the increased galvanizing operations and the fact that supplies of secondary zinc are normally much less of a market factor than other secondary base metals. In 1935 the production of secondary zinc was equivalent to 32 percent of the output of primary metal, whereas the ratios were 111 percent for copper and

87 percent for lead during the same period. The 2-month suspension of operations in the Tri-State district due to labor difficulties was a retarding influence on the earnings of companies in that area. The abandonment of the N. R. A. codes for both lead and zinc caused very little market uncertainty, as the codes for the two metals were primarily labor agreements.

Iron and steel.—The iron and steel industry showed remarkable improvement during 1935. The price of almost all iron and steel products increased during the year, particularly in the last quarter, while production of pig iron and steel ingots was about one-third above 1934.

The increased demand for farm machinery, the revival of the construction industry, and the jump in automobile production as a result of greater demand and the early introduction of the 1936 models in late 1935 were the principal factors in improvement of the iron and steel industry. Production of the lighter lines of the metal continued to advance through most of 1935, whereas the demand for the heavier products lagged until toward the end of the year. Activity at tin-plate plants reached 1929 levels during the year, and sales of sheets, strip, wire, and other light varieties of steel to the automobile and agricultural equipment manufacturers increased sharply. According to the Iron Age, the introduction of beer cans and of all-steel automobile tops promises even greater use of light materials. Demand for the heavier products began to pick up during the latter part of the year when railroads, construction, heavy machinery manufacture, and private ship building came into the market.

Gold.—The world gold production of almost 30,000,000 ounces in 1935 reached the highest total of all time, while in the United States the output of almost 3,700,000 ounces was the greatest since 1917. The higher price for gold in recent years ($35 per ounce in 1935) and relatively low commodity prices stimulated the opening of new gold mines and justified the treatment of lower-grade ores at mines already established. Also, many operations were thereby lifted from a submarginal to a profitable basis. Of particular interest in the United States during 1935 was the beginning of operations at the Golden Queen mine, Mojave, Calif., perhaps the most important discovery of gold in any new district in this country for over 25 years, while an outstanding development from a world standpoint was the relatively large increase in the gold output of Soviet Russia.

Silver.—The mine output of silver increased from 32,800,000 ounces in 1934 to 48,500,000 in 1935 (excluding the Philippine Islands) under the impetus of a rising price paid by the United States Treasury for newly mined silver. The Treasury buying price opened 1935 at 64.65 cents per ounce, advanced to 71.11 on April 10, and later increased to 77.57 cents on April 24, where it remained until the end of the year.

The open market price for silver was extremely erratic during 1935. After opening the year at about 55 cents the price increased rapidly to 81 cents on April 26 as a result of reported speculation on the London exchange. The quotation then began to decline. Sales of silver by oriental countries were reported to be heavy, and the policy of the United States Treasury in purchasing silver almost exclusively on the London exchange was changed to one of buying "in many different places." Considerable confusion resulted in the principal markets, and silver prices declined precipitously. On December 18 a drop of 3 cents was reported, and the quotation continued downward to the end of the year, closing at 49¾ cents.

Aluminum.—The production of aluminum, which increased for the first time since 1930, totaled 119,000,000 pounds in 1935 against 74,000,000 in 1934, while the average price continued the decline evident since 1925. The demand for aluminum for transportation equipment, particularly for air and railroad transport, was an important factor in the recovery of aluminum demand. Secondary alumi-

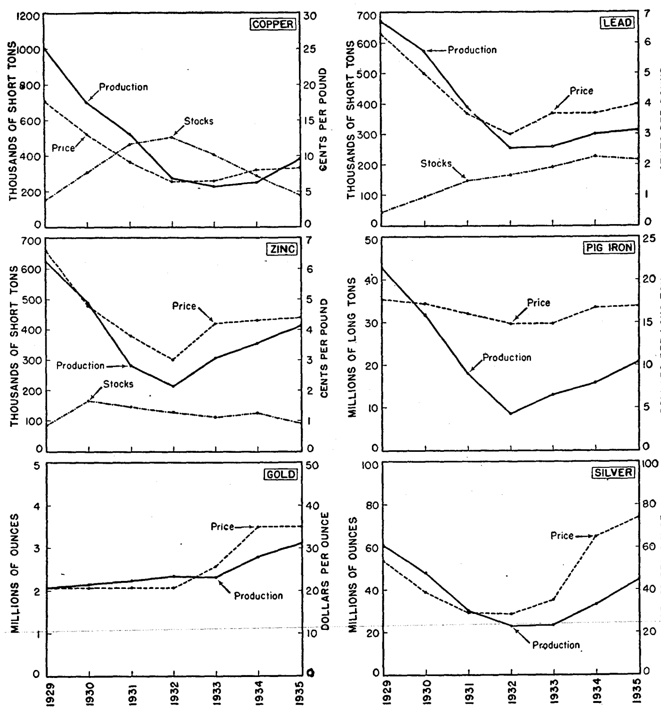

FIGURE 13.—Salient trends in the domestic copper, lead, zinc, pig iron, gold, and silver industries, 1929–35

num, the production of which totaled 102,800,000 pounds in 1935 and 92,800,000 in 1934, continued to be an important problem to the industry.

Tin.—Although the United States produces virtually no tin, there is a vital interest in the international markets dealing in that metal, as this country consumes approximately half of the world production. The apparent consumption of tin in the United States rose from 44,000 long tons in 1934 to 62,000 in 1935, and imports increased from 40,000 to 64,000 tons during the same period. Prices of Straits tin in New York averaged 50.19 cents a pound in 1935, a little less than 2 cents below the previous year but 5 cents above 1929. World stocks at the end of the year totaled 15,300 long tons against 18,200 at the end of 1934.

The production of world tin has been controlled almost entirely since the early part of 1931 by the international tin agreement, which has been fairly successful in maintaining prices, reducing stocks, and reconciling production with consumption. In 1935, however, the cartel experienced considerable difficulty, as, according to press reports,[1] it misjudged demand, which showed a remarkable increase, particularly in the United States, where the automobile and tin-plate industries used larger quantities of tin. The unexpected rise in demand reduced world visible stocks to the lowest level in many years and necessitated successive increases by the International Tin Committee in the production quotas during the last 6 months of the year. Although the Tin Buffer Pool was organized in 1934 to protect tin consumers in case

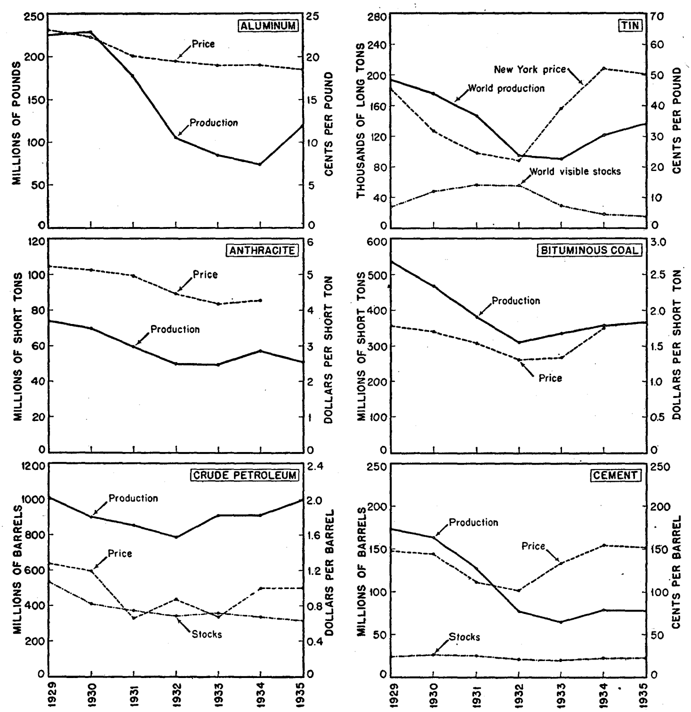

FIGURE 14.—Salient trends in the domestic aluminum, anthracite, bituminous-coal, crude-petroleum, and cement industries and trends in world production and visible stocks, and in the New York price of tin, 1929–35.

of stock shortages, it apparently gave the market little relief in 1935 and was liquidated during that year.

The dependence upon foreign sources for tin and the increased prices of that metal prompted a congressional investigation into methods that might alleviate the situation. A comprehensive report was issued in 1935 which, in brief, recommended establishment of a tin-smelting industry, a search for tin ores in the United States and substitutes for tin, and prohibition of exportation of tin-bearing scrap. The Faddis-Barbour bill was passed in 1936, prohibiting the export of tin-plate scrap.

Bituminous coal.—As a result of general business revival, bituminous-coal production and consumption in 1935 increased about 3 percent over 1934, while the higher rate of industrial activity was reflected by an advance in consumers' stocks. The increased

[1] Annalist, vol. 47, no. 1200, Jan. 17, 1936, p. 82.

demand and output occurred largely in the last quarter, when general business was moving at a relatively rapid pace. Byproduct coke ovens, railroads, steel mills, and public utilities accounted for the largest part of the increased consumption.

Labor troubles and legal uncertainties besieged the industry during 1935. A strike that threatened the industry for much of the year was called in September and lasted for 5 days. The ending of the N. R. A. Bituminous Coal Code was followed by the enactment of the Bituminous Coal Conservation Act, known as the Guffey bill, passed to maintain certain features of the bituminous coal code. The commission that was to administer the act was soon hampered by numerous legal suits, with the result that by the end of 1935 the board was virtually unable to put the act into effect. On May 18, 1936, the act was declared unconstitutional by the United States Supreme Court.

Anthracite.—The output of anthracite decreased about 11 percent in 1935 compared with 1934, while a preliminary survey indicates a 5-percent lower average price in 1935 than 1934.

The growing use of oil burners and of coke for domestic heating purposes has made heavy inroads into the demand for anthracite. The lower production figures probably are due somewhat to the mining and selling of so-called bootleg coal, which has been a source of irritation to the industry for several years and was accentuated in 1935. Although the production of bootleg coal is not included in Bureau of Mines data, such output has been estimated by the industry to be around 3,600,000 tons, although it is difficult to know exactly how much is produced because the individual operators do not report their production.

The industry was not directly affected by dissolution of N. R. A., as it did not operate under a code. A voluntary agreement, however, was instituted in 1935 as a result of severe price cutting within the industry. The agreement provides for filing the terms of sale, prices, and sales policies with the Anthracite Institute.

Petroleum.—The petroleum market was more favorable in 1935 than for several years. As a result of better domestic economic conditions and increased sales abroad, the total demand for all oils set a record in 1935, and demand exceeded that of 1929, the previous high year, by about 7,000,000 barrels.

Crude oil production in the United States was the highest for all time, with the exception of 1929. Crude stocks continued to drop, while the average price at the well ($1.00 per barrel) remained about the same as in 1934. The discovery of the Rodessa (La.) field in 1935 was the most important addition to the potential supply, although production from that source had not become an important market factor by the end of 1935. In California there was considerable oversupply of crude and gasoline in the latter part of the year, which caused a reduction of prices on the Pacific coast, but the effect of the reduction was fairly well localized in that area.

The gain in crude-oil production kept pace with the measured consumption of most of the refined products, particularly gasoline. The consumption of that commodity set an all-time record in the United States as a result of the general business revival and greater use of automobiles and trucks. The demand for gas and fuel oils, kerosene, and lubricants likewise increased. The prices of gasoline and most other refined products advanced substantially, although some of the lubricating-oil prices tended to weaken on account of the shift in demand from the heavier to the lighter lubricants.

Despite the growth of the petroleum industry in other countries, the American companies were able to increase exports of crude and refinery products during 1935, as the foreign demand rose due to military activities and to greater general economic recovery.

With termination of the code and as a result of several important United States Supreme Court decisions, the Federal Government retired, to a considerable extent, from regulation of the oil industry. The State laws regarding production control were strengthened, and regulation by the Federal Government was virtually limited to prevention of interstate shipments of oil produced contrary to State laws.

The chief concern of the industry continued to be to balance supply and demand, but prevention of undue expansion of marketing facilities, particularly in California, continued to be a problem. A change in marketing practice was apparent in 1935 as a result of the growing imposition of State chain-store tax laws, which caused withdrawal of many large companies from direct distribution in some markets where nearly all sales were being made through local independent dealers.

Cement.—The portland cement market was slightly less favorable in 1935 than in 1934. Production was about 77,000,000 barrels (approximately 1,000,000 less than the previous year), and stocks at the end of the year were about 23,000,000 barrels (about 1,500,000 more than in the previous year). The average factory value of portland cement in 1935 dropped to $1.51, about 3 cents below 1934.

A principal reason for the drop in the price and production of cement during 1935 was the tapering off of some of the large Public Works projects, such as Boulder Dam and those in the Tennessee Valley. The increase in private building did not entirely pick up the slack caused by the loss in demand from large Government operations. During the early part of 1936, however, private construction as well as other public works appeared to be absorbing larger amounts of cement than during the last quarter of 1935. Building permits rose substantially during 1935, particularly during the last half of the year, which indicated greater activity in 1936, when construction would actually be undertaken.

EMPLOYMENT IN THE MINING INDUSTRY

Several developments stand out as important to workers in the mining and associated industries during 1935. Most significant was legal invalidation of the National Industrial Recovery Act under which minimum wages and maximum hours were specified for various industry groups. Also important was the fact that mine employment dropped slightly in 1935, according to the United States Bureau of Labor Statistics, although production increased in most branches of mining. Pay rolls for mine workers rose 5 percent, however, as working time and hourly wages increased. In 1935 there was a small increase in the amount of time lost due to strikes and lockouts, principally in the bituminous-coal industry, and considerable attention was given to the problems involved in craft versus industrial types of union organization.

Limitations of data.—Available figures on mine employment that show trends over a period of years are necessarily based on periodic surveys of established operations. Although these cover the bulk of the employment, the large amount of work provided by the development of a mine before it comes into production or by thousands of small scattered placer operations does not find its way readily into the figures. Yet in 1935, under the stimulus of higher prices for the monetary metals, development work at many prospects and small mines provided considerable employment in the metalliferous areas of the West and to some extent in the Southeastern States. Also during the placer season—determined by the availability of water during the summer months—literally thousands worked intermittently at panning for gold, and over 1,000,000 individual deposits of the metal were received during 1935 by the San Francisco Mint. Most of the deposits were very small and were made by individual placer miners. Obviously no statistical survey of monthly employment and pay rolls includes independent placer miners, and to a large extent the miners doing development work at nonproducing properties are not counted. Furthermore, the extent to which contract miners who are not company employees are included in the data on employment at metal mines is not certain.

These difficulties in measuring employment at metal mines as well as the need for a recent complete survey of workers in the petroleum industry are recognized by interested Federal agencies. Thus the Bureau of Mines, in cooperation with the Bureau of the Census and with the advice of the Bureau of Labor Statistics, has undertaken a survey of employment in the mining industry for the calendar year 1935 in connection with its regular annual canvass, but the results of this survey will not be available until the end of 1936. It should be carefully noted, therefore, that all figures in this discussion are based on existing available information, obtained largely from typical established mining operations, and that they are subject to revision upon completion of the detailed study now under way.

Indexes of employment in mining and associated industries compared with indexes of employment in all manufacturing industries, in durable-goods industries, and in nondurable-goods industries, 1929–35 [1]

[1929=100]

Industry	1930	1931	1932	1933	1934	1935
Mining:						
Anthracite	93.4	80.5	62.5	51.7	59.6	53.2
Bituminous coal	93.4	83.2	67.4	67.9	77.2	76.7
Petroleum producing	87.4	65.7	55.3	62.2	77.7	75.0
Metal mining	83.2	59.1	36.5	34.6	41.6	47.3
Nonmetals mining and quarrying	84.3	67.4	49.0	44.9	48.9	46.0
Total mining	90.3	75.6	59.3	58.5	67.9	66.6
Associated industries:						
Smelting and refining [2]	87.0	59.6	49.6	55.5	74.6	88.6
Blast furnaces, steel works, and rolling mills	87.5	66.3	49.9	56.7	67.5	71.4
Cement manufacturing	93.7	72.9	49.7	45.5	54.6	54.8
Petroleum refining	100.4	85.4	77.3	80.2	89.3	88.1
Total associated industries	94.9	75.6	63.0	65.6	76.7	79.2
Total mining and associated industries	91.1	75.6	59.9	59.7	69.4	68.7
All manufacturing	87.3	73.9	61.2	65.8	75.2	78.4
Durable goods	83.0	64.9	49.5	51.5	63.5	68.9
Nondurable goods	91.8	83.1	73.4	80.7	87.4	88.4

[1] All data from Bureau of Labor Statistics. Indexes for manufacturing, durable goods, nondurable goods, and industries associated with mining converted to 1929 as 100.
[2] Copper, lead, and zinc smelting and refining.

Employment.—In spite of the increase in production of most mineral products, employment, as represented by the available figures on the average number of wage earners on the pay rolls during the

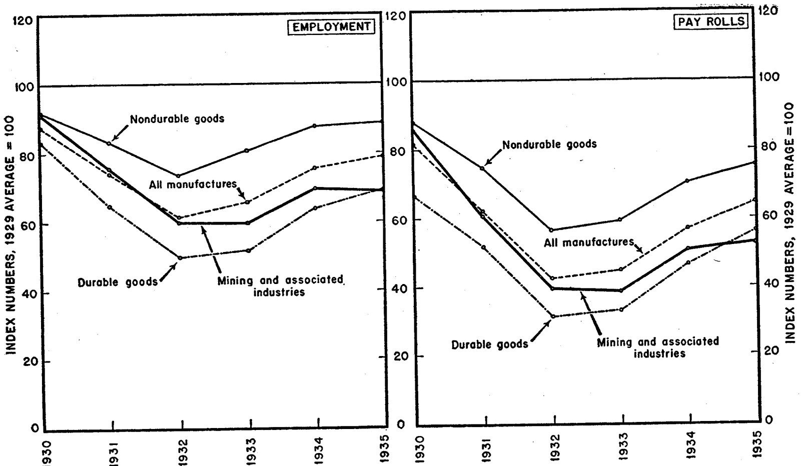

FIGURE 15.—Trends in employment and pay rolls in the mining and associated industries compared with all manufacturing, durable goods, and nondurable goods industries, 1930–35. All data from U. S. Bureau of Labor Statistics. Indexes for manufacturing and for durable and nondurable goods industries converted to 1929 as 100.

pay period nearest the fifteenth of the month at established operations, dropped from approximately 824,000 in 1934 to 815,000 in 1935 or about 1 percent, based on data published by the Bureau of the Census and Bureau of Labor Statistics. The smaller number of workers,

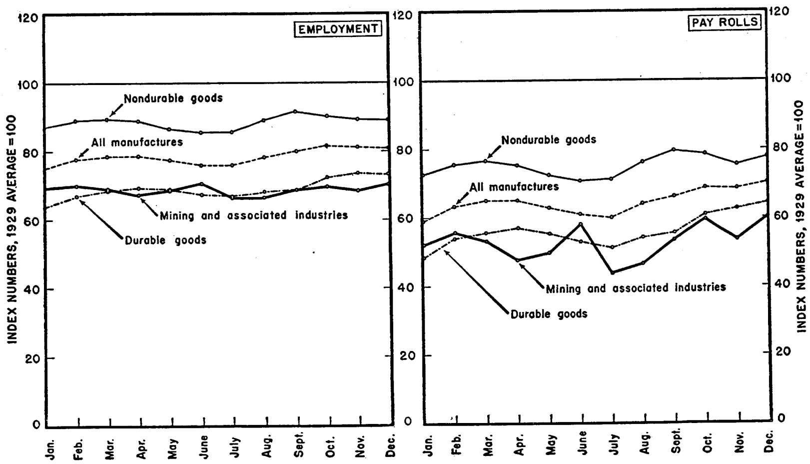

FIGURE 16.—Trends in employment and pay rolls in the mining and associated industries compared with all manufacturing, durable goods, and nondurable-goods industries for 1935, by months. Not adjusted for seasonal variation. All data from Bureau of Labor Statistics. Indexes for manufacturing, durable goods, and nondurable goods industries converted to 1929 as 100.

however, received total wages of about 5 percent more than the total paid in 1934 in contrast with the manufacturing industries, in which the number of wage earners advanced from 6,606,000 in 1934 to 6,891,000 in 1935 (an increase of 4 percent), and total wages paid rose 14 percent during the same period.

The drop in employment in 1935 was most pronounced in primary mining, especially in the anthracite fields. Sharp competition from other fuels and from unauthorized operations in the anthracite field reduced working time at established mines. Also, over a period of years there has been a steady tendency toward strip mining and greater underground mechanization in the anthracite district, both of which require less labor per ton than hand mining. Compared with anthracite, smaller declines in the number of workers were reported for bituminous coal and petroleum production and for nonmetallic mining and quarrying.

Employment in metallic mining was an exception to the downward trend of employment in the extraction group, and increased production of metals was accompanied by a 14-percent increase in the number of workers employed. The number of men on the pay rolls, however, was still less than half the 1929 figure.

In activities usually associated with mining, in which the average employment has been considerably better than in primary mining during recent years, all divisions except petroleum refining gained over 1934 in 1935. Greater production of base metals over 1934 resulted in employment advances of 19 percent in the smelting and refining of copper, lead, and zinc, while increased demand for heavy goods brought a rise of 6 percent in employment in blast furnaces, steel works, and rolling mills during the same period. Employment in the cement industry showed virtually no change in 1935, and employment in the petroleum-refining industry dropped a little more than 1 percent below 1934.

Indexes of pay rolls in mining and associated industries compared with indexes of pay rolls in all manufacturing, durable goods, and nondurable goods industries, 1929–35 [1]

[1929=100]

Industry	1930	1931	1932	1933	1934	1935
Mining:						
Anthracite	95.3	75.4	53.7	45.8	55.9	47.5
Bituminous coal	81.3	57.5	35.6	37.8	54.2	58.2
Petroleum producing	85.9	61.7	44.1	44.1	56.9	57.9
Metal mining	78.0	44.8	21.6	20.6	26.7	33.9
Nonmetallic mining and quarrying	79.3	53.4	29.1	24.7	29.6	30.6
Total mining	84.0	59.4	38.0	37.0	49.4	50.9
Associated industries:						
Smelting and refining [2]	79.5	46.2	27.4	29.4	42.4	54.1
Blast furnaces, steel works, and rolling mills	80.0	48.9	22.6	32.3	44.9	56.6
Cement manufacturing	89.8	61.2	29.8	23.9	32.9	34.6
Petroleum refining	100.9	81.9	66.1	64.3	73.0	76.8
Total associated industries	91.8	66.6	45.8	45.7	55.9	62.0
Total mining and associated industries	85.3	60.6	39.3	38.5	50.5	52.8
All manufacturing	81.3	61.9	42.3	44.5	56.7	64.4
Durable goods	76.2	51.7	31.2	32.9	46.2	56.0
Nondurable goods	87.8	74.5	56.2	58.9	70.1	75.1

[1] All data from Bureau of Labor Statistics. Indexes for manufacturing, durable goods, nondurable goods, and industries associated with mining converted to 1929 as 100.

[2] Copper, lead, and zinc smelting and refining.

Pay rolls.—Pay rolls in the mining and associated industries, which had dropped to low levels in 1933 and rose sharply in 1934, increased about 5 percent in 1935 over the preceding year, although they were still well below employment relative to 1929. As in the case of

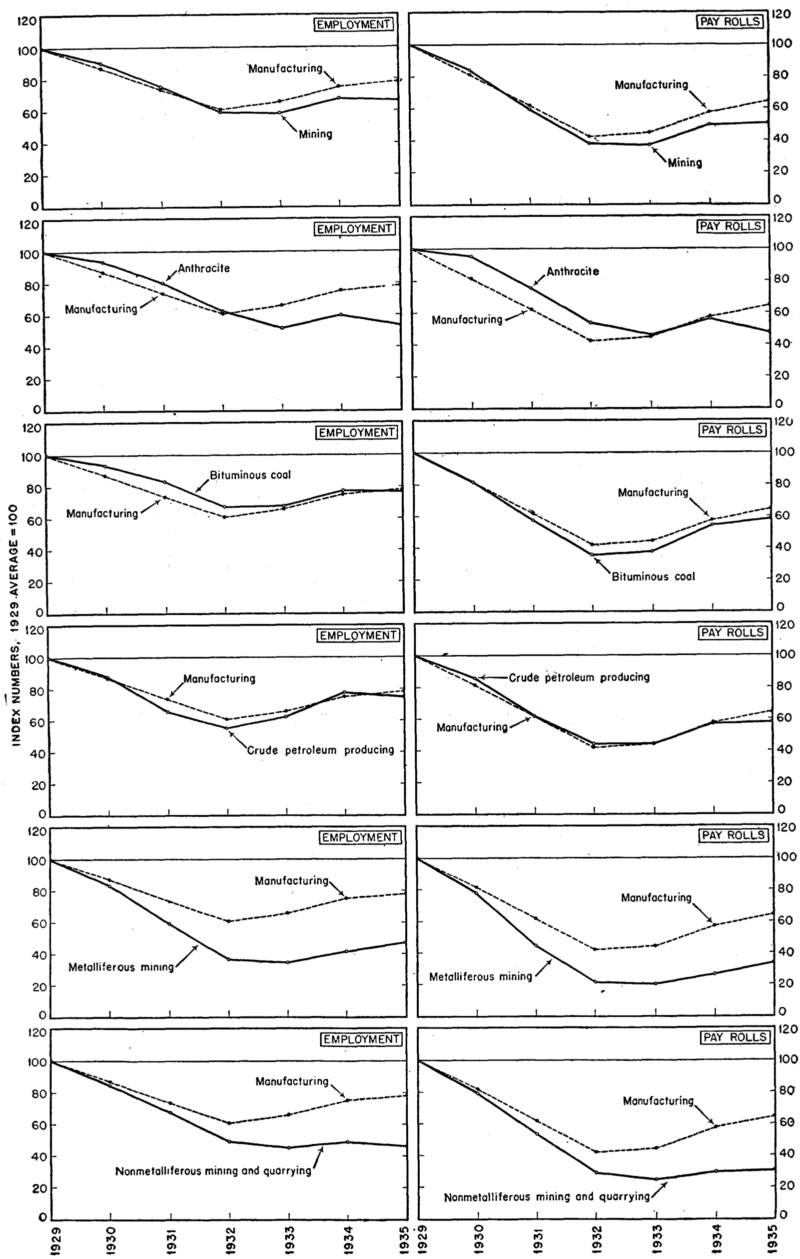

FIGURE 17.—Trends in employment and pay rolls in all mining industries; anthracite; bituminous coal; crude petroleum producing; metallic mining; and nonmetallic mining and quarrying compared with all manufacturing industries, 1929–35. All data from Bureau of Labor Statistics; manufacturing indexes converted to 1929 as 100.

employment, pay rolls for the strictly mining group were in a less favorable position than those for the associated industries. Anthracite experienced the greatest decline, due to a drop both in the working time and in number of workers.

In the industries associated with mining, pay rolls advanced substantially in 1935, particularly in the smelting and refining of base

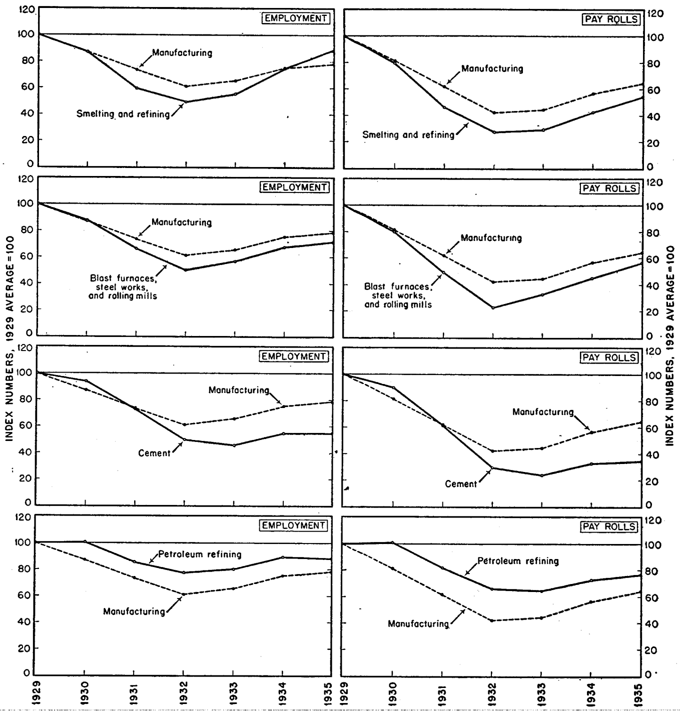

FIGURE 18.—Trends in employment and pay rolls; smelting and refining of copper, lead, and zinc; blast furnaces, steel mills, and rolling mills; cement manufacture; and petroleum refining compared with all manufacturing industries, 1929–35. All data from Bureau of Labor Statistics; manufacturing indexes converted to 1929 as 100.

metals and in blast furnaces, steel works and rolling mills. A gain of 5 percent was also reported for petroleum refining, and a small increase was shown for the cement industry, although production dropped compared with 1934.

Employment and pay rolls in all manufacturing industries.—Employment and pay rolls in all manufacturing industries during the past several years have been at higher levels than in the mining and associated industries. In fact, with reference to employment and pay rolls the mining and associated industries have followed closely the course of the durable-goods industries, where labor suffered from the sharply curtailed demand for heavy products. The nondurable- or consumers'-goods producers maintained a better rate of output throughout the depression, and employment and pay rolls did not slump as drastically as in the durable-goods group. During the last half of 1935, however, the increased activity in the heavy industries was reflected in considerably better employment and pay rolls at durable-goods plants, and a corresponding increase in pay rolls in the mining and associated industries indicates the close relationship of these two branches of business. The adjustment of automobile-production schedules, at President Roosevelt's suggestion, so that employment could be spread through the winter months, was an important factor in maintaining employment in the durable-goods and mineral industries during the latter part of 1935.

Average weekly and hourly wages and average number of hours worked per week in the mining and associated industries and all manufacturing industries, 1934–35 [1]

Industries	Average weekly wages (dollars)		Average hourly wage (cents)		Average hours worked per week	
	1934	1935	1934	1935	1934	1935
Bituminous coal	18.37	19.64	67.8	74.7	27.1	26.3
Anthracite	27.09	25.59	82.6	82.3	32.8	31.1
Crude petroleum producing	27.31	28.04	77.8	77.9	35.1	36.0
Metallic mining	20.62	22.46	55.9	58.5	36.9	38.4
Nonmetallic mining and quarrying	15.66	16.53	47.3	47.5	33.1	34.8
Smelting and refining, copper, lead, and zinc	20.03	21.83	53.4	55.8	37.5	39.1
Blast furnaces, steel works, and rolling mills	19.21	23.07	63.2	66.3	30.4	34.8
Cement manufacturing	18.46	19.30	56.1	57.1	32.9	33.8
Petroleum refining	26.04	28.00	74.6	80.0	34.9	35.0
All manufacturing	19.02	20.85	54.8	56.8	34.7	36.7
Durable goods	[2] 20.18	22.70	[2] 59.0	60.7	[2] 34.2	37.4
Nondurable goods	[2] 18.11	19.22	[2] 52.2	53.4	[2] 34.7	36.0

[1] Average hourly wage and average hours per week from Bureau of Labor Statistics. Average weekly wages obtained by multiplying average hourly wage by average number of hours worked per week.
[2] Average for last 9 months of year.

Labor difficulties.—The loss of time due to strikes and lock-outs in the mining and associated industries increased to about 4,000,000 man-days in 1935 (10 percent above 1934), according to the Bureau of Labor Statistics, in contrast to a decline of 27 percent during the same period in the amount of time lost over labor disputes in all manufacturing industries.

Based on estimated total employment, the average number of days lost for each man employed in the mining and associated industries increased from 4.5 days in 1934 to 5.0 in 1935. The total number of workers involved in the strikes and lock-outs in those industries practically doubled over 1934 in 1935, but the average number of days lost per worker involved declined.

The actual number of strikes and lock-outs in the mining and associated industries dropped about one-third in 1935 compared with 1934, but there was a greater loss of time per strike because of the larger number of workers concerned.

The extraction branch accounted for about 99 percent of the time lost over labor disputes in 1935 in the mining and associated industries. For September the Bureau of Labor Statistics reports that over 2,000,000 man-days were lost in the bituminous-coal industry on account of wage disputes, and the number remained relatively large although decreasing until the end of the year. Labor difficulties in the anthracite industry caused a loss of 789,000 man-days in 1935, a large part of which occurred in August when 166,000 man-days were lost. Metallic mine employees lost 192,000 man-days in 1935, mostly in the middle of the year in the Tri-State lead and zinc field. Idle time due to labor disputes in quarrying and nonmetallic mining was relatively small, and the only sizable loss was at Martinsburg, W. Va., where union recognition and wage increases were at issue. The crude-petroleum-producing industry was relatively free from labor difficulties during 1935.

Statistics on strikes and lock-outs in the mining and associated industries compared with manufacturing industries and all industries, 1934–35

	Mining and associated industries		Manufacturing industries		All industries	
	1934	1935	1934	1935	1934	1935
Total man-days lost due to strikes and lock-outs	3,721,888	4,077,013	12,191,021	8,839,134	19,591,949	15,641,329
Estimated total employment in mining and associated industries [1]	824,000	815,000	6,606,000	6,891,000	(2)	(2)
Average number of days lost per man employed	4.5	5.0	1.8	1.3	(2)	(2)
Total workers involved in strikes and lock-outs	245,521	487,716	846,111	413,935	1,466,695	1,117,213
Average number of days lost per involved worker	15.2	8.4	14.4	21.4	13.4	14.0
Number of strikes and lock-outs	166	105	1,059	1,190	1,856	2,014
Average number of workers involved per strike and lock-out	1,479	4,645	799	347	790	555
Average number of man-days lost per strike	22,421	38,829	11,512	7,428	10,556	7,766

[1] Wage earners only. Based on data supplied by Bureau of Labor Statistics and Bureau of the Census.
[2] No data available.

The amount of idle time due to labor disputes in industries associated with mining was 85 percent less in 1935 than in 1934 and was only about 1 percent of the total time lost in the extraction group in 1935. The principal losses in the associated industries occurred at the blast furnaces, steel mills, and rolling mills group at Monroe, Mich., during April and May. Some working time was also reported lost in the smelting and refining of base metals during the middle of the year at Mascot, Tenn. No idle time due to labor disputes was reported in either the cement-manufacturing or the petroleum-refining industries during 1935.

Craft versus industrial unions.—Attention was focused during 1935 on the problems involved in organizing labor under either the craft (horizontal) or the industrial (vertical) type of union. In the mining industry the industrial type of union prevails, although there are some craft unions in that field. In 1935 the United Mine Workers of America, the Oil Field, Gas Well and Refinery Workers of America, and the International Union of Mine, Mill, and Smelter Workers—three of the outstanding unions in the minerals industry—were among the unions that organized the Committee for Industrial Organization to promote union organization of the industrial type.

THE FOREIGN SITUATION

Foreign trade of the United States.—The foreign trade in minerals as well as in all merchandise improved decidedly both in quantity and value in 1935 over the previous year, although quantity increased at a more rapid rate than value. The volume of mineral imports as well as all commodities, both of which increased at a more rapid rate than domestic production, advanced remarkably due to the greater domestic economic activity that necessitated larger supplies of raw materials. The volume of exports of minerals and all merchandise continued to lag somewhat behind domestic production but nevertheless advanced due to industrial revival in some foreign countries, to the substantial demand for minerals in the defense plans of many nations, and to the establishment by the United States of reciprocal trade agreements with several other countries.

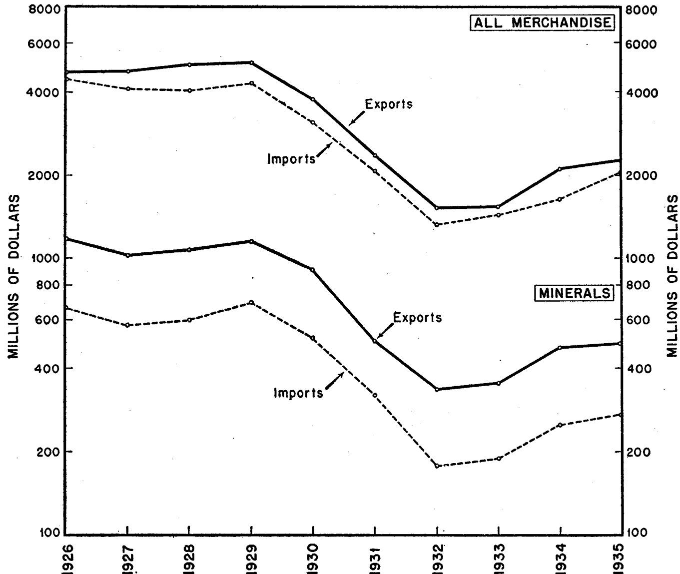

FIGURE 19.—Trends in the value of imports and exports of minerals and their products compared with all merchandise, 1926–35. Based on figures published by Bureau of Foreign and Domestic Commerce.

Mineral imports.—Mineral imports increased about one-third in volume in 1935 over 1934 but made a smaller advance in value due to a general decline in the average of import prices. A large increase in volume of imports was reported for such minerals as tin, crude asbestos, mica, graphite, diamonds, industrial diamonds, manganese, chrome ore, and nickel, for which domestic supplies are either deficient or lacking. Fuel oil, aluminum, and copper imports likewise increased over the previous year. No losses in volume of imports were reported among the major mineral commodities, except for crude oil, which was offset by an increase in fuel oil. The decline in the average of import prices was due to the drop in prices of three major import commodities—fuel oil, tin, and industrial diamonds. Fuel oil, which is imported in large quantities from South America for bunker purposes on the eastern coast of the United States, declined in average import price due in part to a temporary oversupply in New York harbor. Tin import prices dropped with the decline of about 2 cents in the average world price, while industrial diamonds continued the price decline of the last 5 years due to the shift to importation of lower-priced stones.

Trends in quantity indexes of production for minerals and all industrial production compared with indexes of imports and exports of minerals and their products and all merchandise, 1929–35

[1925–29 average=100]

Year	Minerals			All merchandise		
	Production	Exports [1]	Imports [1]	Industrial products [2]	Exports [3]	Imports [3]
1929	109	112	123	108	109	114
1930	97	98	109	87	90	97
1931	82	71	84	74	74	85
1932	67	52	58	58	57	69
1933	73	54	52	69	57	75
1934	79	63	69	72	61	75
1935	85	69	91	82	64	92

[1] Compiled from data published by Bureau of Foreign and Domestic Commerce.
[2] Federal Reserve Board data, converted to 1925–29 base as 100.
[3] From Bureau of Foreign and Domestic Commerce, converted to 1925–29 base as 100.

Mineral exports.—The exports of minerals increased almost 10 percent in quantity and about 4 percent in value over 1934. Exports of minerals, although continuing to lag behind domestic mineral production, increased as a result of industrial revival in many foreign countries. Also, sales of strategic minerals were augmented by international political tension during which nations sought to build up armaments as well as reserve stocks of raw materials. Exports of crude petroleum and its products, except kerosene and fuel oil, advanced substantially over 1934, and Japan, Italy, Argentina, and United Kingdom took considerably larger quantities than in the previous year. Exports likewise increased over the previous year of some of the iron and steel products, such as iron ore; iron, steel, and tin-plate scrap; steel bars; and iron and steel plates and sheets. Other significant increases included ferro-alloys, bauxite, copper rods, and lead pigs and bars. Some losses in export business in 1935 were reported for sulphur; tin plate, taggers tin, and terneplate; and pipe. The decline in the overseas movement of sulphur was due in part to the increased production of byproduct elemental sulphur from the production of pyrites in the European countries while the completion of pipe-line construction in Iraq accounted for part of the drop in pipe exports.

United States imports and exports of minerals and their products compared with all merchandise, 1929–35 [1]

[All indexes, 1925–29 average=100]

	1929	1930	1931	1932	1933	1934	1935
Imports:							
Minerals....value in millions of dollars	697	513	320	178	190	250	272
All merchandise....do	4,339	3,114	2,088	1,325	1,433	1,636	2,039
Minerals....index of value	112	83	52	29	31	40	44
All merchandise....do	103	72	49	31	34	39	48
Minerals....index of quantity	123	109	84	58	52	69	91
All merchandise....do	114	97	85	69	75	75	92
Exports:							
Minerals....value in millions of dollars	1,164	915	505	336	354	475	492
All merchandise....do	5,157	3,781	2,378	1,576	1,647	2,100	2,241
Minerals....index of value	107	84	46	31	33	44	45
All merchandise....do	106	78	49	32	34	43	46
Minerals....index of quantity	112	98	71	52	54	63	69
All merchandise....do	109	90	74	57	57	61	64

[1] From data published by Bureau of Foreign and Domestic Commerce.

United States foreign trade in all merchandise.—The volume of United States foreign trade in all merchandise increased in 1935. The better economic condition of some foreign countries, armament programs, and reciprocal-trade agreements effected increases in the export volume of finished manufactures, semimanufactures, and crude materials. Losses were shown, however, in the volume of crude and manufactured foodstuffs exported. The value for most exports, except manufactured foodstuffs, likewise increased. On the import side, total merchandise increased remarkably in volume over that of the previous year. Average prices stayed about the same, with the result that the value also increased. The largest increases in volume of imports were shown in crude materials, such as rubber, raw silk,

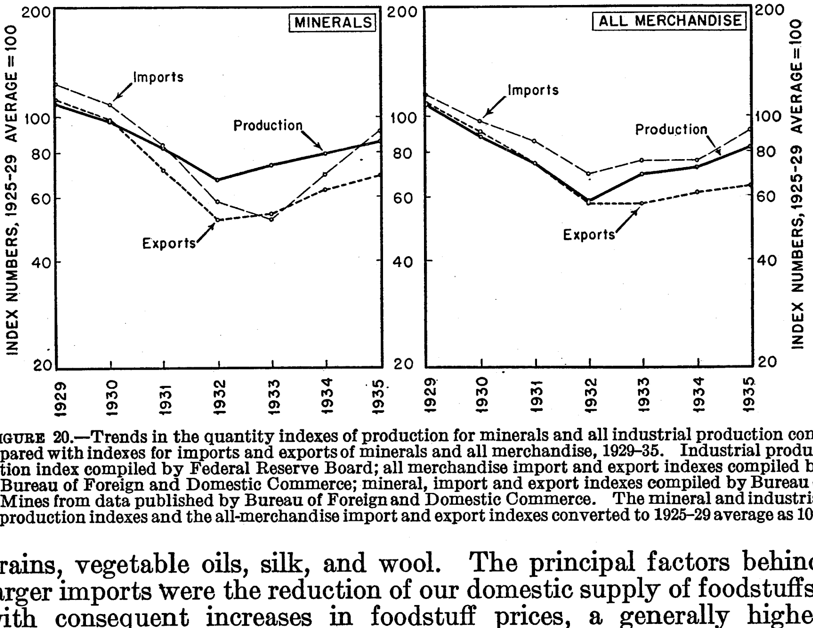

FIGURE 20.—Trends in the quantity indexes of production for minerals and all industrial production com pared with indexes for imports and exports of minerals and all merchandise, 1929–35. Industrial production index compiled by Federal Reserve Board; all merchandise import and export indexes compiled by Bureau of Foreign and Domestic Commerce; mineral, import and export indexes compiled by Bureau of Mines from data published by Bureau of Foreign and Domestic Commerce. The mineral and industrial production indexes and the all-merchandise import and export indexes converted to 1925–29 average as 100.

grains, vegetable oils, silk, and wool. The principal factors behind larger imports were the reduction of our domestic supply of foodstuffs, with consequent increases in foodstuff prices, a generally higher domestic purchasing power, and greater industrial demands for raw materials.

World foreign trade in minerals.—In spite of trade restrictions, from a world standpoint, the international commerce in minerals probably fared better than that of most other commodities. A larger world production of most mineral products (particularly gold, petroleum, and nickel), an increasing demand for mineral raw materials by many of the larger industrial countries, and the fact that no major manufacturing nation is adequately supplied from domestic sources accounted for a more active international flow of mineral commodities in 1935. As already noted, the increased demand for mineral raw materials in 1935 resulted from expanded national defense plans of many countries as well as from the necessity of supplying larger peacetime needs.

World foreign trade in all merchandise.—The volume of general world trade in all commodities was better in 1935 than for any recent year, according to the Bureau of Foreign and Domestic Commerce. The value of the movement, however, showed only a slight increase, for prices in terms of international exchange have been generally dropping, on a gold basis, from 1929 to the middle of 1935. In many countries foreign trade, however, failed to keep pace with domestic revival due to continued subordination of economic activity to political expediency and nationalistic tendencies. In 1935 some countries sought to help employment by export subsidies and by the restriction of imports through such devices as quotas, tariffs, and

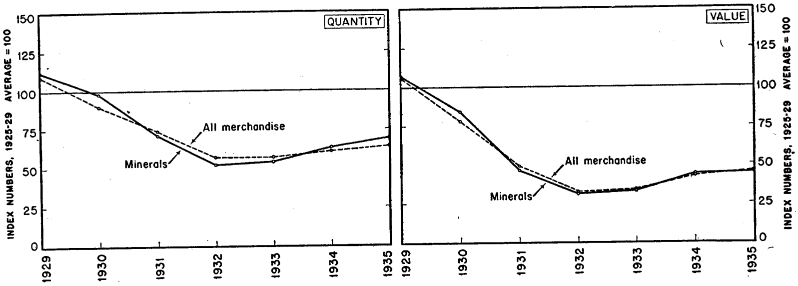

FIGURE 21.—Trends in the quantity and value of exports of minerals and their products compared with all merchandise, 1929–35. Based on data published by Bureau of Foreign and Domestic Commerce.

decreased use of the most-favored-nation clause, while others are reported to have sold goods in foreign markets at a sacrifice to obtain foreign exchange. World trade has been hampered further by currency fluctuations as well as by the inability of many countries to obtain sufficient foreign exchange to finance their imports. Foreign investments by the large creditor nations, which characterized previous recoveries in world trade, have been noticeably lacking during the present revival of world economic activity, and the lack of such investments has been an important factor in the deficiency of foreign

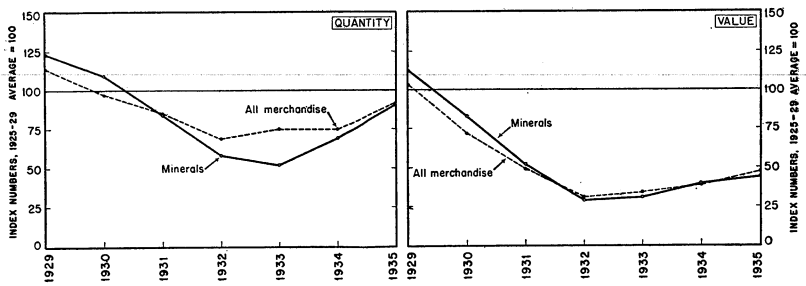

FIGURE 22.—Trends in the quantity and value of imports of minerals and their products compared with all merchandise, 1929–35. Based on data published by Bureau of Foreign and Domestic Commerce.

exchange in many countries. Bilateral agreements and barter exchanges have also tended to restrict international flow of goods, for through these trade is narrowed down to a smaller number of nations. The drop in trade of the gold-bloc countries, as well as application of sanctions against Italy by the large majority of the number of countries belonging to the League of Nations, likewise reduced world trade in 1935. From a long-time viewpoint, some loss of trade has also followed partial industrialization of agrarian areas. All the depressing factors, however, were offset in 1935 by the demand for strategic materials and by the greater normal needs of such countries as the United States, the United Kingdom, Sweden, Australia, Canada, Union of South Africa, and Argentina, where considerable progress was made toward economic recovery.

Reciprocal trade agreements.—In an effort to offset the restricting effects of economic nationalism on international trade, the United States has sponsored reciprocal trade agreements with foreign nations since 1934. These agreements include the "most-favored-nation" clause so that the benefits of lower trade barriers can be extended to many other nations. This departure in commercial diplomacy undoubtedly helped trade during 1935. The first trade agreement of this nature was effected with Cuba in 1934, and agreements with eight additional countries were signed in 1935. The agreements with European countries included Belgium, Sweden, and Netherlands, while those in the Western Hemisphere included Canada, Brazil, Colombia, Honduras, and Haiti. In agreements with European countries both parties granted concessions on iron and steel products and other manufactures and semimanufactures, although silica sand and cement were important in the concessions granted Belgium. In agreements with the Latin American nations concessions to those countries by the United States were mostly on crude foodstuffs, while the concessions granted the United States were largely on manufactured articles. In the agreement with Brazil the United States granted a 50-percent reduction in the tariff on manganese. About 17 mineral items were affected by the Canadian treaty, but minerals were not considered important compared with the balance of the agreement. Further details regarding the reciprocal agreements are given in the chapter entitled "World Production of Minerals and Economic Aspects of International Mineral Policies."

Sanctions.—The application of sanctions against Italy by a majority of the members of the League of Nations was an important development during 1935. The importance of minerals in our present-day civilization and in international trade was brought to the attention of the world very pointedly by the fact that out of 17 products on the sanctions list, 15 were mineral commodities, namely: Aluminum and alumina, bauxite, iron ore, scrap iron, nickel, chrome, manganese, titanium, tungsten, vanadium, ferromolybdenum, ferrosilicon, ferrosilicomanganese, ferrosilicon-manganese-aluminum, and tin and tin ore. The only nonmineral products on the list were draft animals and rubber. Petroleum was considered an addition to the list, but it was never added. The United States did not join in the application of sanctions, but its policy was to discourage larger than normal peacetime exports of essential materials to belligerent countries, as such shipments were not considered in the spirit of the Neutrality Act. The neutrality policy was defined by the President in a statement on October 30, 1935, and later in a press release by the Secretary of State on November 15, 1935, which read as follows:

> The American people are entitled to know that there are certain commodities, such as oil, copper, trucks, tractors, scrap iron, and scrap steel, which are essential war materials, although not actually "arms and munitions are implements of war" and that according to recent Government trade reports considerable increased amount of these is being exported for war purposes. This class of trade is directly contrary to the policy of this Government as announced in official statements of the President and the Secretary of State, and it is also contrary to the general spirit of the Neutrality Act.

The actual shipment of materials to the belligerent countries was not, however, prohibited.

Production control.—With Government cooperation in directing production through the N. R. A. declared unconstitutional in the United States, the principal developments in production control were abroad. Negotiations were reported in progress for re-formation of the International Zinc Cartel, which had been dissolved at the beginning of the year. During 1935 the European Potash Cartel added the important Spanish producers, which meant that from the cartel's standpoint the most troublesome factors restricting cartel control of prices had been eliminated. England joined the International Iron and Steel Cartel, while Japan was reported to be identified with the Nitrate Cartel.

In the early part of 1935 the large copper producers of the world met in New York, and according to a carefully worded statement at the completion of that meeting an agreement was made to curtail production 240,000 tons of copper per year from current output, starting June 1, 1935. A statistical agency was created, and provision was made for cooperation of certain copper producers in foreign markets. Uniform trade practices were to be adopted, but no pooling of sales or fixing of prices was to be attempted, although efforts were made toward insuring a stable market and price. Subject to certain conditions, the copper agreement will run until July 1, 1938.

Control by the International Tin Committee experienced difficulties, as stocks of the world's visible supply of tin dropped to very low levels during 1935. The production quotas were raised successively during the latter part of the year to offset apparent increased consumption. The average price, however, was about 2 cents below 1934, although there were some rather violent fluctuations during 1935 in spite of the stabilizing influence of the cartel.

STATISTICAL SUMMARY OF MINERAL PRODUCTION

By M. B. Clark

Mineral products of the United States, 1934–35 [1]

Product	1934		1935	
	Quantity	Value	Quantity	Value
METALLIC				
Aluminum ... pounds	74,177,000	$14,094,000	119,295,000	$22,070,000
Antimonial lead ... short tons (2,000 pounds)	[2] 16,607	(2)	[2] 16,384	(2)
Antimony:				
Metal ... do	(3 4)	(3 4)	(3 4)	(3 4)
Ore (concentrates) ... do	897	(5)	111	(5)
Bauxite ... long tons (2,240 pounds)	157,838	1,129,053	233,912	1,556,595
Cadmium ... pounds	2,777,384	(5)	3,477,091	(5)
Chromite ... long tons	369	4,653	515	6,163
Copper,[6] sales value ... pounds	488,454,107	39,076,000	762,587,340	63,295,000
Ferro-alloys ... long tons	428,798	34,634,957	592,176	48,891,592
Gold [7] ... troy ounces	3,091,183	108,191,400	3,546,169	124,115,915
Iron:				
Ore [4] ... long tons	25,792,606	[4] 66,483,846	33,308,000	[4] 82,864,000
Pig ... do	[8] 15,626,192	[8] 261,399,963	21,178,353	358,145,499
Lead (refined),[6] sales value ... short tons	299,841	22,188,000	310,505	24,840,000
Manganese ore (35 percent or more Mn) long tons	26,514	571,748	26,428	557,340
Manganiferous ore (5 to 35 percent Mn) long tons	221,822	621,090	524,184	1,322,611
Mercury:				
Metal ... flasks (76 pounds net)	15,445	1,140,845	17,518	1,261,121
Ore ... short tons	(9)	(10)	(9)	(10)
Nickel ... do	157	108,414	160	129,500
Ores (crude), old tailings, etc.:				
Copper ... do	11,717,000	(10)	(11)	(10)
Copper-lead and copper-lead-zinc ... do	121,000	(10)	(11)	(10)
Dry and siliceous (gold and silver) ... do	11,853,000	(10)	(11)	(10)
Lead ... do	3,360,000	(10)	(11)	(10)
Lead-zinc ... do	6,384,000	(10)	(11)	(10)
Zinc ... do	6,237,000	(10)	(11)	(10)
Platinum and allied metals (value at New York City) ... troy ounces	47,274	1,686,000	42,060	1,414,000
Silver [12] ... do	32,725,353	21,155,784	44,824,629	33,080,576
Tin (metallic equivalent) ... short tons	9	9,600	45	45,800
Titanium ore:				
Ilmenite ... do	(5)	(5)	(5)	(5)
Rutile ... do	(5)	(5)	(5)	(5)
Tungsten ore (60 percent concentrates) ... do	2,049	1,791,316	2,395	1,921,017
Uranium and vanadium ores ... do	(5)	(5)	(5)	(5)
Zinc,[6] sales value ... do	355,366	30,561,000	412,184	36,272,000
Total value of metallic products (approximate)		540,300,000		721,600,000

[1] In this general statement certain of the figures represent shipments rather than quantity mined, and some of the figures for 1935 are subject to revision.
[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 $35.00 per ounce.
[8] Revised figures.
[9] Figures not available.
[10] Figures showing values not available
[11] Figures for 1935 not yet available.
[12] According to Bureau of the Mint.

Mineral products of the United States, 1934–35—Continued

Product	1934 Quantity	1934 Value	1935 Quantity	1935 Value
NONMETALLIC				
Arsenious oxide ... short tons	15,623	$797,278	12,670	$497,458
Asbestos ... do	5,087	158,347	8,920	292,927
Asphalt:				
Native ... do	440,852	2,365,750	347,397	2,148,761
Oil (including road oil)[4] ... do	2,515,628	[4] 23,413,386	2,851,795	[4] 24,684,119
Barite (crude) ... do	209,850	1,109,378	225,111	1,251,268
Borates (naturally occurring sodium borates and colemanite) ... short tons	242,500	4,822,014	272,967	5,381,560
Bromine ... pounds	15,344,290	3,227,425	16,428,533	3,483,239
Calcium-magnesium chloride ... short tons	76,719	1,153,159	83,546	1,039,103
Cement ... barrels (376 pounds net)	76,579,483	117,881,816	76,250,005	114,942,212
Clay:				
Products [13]	----------	116,171,631	----------	([13])
Raw [4] ... short tons	2,187,263	[4] 8,197,253	2,795,924	[4] 10,290,425
Coal:				
Bituminous [14] ... do	359,368,022	628,112,000	369,324,000	699,900,000
Pennsylvania anthracite ... do	57,168,291	244,152,245	51,003,000	207,600,000
Coke [4] ... do	31,821,576	[4] 159,425,674	35,141,261	[4] 176,853,135
Diatomite and tripoli [15] ... do	20,529	329,356	27,375	383,416
Emery ... do	189	1,800	176	1,606
Feldspar (crude) ... long tons	154,188	853,136	189,550	1,005,021
Fluorspar ... short tons	85,786	1,391,405	123,561	1,858,334
Fuller's earth ... do	220,264	2,085,081	227,745	2,230,229
Garnet for abrasive purposes ... do	2,591	214,815	([16])	([16])
Gems and precious stones	----------	([17])	----------	([17])
Graphite:				
Amorphous ... short tons	([16])	([16])	([16])	([16])
Crystalline ... pounds	([16])	([16])	([16])	([16])
Grindstones and pulpstones ... short tons	12,630	463,234	14,587	505,378
Gypsum ... do	1,536,170	13,761,977	1,937,500	([18])
Helium ... cubic feet	([19])	([19])	([19])	([19])
Lime ... short tons	2,397,087	17,164,024	2,955,000	21,438,000
Magnesite (crude) ... do	100,973	730,630	177,154	1,192,052
Mica:				
Scrap [20] ... do	7,719	99,791	18,852	243,951
Sheet ... pounds	583,528	90,268	936,633	161,150
Millstones	----------	10,101	----------	9,530
Mineral paints:				
Natural pigments [21] ... short tons	([21])	([21])	([21])	([21])
Zinc and lead pigments [22] ... do	114,661	12,617,296	137,972	13,828,447
Mineral waters ... gallons sold	([17])	([17])	([17])	([17])
Natural gas ... M cubic feet	1,770,721,000	395,378,000	1,875,000,000	422,000,000
Natural gasoline ... gallons	1,535,360,000	60,523,000	1,632,036,000	73,400,000
Oilstones, etc ... short tons	396	94,419	439	105,589
Peat ... do	40,544	214,185	37,060	199,377
Petroleum ... barrels (42 gallons)	908,065,000	904,825,000	993,942,000	994,000,000
Phosphate rock ... long tons	2,834,523	10,040,005	3,042,381	10,935,672
Potassium salts ... short tons	[23] 114,122	2,813,218	[23] 224,721	4,993,481
Pumice ... do	56,169	207,058	57,116	236,727
Pyrites ... long tons	432,524	1,216,363	506,215	1,569,672
Salt ... short tons	7,612,074	22,850,797	8,005,000	22,226,000
Sand and gravel:				
Glass sand ... do	1,923,614	3,326,538	2,180,000	3,706,000
Sand (molding, building, etc.) and gravel ... short tons	114,688,075	57,920,635	123,510,000	62,532,000
Sand-lime brick [13] ... thousands	41,408	355,560	([13])	([13])

[4] Value not included in total value.
[13] Figures obtained through cooperation with Bureau of the Census. Figures for 1935 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] Figures represent tripoli only. Value of diatomite included in total value of nonmetallic products; Bureau of Mines not at liberty to publish figures.
[16] Value included in total value of nonmetallic products; Bureau of Mines not at liberty to publish figures.
[17] No canvass. Estimate of value included in total value of nonmetallic products.
[18] Figures not yet available; estimate of value included in total value of nonmetallic products.
[19] Value included in total value of nonmetallic products. For details of production in fiscal years see chapter of this volume on Helium.
[20] 1934: Figures include fine mica recovered as byproduct in washing kaolin but do not include mica obtained by grinding mica schists; mica schists are included as "micaceous minerals" under last item ("Unspecified"). 1935: Figures include 6,667 tons, valued at $111,345, recovered from kaolin and mica schists. See chapter of this volume on Mica.
[21] Canvass discontinued after 1915. Value of iron ore sold for paint included under last item ("Unspecified").
[22] Sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide.
[23] Equivalent as K_2O.

Mineral products of the United States, 1934–35—Continued

Product	1934		1935	
	Quantity	Value	Quantity	Value
NONMETALLIC—continued				
Silica (quartz) short tons	18,293	$129,965	17,178	$111,784
Slate do	232,730	2,707,928	322,500	3,631,000
Stone [24] do	92,063,830	98,979,936	78,379,000	82,490,000
Sulphur long tons	1,613,838	28,900,000	1,634,990	29,300,000
Sulphuric acid (60° Baumé) from copper and zinc smelters short tons	575,660	4,227,096	(18)	(18)
Talc and ground soapstone [24] do	[8] 138,505	[8] 1,448,685	172,716	1,848,055
Total value of nonmetallic products (approximate)		2,770,300,000		2,950,000,000
SUMMARY				
Total value of metallic products		540,300,000		721,600,000
Total value of nonmetallic products (exclusive of mineral fuels)		537,200,000		553,000,000
Total value of mineral fuels		2,233,100,000		2,397,000,000
Total value of "unspecified" (metallic and nonmetallic) products (partly estimated)[25]		[25] 14,500,000		[25] 16,400,000
Grand total approximate value of mineral products		3,325,100,000		3,688,000,000

[8] Revised figures.
[18] Figures not yet available; estimate of value included in total value of nonmetallic products.
[24] Figures for soapstone used as dimension stone included in figures for stone.
[25] Includes value of following products. Figures are shown wherever Bureau of Mines is at liberty to publish them.

1934: Bismuth, cadmium compounds, chats ($518,110), flint lining for tube mills, iodine ($342,957), iron ore sold for magnets, iron ore sold for paint ($26,151), lithium minerals ($20,980), new ingot magnesium, natural magnesium hydrate (brucite), natural magnesium salts ($1,266,325), calcareous marl ($22,236), greensand marl ($209,278), micaceous minerals (mica schists and vermiculite) ($123,796), molybdenum ($6,502,000), pebbles for grinding, selenium, silica sand and sandstone (finely ground) ($1,301,285), sodium salts (carbonates and sulphates) from natural sources ($1,402,338), tantalum ore ($968), tellurium, and an estimate of the value of miscellaneous mineral products for which statistics are not collected annually by the Bureau of Mines.

1935: Bismuth, cadmium compounds, chats ($581,353), flint lining for tube mills, optical fluorspar ($184), iodine ($248,654), iron ore sold for paint, lithium minerals ($26,924), new ingot magnesium, natural magnesium salts ($1,286,804), calcareous marl ($96,658), greensand marl ($219,749), micaceous minerals (vermiculite), molybdenum ($8,032,000), pebbles for grinding, selenium, silica sand and sandstone (finely ground) ($1,783,439), sodium salts (carbonates and sulphates) from natural sources ($1,548,946), tantalum ore ($4,521), tellurium, and an estimate of the value of miscellaneous mineral products for which statistics are not collected annually by the Bureau of Mines.

WORLD PRODUCTION OF MINERALS AND ECONOMIC ASPECTS OF INTERNATIONAL MINERAL POLICIES

By J. S. McGrath

SUMMARY OUTLINE

National policies of the major powers adopted in recent years have been inspired primarily by the desire to insure security and promote domestic prosperity. Little distinction, however, can be made today between foreign and domestic phases of national policy, and events of the past year, as summarized hereafter, clearly demonstrate the interrelationship of national policies and international trade.

RECIPROCAL TRADE AGREEMENTS

Under authority of the Trade Agreements Act of June 12, 1934, the United States during 1935 continued negotiations with selected foreign countries, and several reciprocal trade agreements were concluded, signed, and became effective. Up to May 20, 1936, 10 trade agreements were concluded and in effect under this act. The following summary shows in general the extent to which foreign trade in mineral commodities may be influenced by these agreements.

Cuba.—The reciprocal trade agreement between Cuba and the United States was signed in Washington on August 24, 1934, and became effective September 3, 1934. It will remain in effect for 3 years and thereafter until either country gives 6 months' notice. Under the terms of the agreement the United States reduced the import duty of cement floor and wall tiles, and Cuba's import duty concessions comprise reductions on a wide range of iron and steel products, copper and alloys, and nickel, aluminum, tin, and zinc manufactures. The agreement, as signed, provides for no additional concessions to American petroleum products; a provisional note stipulates that in the event of changes in its present tariff schedule on petroleum, Cuba will reopen the question of nomenclatures, rates, and preferences with reference to petroleum and its products for negotiation with the United States.

Brazil.—The trade agreement between Brazil and the United States, signed at Washington on February 2, 1935, became effective January 1, 1936, to remain in force for at least 2 years unless abrogated before that time under the quota provision of the agreement; it may be terminated at the end of that period or subsequently upon 6 months' notice. The agreement contains a reciprocal assurance of unconditional most-favored-nation treatment of each other's commerce in all respects and special safeguards against the impairment of the trade benefits of the agreement through import quotas, new internal taxes, or exchange control. Manganese ore is the only mineral product on which the United States agreed to reduce the existing import duty. In addition to numerous other classes of commodities, Brazilian import duties were reduced on white cement and a number of manufactured products, such as steel furniture, steel files, gasoline pumps, etc. Existing favorable Brazilian customs treatment of numerous items, such as agricultural machinery, mechanical refrigerators, etc., was "bound" [1] for the life of the agreement.

Belgium.—The trade agreement between Belgium and the United States, signed on February 27, 1935, became effective May 1, 1935, and will remain in force until 6 months from the day on which either Government shall give notice of its intention to terminate it. This agreement is of the unconditional most-favored-nation type and constitutes an assurance that American exports to Belgium will receive as favorable treatment as those from a third country and, conversely, that Belgian exports to the United States will be accorded as favorable treatment as that given imports from any other foreign country. In view of the customs union between Belgium and Luxemburg, the concessions granted and received by the United States will apply to Luxemburg as well as Belgium. The concessions in the form of reductions in import duty granted by the United States to Belgium cover a variety of iron and steel manufactures and such miscellaneous products of mineral origin as asbestos shingles and roofing, chalk or whiting, silica sand, portland cement and clinker, certain classes of plate, sheet, and laminated glass, engraved ornamental glassware, cylinder glass tiles, and certain types of decorative metal laces. In addition to the duty reductions granted on these products, duties on certain types of plate glass and sheet glass are "bound" against future increases. The principal concessions granted by Belgium to the United States covered miscellaneous manufactures or industrial products, none of which can be classified as metals or minerals.

Haiti.—The trade agreement between the United States and Haiti signed at Washington on March 28, 1935, effective June 3, 1935, is to remain in force for at least 3 years and may be terminated at the end of that period or subsequently upon 6 months' notice.

In return for the assurance of continued duty-free admission into the United States of specified agricultural products and reductions in the prevailing American duties on certain other agricultural products, Haiti, under the agreement, is to grant duty concessions on a wide range of American export products, but none of them include commodities classified as minerals or metals. However, among the commodities on which the present favorable Haitian customs treatment has been "bound" against increase for the life of the

[1] "Bound" indicates that the rate or free status of the commodity involved will not be changed during the existence of that particular trade agreement.

agreement, are plain and plate glass, iron and steel pipes and fittings, a broad range of electrical machinery and appliances, and still mineral waters.

Sweden.—The United States and Sweden signed a trade agreement which provides for reciprocal concessions on May 25, 1935; it became effective on August 5, 1935, and will remain in force for 3 years unless terminated in accordance with articles 7, 10, or 14 of the agreement. The agreement provides for unconditional most-favored-nation treatment with respect to customs duties and related matters. Concessions obtained by the United States from Sweden affect a total of 64 different items and include duty reductions on 21 items, the "binding" of the prevailing comparatively favorable rates on 27 items, and the "binding" of 16 items on the free list. Mineral and metal products are not included in the first group, but among the 16 items that Sweden agrees to "bind" on the free list are sulphur, which is consumed in large quantities by the Swedish chemical wood-pulp industry; copper, used extensively by Swedish industries; and electrodes for electric furnaces. Among the 27 items "bound" during the life of the agreement at the prevailing rate of duty are gasoline, carbon black, several types of abrasives, and hacksaw blades. Concessions granted by the United States to Sweden include reductions in import duty on a large variety of iron and steel manufactured products and unmanufactured granite and granite paving blocks. Certain types of machine knives and slicing blades are "bound" at the prevailing rate of duty.

Colombia.—The trade agreement between Colombia and the United States, signed on September 13, 1935, became effective on May 20, 1936, and was the tenth agreement to take effect under the Trade Agreements Act of June 12, 1934. It will remain in force for a minimum of 2 years and may be terminated on expiration of that period upon 6 months' prior notice or any time thereafter upon 6 months' notice. This agreement, like those with Brazil, Belgium, Haiti, and Sweden, provides for reciprocal tariff advantages and is based upon the principle of unconditional most-favored-nation treatment. About 95 percent of Colombia's exports of platinum are shipped to the United States. Colombia, whose emerald mines are the largest in the world, is also this country's principal source of supply for uncut emeralds.

With regard to metals and their manufactures, the United States is granted concessions in the form of reductions in duties applied to Colombian imports of copper and brass pipes and fittings, plain and galvanized iron and steel sheets, tin plate, steel furniture, and manufactures of asbestos. In addition to these tariff reductions, the prevailing favorable rates of duty on copper wire and cable, certain types of iron and steel pipes and fittings, tin plate for canning, safes, numerous types of hardware, including wire, screws, bolts, nails, fencing, etc., and structural steel, have been "bound" against increase.

With reference to mineral commodities, concessions granted by the United States to Colombia consist of assurances that uncut emeralds and platinum in ingots, bars, sheets, or plates of a certain thickness, sponge or scrap, shall not be subject to an import duty during the period the agreement is in force.

Canada.—On November 15, 1935, the trade agreement between United States and Canada was signed and on January 1, 1936, came into force, pending ratification on the part of Canada. The agreement will remain in effect until December 31, 1938, unless terminated before that time under special provisions in the agreement. Unless at least 6 months before December 31, 1938, either Government has given notice of intention to terminate the agreement on that date, it will remain in force thereafter until 6 months from the day on which such notice is given. In this trade pact the concessions made by the United States to Canada with reference to minerals and products thereof are not considered important compared with the balance of commodities affected. About 17 mineral items are affected by the reductions granted. Those on which duties were reduced include cobalt oxide, firebrick, limestone not suitable for building stone, lime, hydrated lime, crude feldspar, talc, steatite or soapstone, dead-burned lime-magnesia, refractory material, ferromanganese containing not less than 4 percent carbon, ferrosilicon containing not less than 8 percent and not more than 30 percent silicon, ferrotitanium, ferrovanadium, and ferrouranium. In addition, articles now on the United States free list, which are "bound" to it for the life of the agreement, include unmanufactured asbestos, cobalt, cobalt ore, crude artificial abrasives, nickel ore, nickel matte, nickel oxide, crude plaster rock and gypsum, sulphuric acid, calcium cyanamid or lime nitrogen, and sodium cyanide.

Concessions granted by Canada on mineral products imported from the United States, include "binding" on the free lists of zinc dust, strips, and sheets; reductions in duty were granted for steel rails and wire of all metals and kinds. Significant reductions were made by Canada on imports from the United States of machinery of many kinds, especially metal- and coal-mining equipment.

Honduras.—The treaty with Honduras, signed on December 18, 1935, and effective on May 2, 1936, does not mention any mineral products.

Netherlands.—The trade agreement between the United States and the Kingdom of the Netherlands, signed on December 20, 1935, became effective February 1, 1936, and will remain in force until January 1, 1939; if not then terminated on 6 months' previous notice, it will continue until 6 months after notice is given. The general provisions of the agreement are the same in their general purpose and effect as those included in previous trade agreements, although they differ considerably in technical detail. The agreement contains the usual provisions for unconditional most-favored-nation treatment in regard to duties and other charges. The United States granted the Netherlands a concession on lithopone containing less than 30 percent zinc sulphide by reducing the United States import duty and lowering the computed ad-valorem equivalent of the duty.

The Netherlands tariff concessions on mineral products imported from the United States include the "binding" on the free list of copper in pigs, ingots, and bars, lubricating oil in bulk, crude and refined sulphur in bulk, and minimum annual import quota allotments for United States exports of Chilean or synthetic nitrate, zinc sheets, and fertilizers.

Switzerland.—The trade agreement between the United States and Switzerland was signed at Washington on January 9, 1936, became effective February 15, 1936, will remain in effect for 3 years, and, if not then terminated on 6 months' previous notice, will continue in force until 6 months after notice is given. These provisions regarding the duration of the agreement are subject to the special termination clauses in several articles of the agreement.

By the agreement the United States obtains from Switzerland concessions in both tariff rates and import quotas which will benefit American producers and exporters. Swiss duties have not been the primary cause for the decline of imports from the United States into Switzerland, consequently the most important type of concession obtained from Switzerland relates to the system of import permits or quotas. The Swiss quota system has been the one outstanding barrier to the United States export trade with that country. The primary aim of the negotiations leading to the agreement, therefore, was to obtain relaxation of the artificial limitation through quotas of imports from the United States into Switzerland.

As a result of the agreement, Switzerland now grants new and liberalized quotas on 19 American products, the only item considered of mineral origin being petroleum products. As to Swiss tariff concessions, duties have been reduced on 10 items, none of which may be classified as mineral or metal products. The Swiss Government has agreed not to increase the duties on 19 commodities; manufactures of mineral origin included are artificial abrasives, certain coal-tar derivatives, and lubricating grease.

In addition to the specific concessions the United States obtains benefits through the general provisions of the agreement which give assurance that the United States will enjoy most-favored-nation treatment as regards both tariff duties and the allocation of quotas.

Concessions granted by the United States to Switzerland involve reduction of import duties. Duty reductions apply to 59 commodities, but comparatively few may be classified as minerals or metals. Certain chemicals, such as lead pigments, certain ferro-alloys, aluminum foil, and certain coal-tar products, are among the items affected by a reduction of United States import duties.

LEGISLATION INFLUENCES FOREIGN TRADE

United States licenses exports of tin-plate scrap.—On February 17, 1936, an act was signed by the President which provides for the protection and preservation of domestic sources of tin. This act prohibits the exportation of tin-plate scrap, except under special license of the President. The licensing feature of the bill was placed under the control of the Secretary of State, who, as chairman of the National Munitions Control Board, placed an embargo on the exportation of tin-plate scrap from April 16 to July 1, 1936. Unless the embargo is maintained, exports under license may be made subsequently to July 1, 1936.

Proposal to maintain Government stocks of strategic minerals.—In February 1936 a bill was introduced in Congress which, should it be enacted into law, would authorize the Government to acquire stocks of manganese, chrome, tungsten ores, and pig tin on a barter basis or in payment of foreign war debts or by outright purchase.

First free port established in United States.—On January 29, 1936, the Foreign-Trade Zones Board announced a grant to the city of New York of the privilege of establishing, operating, and maintaining a foreign-trade zone at Stapleton, Staten Island, N. Y. This grant was made in accordance with the Foreign-Trade Zones Act approved

June 18, 1934. This act provides for the "establishment, operation, and maintenance of foreign-trade zones in ports of entry in the United States, to expedite and encourage foreign commerce and for other purposes." Transshipment business, as conducted through foreign-trade zones, has been an important factor in the development of some of the world's leading ports. The purpose of a foreign-trade zone is to foster the handling of foreign goods, not for domestic consumption, but for reshipment to foreign markets. Those interested in the development of foreign-trade zones in the United States believe that cumbersome restrictions necessarily imposed on goods under customs supervision will be eliminated. The law requires foreign-trade zones to be furnished with the necessary facilities for loading, unloading, storing, and manipulating but prohibits manufacturing or exhibiting. Within the zone, merchandise may be broken up, repacked, assembled, distributed, sorted, graded, cleaned, stored, mixed with foreign or domestic merchandise, or otherwise prepared for reexport. Foreign merchandise may be sent into customs territory from foreign-trade zones, but it is then subject to the laws and regulations affecting imported merchandise.

Trade restrictions and controls continue in 1935.—The past year was marked in most foreign countries by a substantial continuance or even accentuation of import restrictions, according to Henry Chalmers, chief, Division of Foreign Tariffs, in Commerce Reports, February 15, 1936, page 115. Complicated systems of quotas, exchange controls, and clearing agreements developed by most countries of continental Europe were continued in 1935, and in Germany and Italy particularly such measures became more stringent. According to Charles W. Wright, foreign mineral specialist, Bureau of Mines, the pressure of Italy's military requirements with consequent maximum exploitation of that country's mineral resources forced adoption in December 1935 of measures for promoting and regulating mining activities as well as imports of mineral commodities to insure an adequate supply of such products for consuming industries.

Three new Government agencies were organized to administer these regulatory measures, closely resembling the three agencies already functioning for petroleum products, which are regulated by a petroleum board created by Government decree of October 24, 1935. In Germany there is even greater regimentation of the mining and metallurgical industries; according to Wright, mineral developments are carried on for political, financial, or military reasons regardless of commercial results. American Consul Lester L. Schnare, Hamburg, Germany, states that a brief inspection of trade developments during 1934 and 1935 with respect to the principal sources from which Germany has maintained its supplies of mineral oils is sufficient to show the strong influence on this trade of the clearing agreements between Germany and oil-producing countries in favor of the "clearing" countries. This development is due to the fact that, with relatively few, unimportant exceptions, foreign exchange is not made available by the German exchange and import control authorities to pay foreign suppliers for imports of mineral oils; in consequence, payment for the bulk of imports into Germany must be arranged through barter in German exportable merchandise or through the clearing agreements that facilitate the exchange of goods between Germany and the countries with which it has made these agreements. The United States has no clearing agreement with Germany. Of the 11 principal sources from which Germany has imported mineral oils in recent years, six are countries with which there exist clearing or trade agreements. From these six sources imports into Germany of mineral oils increased by 32 percent in 1935 compared with 1934. From the five "nonclearing" countries, including the United States, total imports increased in 1935 by only a fraction of 1 percent; if the imports from the United States which were refined and reexported are deducted from the 1935 total, the result will show a decline of 15 percent in imports of mineral oils from "nonclearing" countries.

MINERAL SELF-SUFFICIENCY OF MAJOR POWERS

The Great Powers in World Politics, by Simonds and Emeny, classifies the major world powers into two groups. The first comprises nations that are richly endowed in natural resources and have achieved ethnic unity; the second group lacks a sufficiency of natural resources, and its unification is incomplete. The less-fortunate nations are always confronted with the choice of retaining their present position of material inferiority or expanding their territory. Members of the first group demand security based upon their status quo, while prosperity, or unity, or essential raw materials may be attained by nations in the second group only by some modification of their status.

The accompanying table illustrates clearly the relative position of the major industrial nations with respect to their dependence for, or self-sufficiency in, the 32 principal mineral commodities that enter international trade.

75731—36——5

Principal world producers of major industrial minerals

[Percentages represent the proportions of total world production based on the annual average for 1932–34, inclusive]

Countries	Aluminum	Antimony	Asbestos	Barite	Bauxite	China clay	Chrome	Coal	Copper	Crude petroleum	Fluorspar	Graphite	Gypsum	Iron ore	Lead	Magnesite
Australia														0.89	18.01	
British Guiana					4.43											
British India							4.20							1.73	7.17	
Canada	10.70		52.14						12.78				5.67		10.54	
Ceylon												11.10				
Northern Rhodesia									11.74							
Southern Rhodesia			9.32				9.24									
United Kingdom	7.32			13.86		22.96		18.10			13.85		14.23	8.96		
Union of South Africa			5.43				8.63									
Belgium								2.04						3.72		
Belgian Congo									7.12							
France	9.71				41.56			4.02			7.93			31.28		
Madagascar												6.06				
Algeria													1.24	.88		
New Caledonia							13.14									
Germany	16.20			45.02		24.53		21.18	2.66		29.66	23.33	8.06	2.80	4.80	
Italy	8.25			5.37	9.14							4.03	7.25			
Japan						15.33	4.48	2.88	6.89							
Chosen											5.04	28.39				
Spain				2.14					3.36				10.22	1.97	6.46	
U. S. S. R. (Russia)	4.25		27.47		4.36		23.32	6.51	3.36	11.49				16.82		46.65
United States	25.74		1.59	28.75	12.14	13.50		29.43	18.66	60.80	29.27		18.52	18.36	20.72	8.75
Austria												17.47				21.72
Hungary					10.79											
Norway	10.42								1.79							
Yugoslavia					6.81		8.84		3.00						4.83	
Cuba							5.59									
Mexico		8.73							3.68	2.45		3.46			11.31	
Bolivia		6.27														
Chile									16.10					.59		
Colombia										1.09						
Surinam (Dutch Guiana)					9.76											
Peru									2.33	.92						
Venezuela										8.66						
China		71.85						2.33						2.52		
Netherland India										3.00						
Turkey							18.84									
Total	92.59	86.85	95.95	95.14	98.99	76.32	96.28	86.49	93.47	88.41	85.75	93.84	65.19	90.52	83.84	77.12
Other countries	7.41	13.15	4.05	4.86	1.01	23.68	3.72	13.51	6.53	11.59	14.25	6.16	34.81	9.48	16.16	22.88
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Principal world producers of major industrial minerals—Continued

Countries	Manganese	Mercury	Mica	Nickel	Phosphate rock	Pig iron	Platinum	Potash	Pyrite	Sulphur	Talc	Tin	Tungsten	Vanadium	Zinc	Natural sodium nitrate
Australia												2.58			10.97	
British India	14.48		17.60			2.22						3.38	26.19			
British Malaya												30.05	10.30			
Canada			3.60	78.49			38.59								8.72	
Gold Coast	11.33															
Nigeria												4.21				
Newfoundland															6.31	
Other British West Africa														20.00		
United Kingdom						9.19										
Union of South Africa	1.34		1.89				8.14									
Belgium						9.42										
Belgian Congo												2.09				
France						11.93		19.70			17.86					
Morocco					14.20											
Tunisia					22.06											
Madagascar			1.06													
Algeria					7.09											
New Caledonia				13.28												
Germany						15.01		61.28	3.07						8.93	
Italy		30.55							10.65	20.23	8.95				3.08	
Japan	2.16					2.81			13.61	6.19						
Spain		38.30						5.06	33.28							
U. S. S. R. (Russia)	63.60		34.51		7.45	15.67	34.79	5.16	5.73							
United States	1.19	19.25	38.64		30.00	25.73		6.02	4.75	71.43	34.69		8.63		28.86	
Austria											5.04					
Norway									13.18		5.81					
Yugoslavia															4.62	
Cuba	1.80															
Mexico		8.36													7.80	
Bolivia												18.93				
Chile																100.00
Colombia							13.80									
Peru														78.23		
China											14.28	5.80	38.02			
Netherland India												15.87				
Siam												9.69				
Total	95.90	96.46	97.30	91.77	80.80	91.98	95.32	97.22	84.27	97.85	86.63	92.60	83.14	98.23	79.29	
Other countries	4.10	3.54	2.70	8.23	19.20	8.02	4.68	2.78	15.73	2.15	13.37	7.40	16.86	1.77	20.71	
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Industrial development of a nation obviously is predicated largely on accessibility to reserves of energy-producing raw materials and those other raw-material resources essential to industry. Accessibility to the essential raw materials may be based on actual possession within a country or its territorial possessions of a considerable portion of the primary elements of industry or close proximity to countries with such resources.

For the United States eight commodities represent a more or less serious strategic problem—antimony, chrome, manganese, mercury, nickel, platinum, tin, and tungsten. Of the remaining items it is apparent that copper, iron ore, lead, molybdenum, and zinc are without strategic importance so far as availability of domestic supplies in sufficient quantities is concerned. A few products, such as bauxite and vanadium, are imported into the United States in comparatively large tonnages, but dependence upon imports is determined by the high grade and comparative cheapness of the imported material rather than by lack of domestic reserves. Although the United States surpasses all other nations in the variety of its mineral resources, no one nation has a complete supply of the minerals necessary for modern industry. Specialization, reciprocity, and large-scale movements between nations are necessitated by nature's unequal distribution of minerals. The fact that the principal sources of supply of most minerals are relatively few compared with consumer nations has resulted in world flow of minerals along certain natural lines. The apparent determination of many nations during the last few years to strive for economic self-sufficiency or economic nationalism has resulted in diverting international flow.

Mineral production increases in 1935.—World production of virtually all minerals during 1935 was greater than the annual output for either of the 2 preceding years. For nickel, a record output is reported. Inauguration of definite national defense programs by many of the world powers and gradual adoption by large-scale consumers of mineral raw materials of their predepression practice of maintaining working stocks or standing reserves were influences that account for the increase in world production of the essential mineral raw materials. During 1935 an apparent compelling motive of national policy that obviously influenced international relations was the triple necessity for certain major powers to acquire outlets for their manufactured products, to acquire territory that would eliminate their present lack of essential raw materials, and to acquire territory suitable for colonization by ever-increasing populations at home.

International metals cartels.—Cooperative agreements among world producers, regulating output of production and sales of certain products, such as tin, copper, and lead, remained in effect during 1935.

Operation of the international tin-restriction scheme in conjunction with the buffer and private pools during 1935 precipitated an artificial shortage of the metal, resulting in disorganized markets and prices in the latter half of the year. During 1936 a new agreement must be adopted if world tin production is to be regulated as during the past few years.

An outstanding feature of 1935 in the metals industries was the inauguration of the restriction program by which seven of the world's largest copper interests, exclusive of American and Canadian producers, agreed to a production-quota scheme. Although the agreement for control of production and marketing of copper was announced

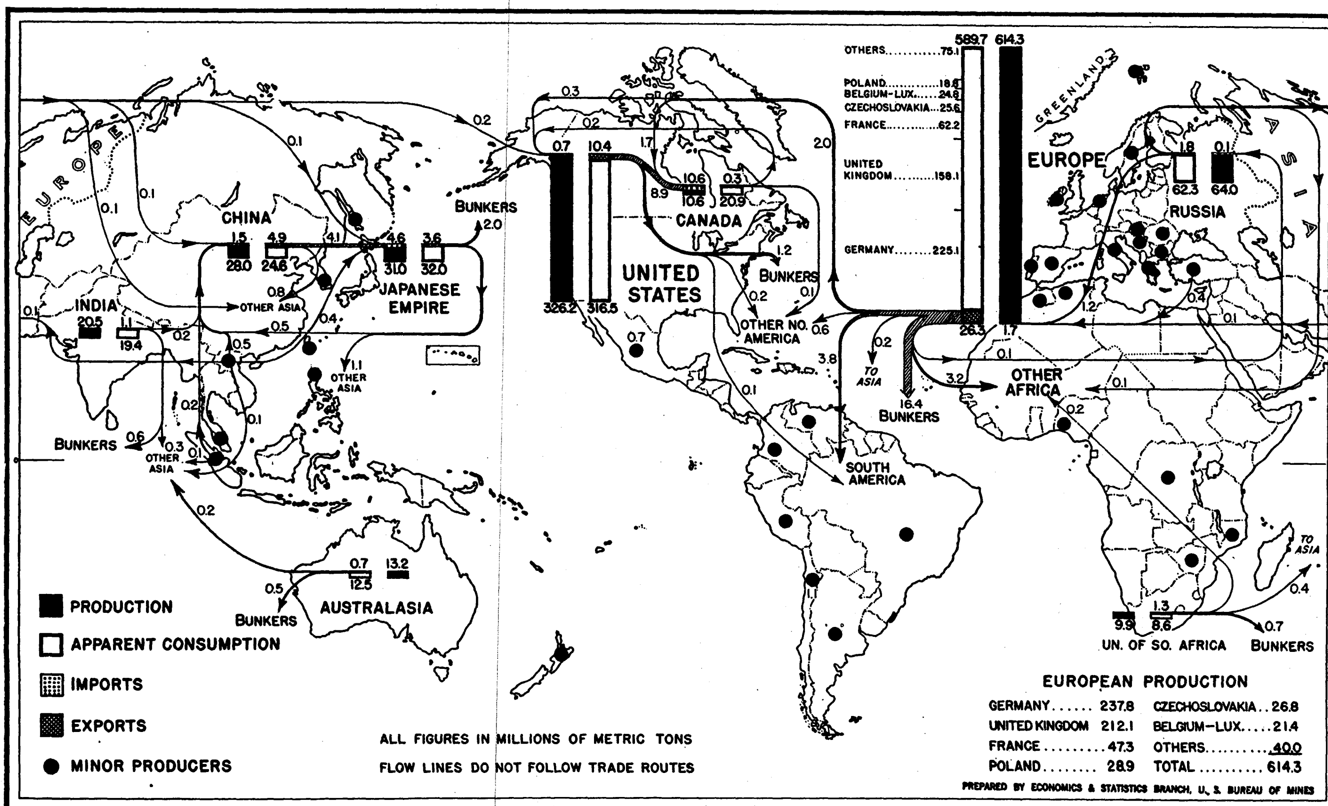

FIGURE 30.—World production and consumption of coal in 1932.

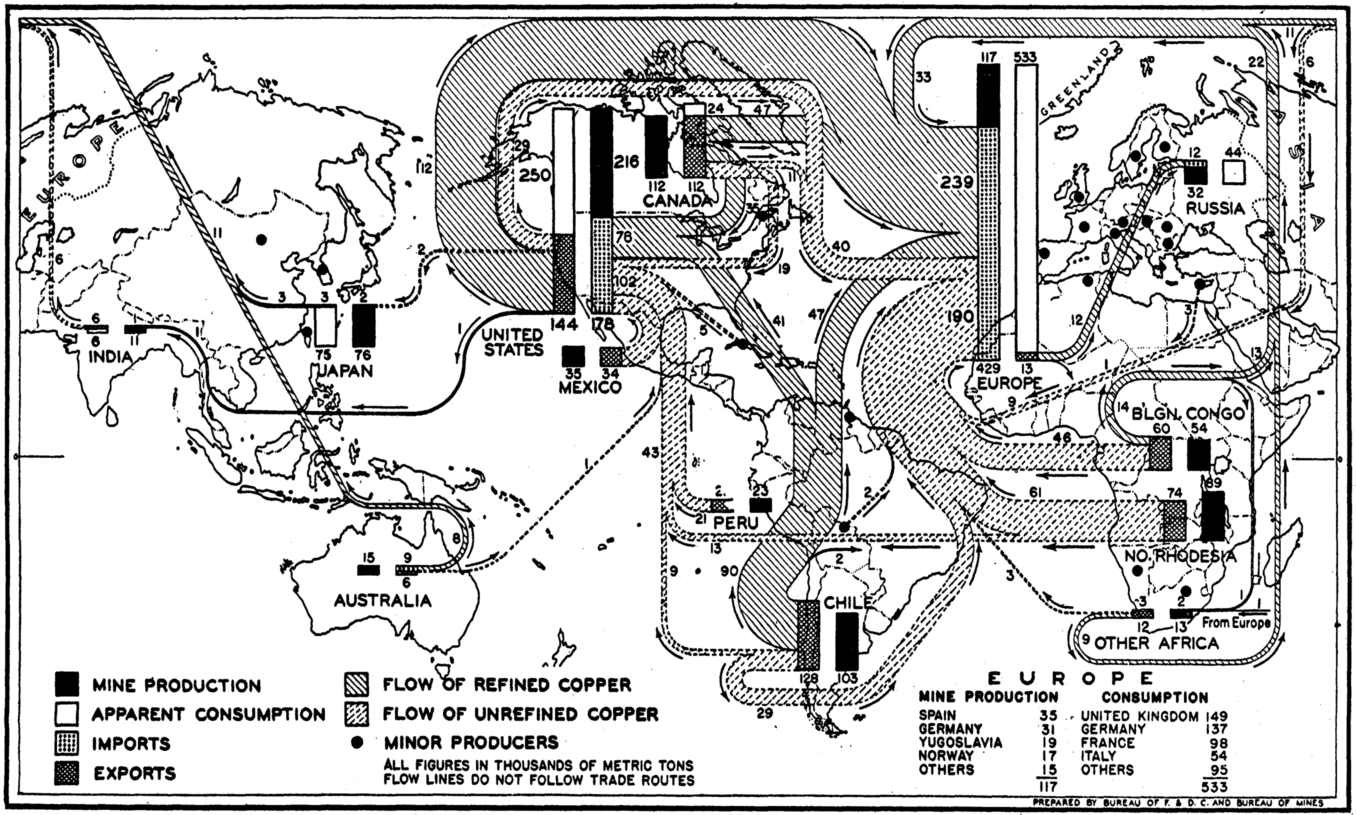

FIGURE 31.—World production and consumption of copper in 1932.

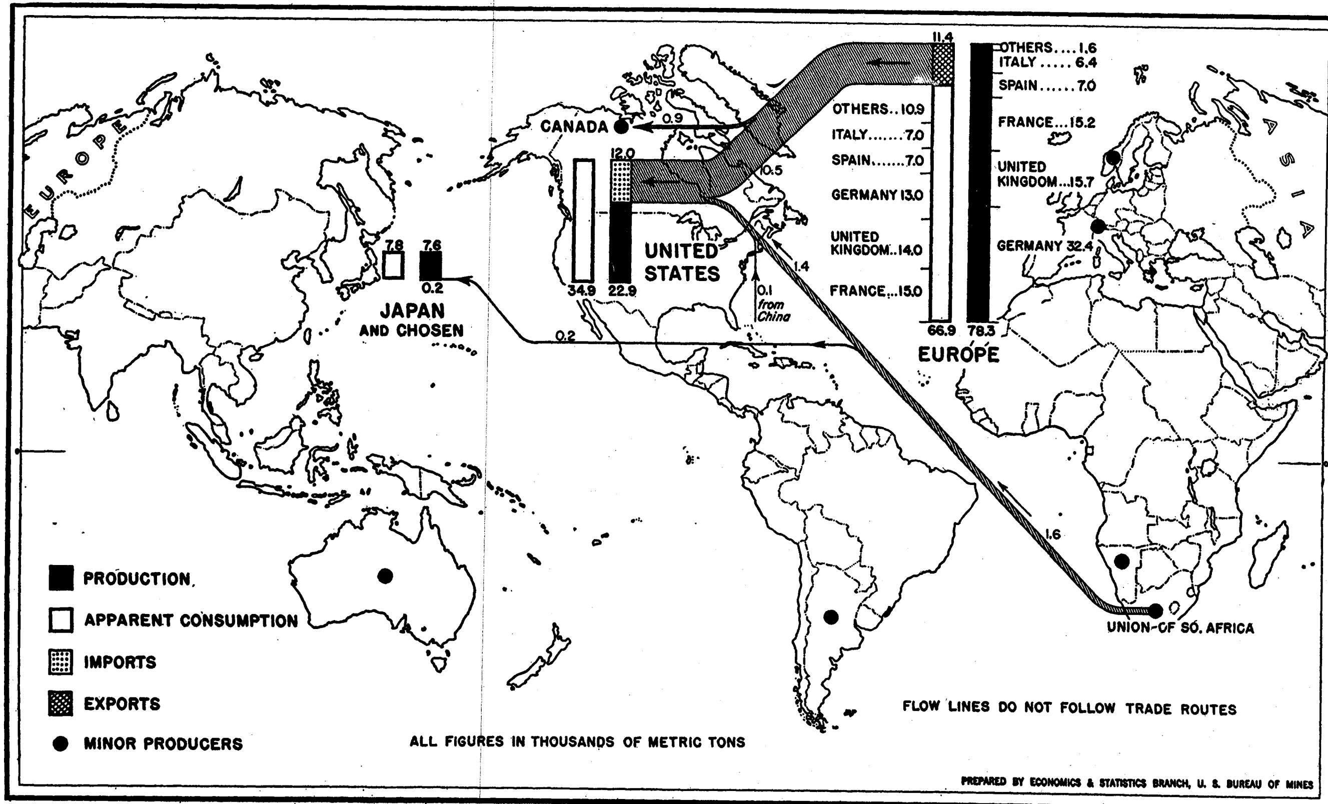

FIGURE 32.—World production and consumption of fluorspar in 1932.

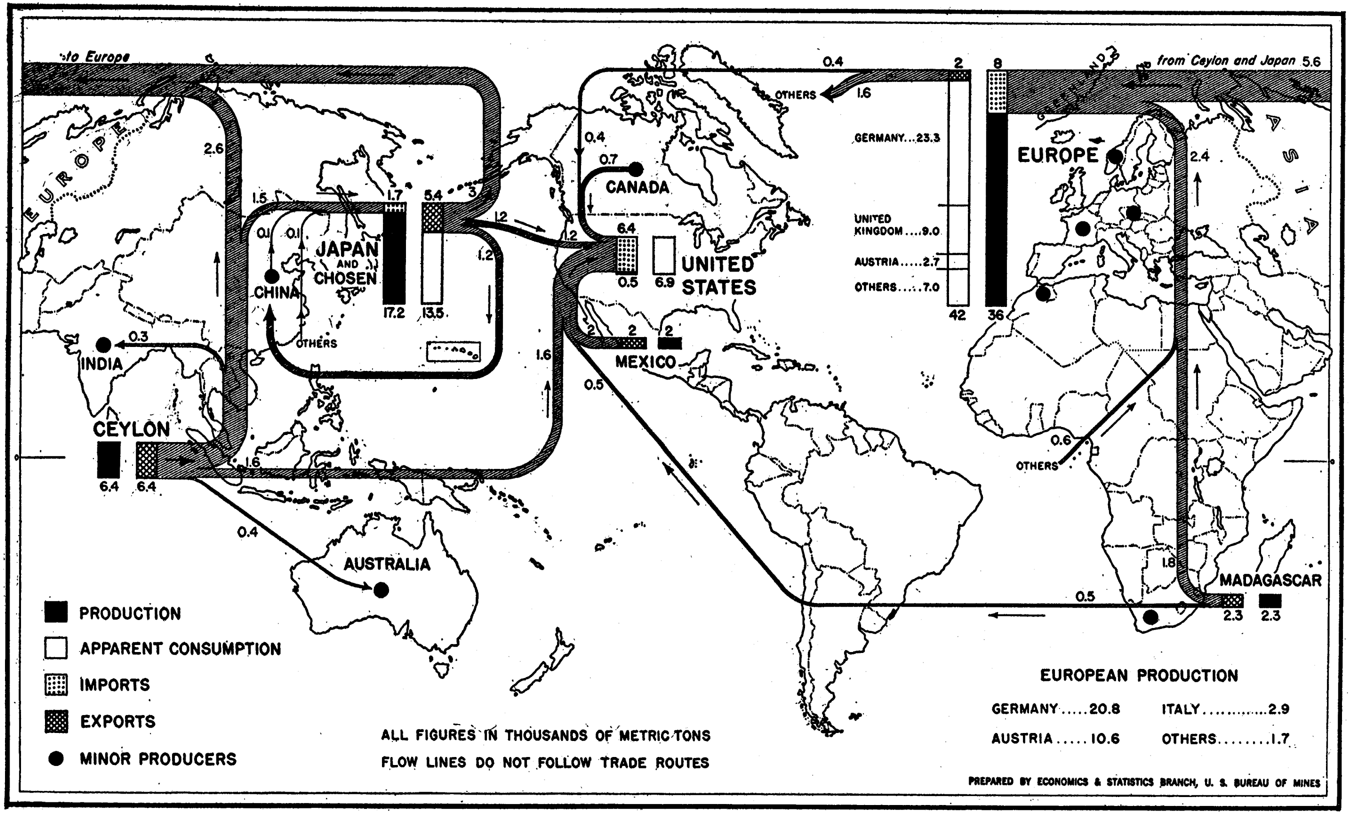

FIGURE 33.—World production and consumption of graphite in 1932.

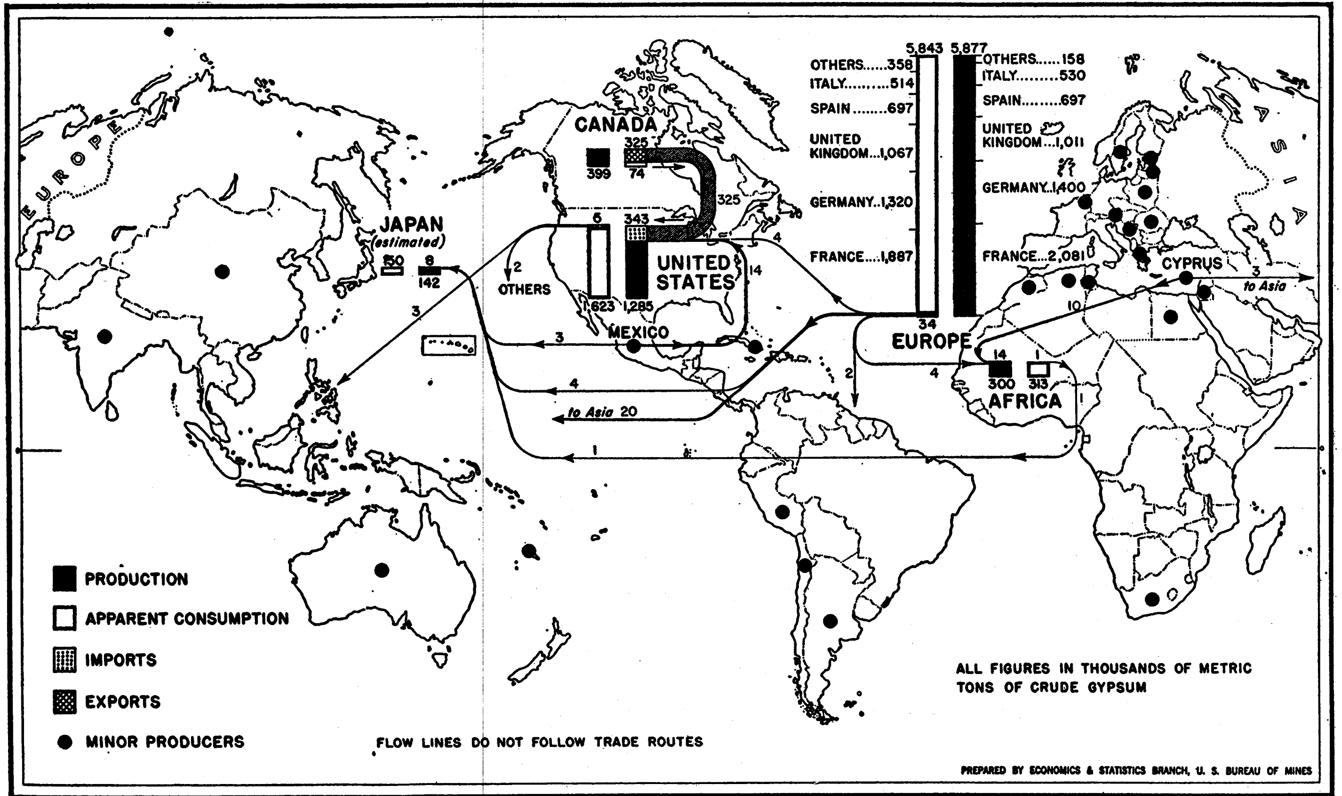

FIGURE 34.—World production and consumption of gypsum in 1932.

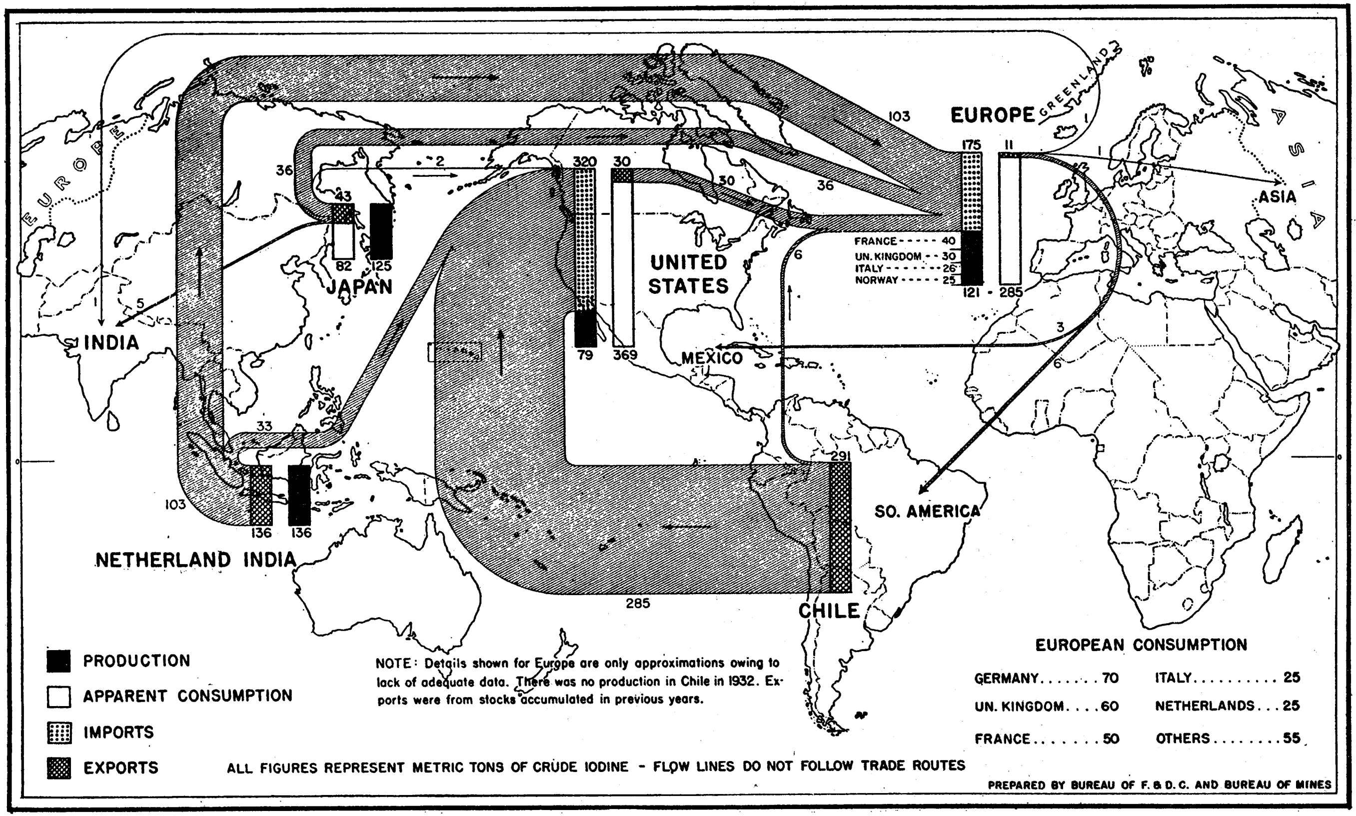

FIGURE 35.—World production and consumption of iodine in 1932.

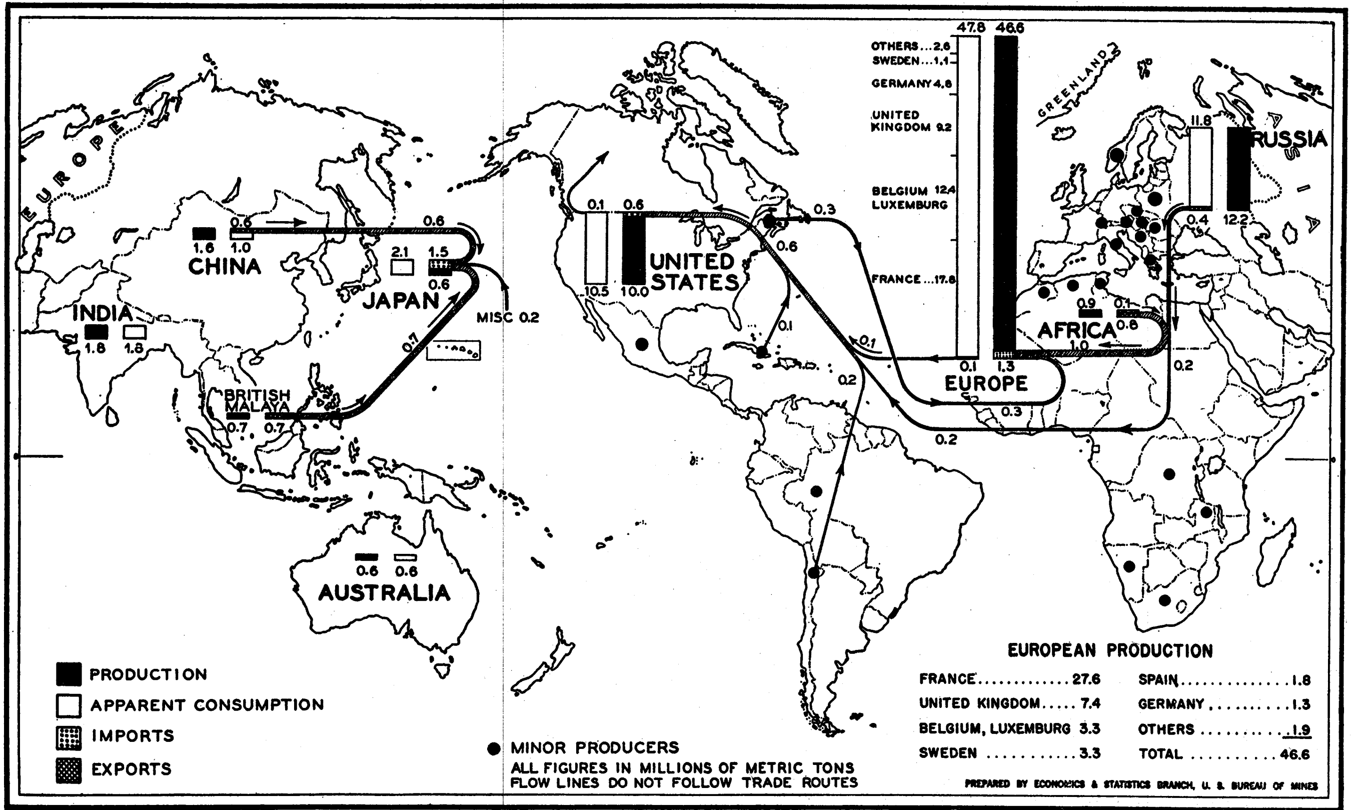

FIGURE 36.—World production and consumption of iron ore in 1932.

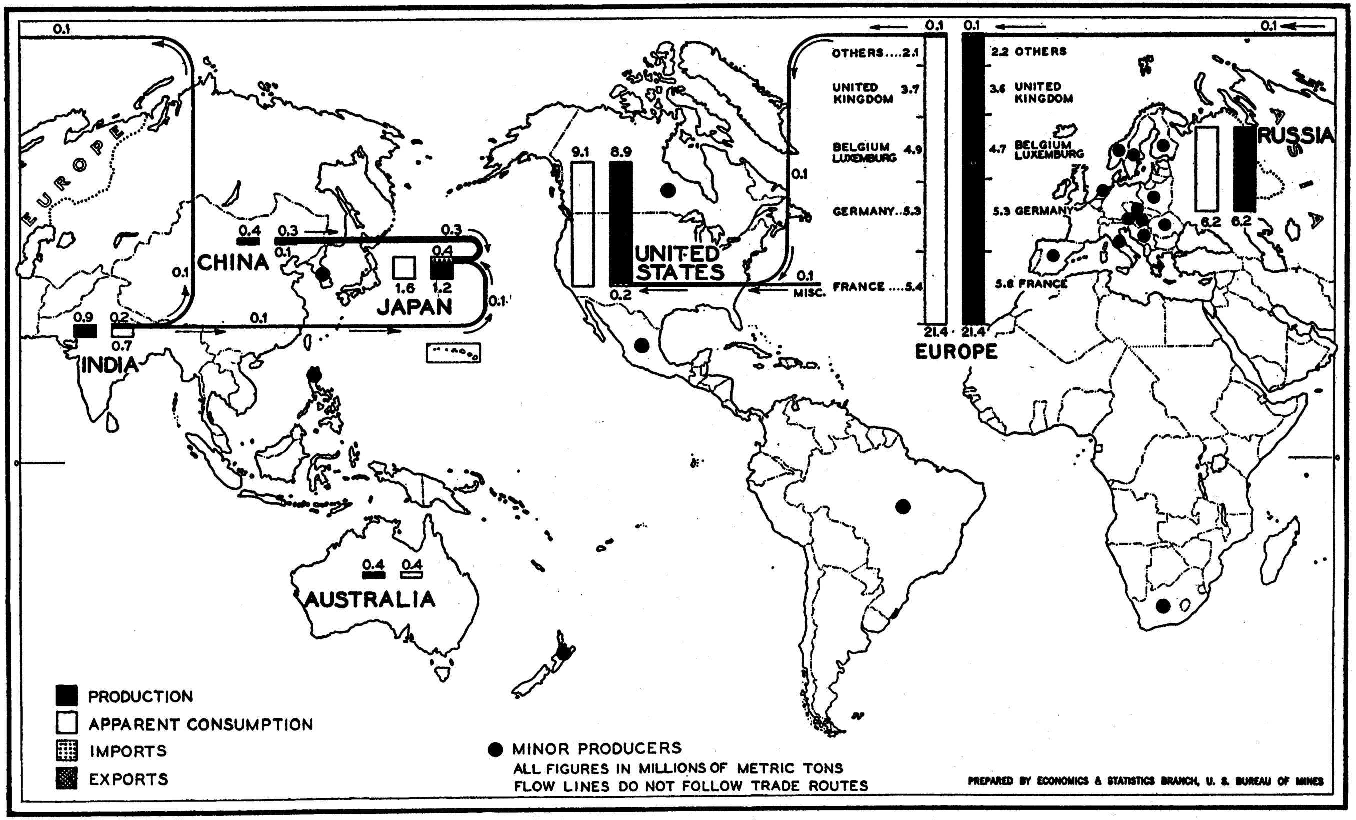

FIGURE 37.—World production and consumption of pig iron in 1932.

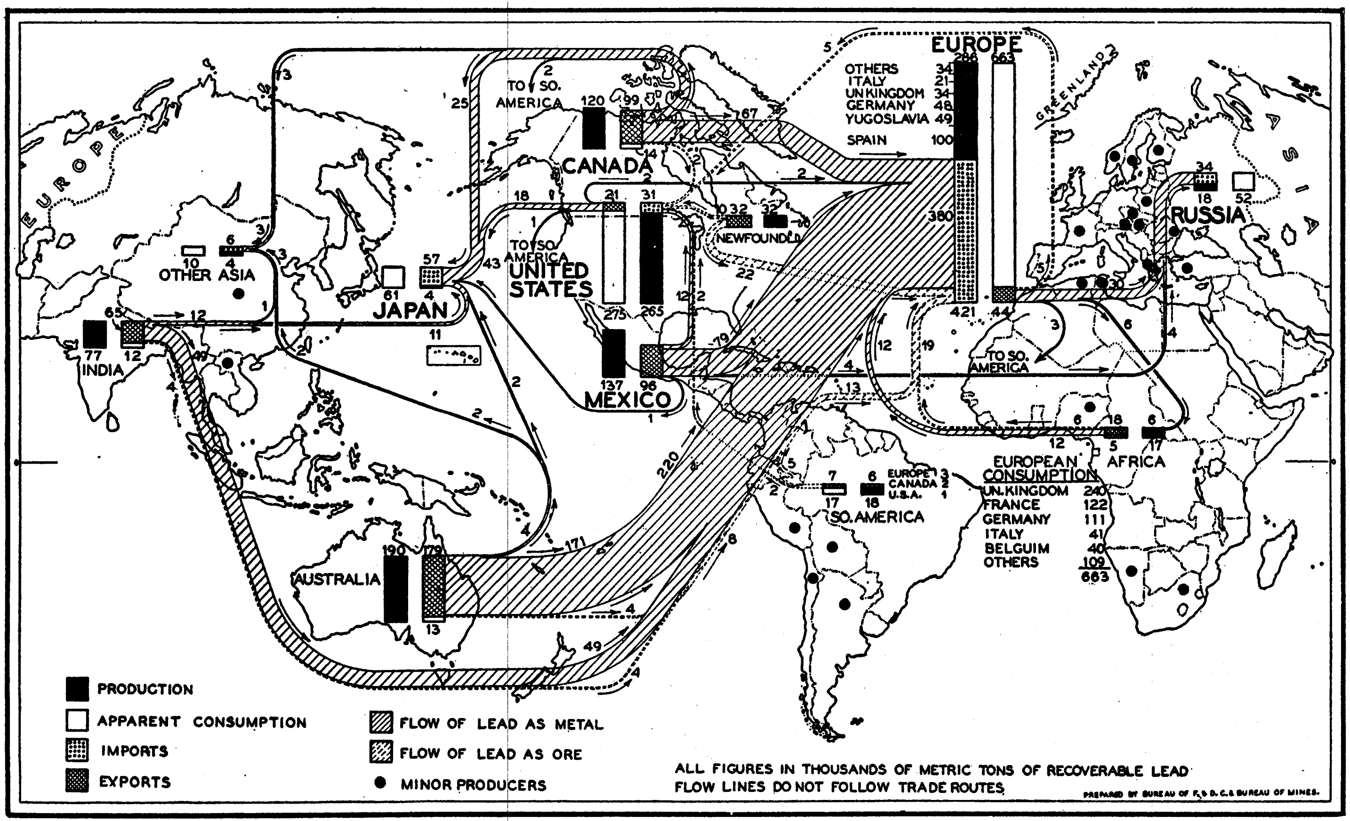

FIGURE 38.—World production and consumption of lead in 1932.

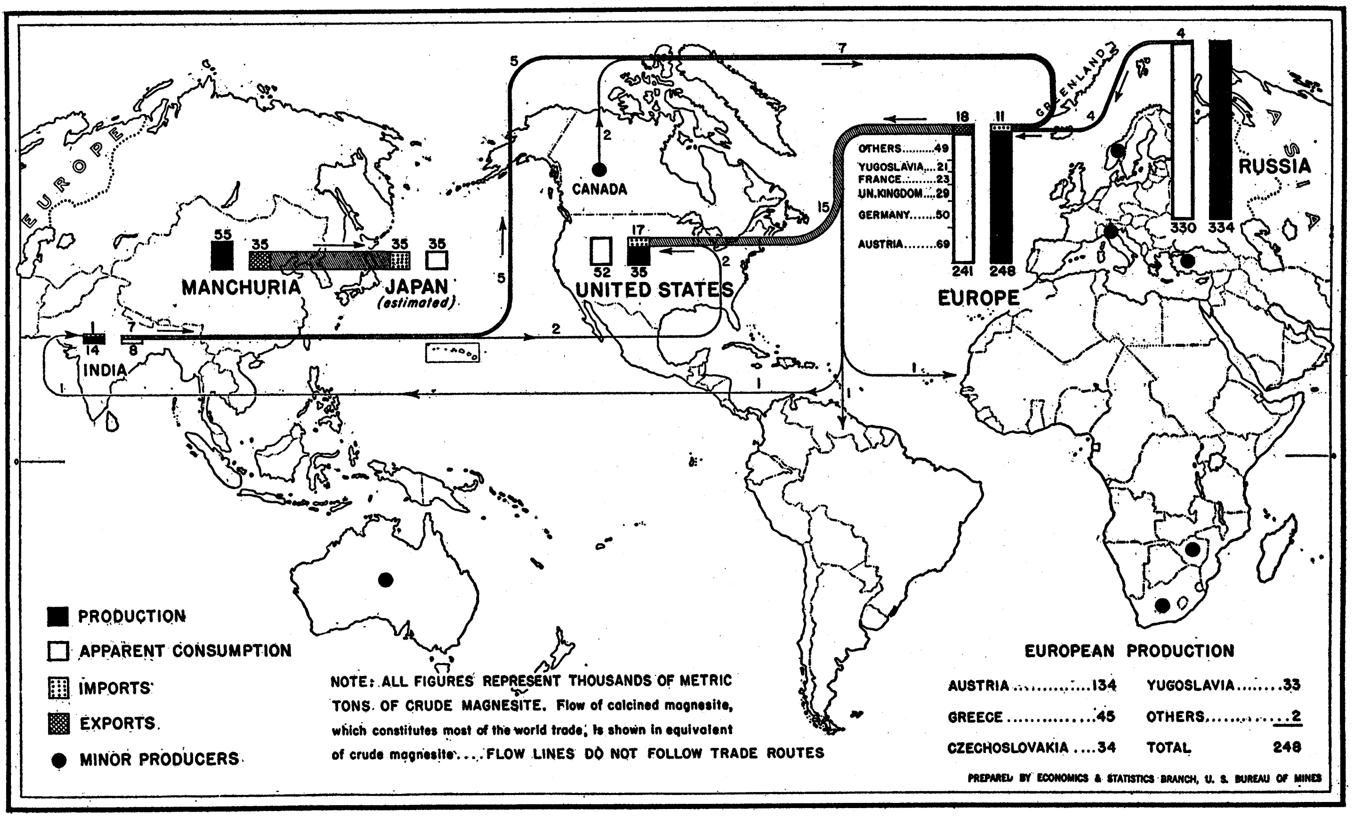

FIGURE 39.—World production and consumption of magnesite in 1932.

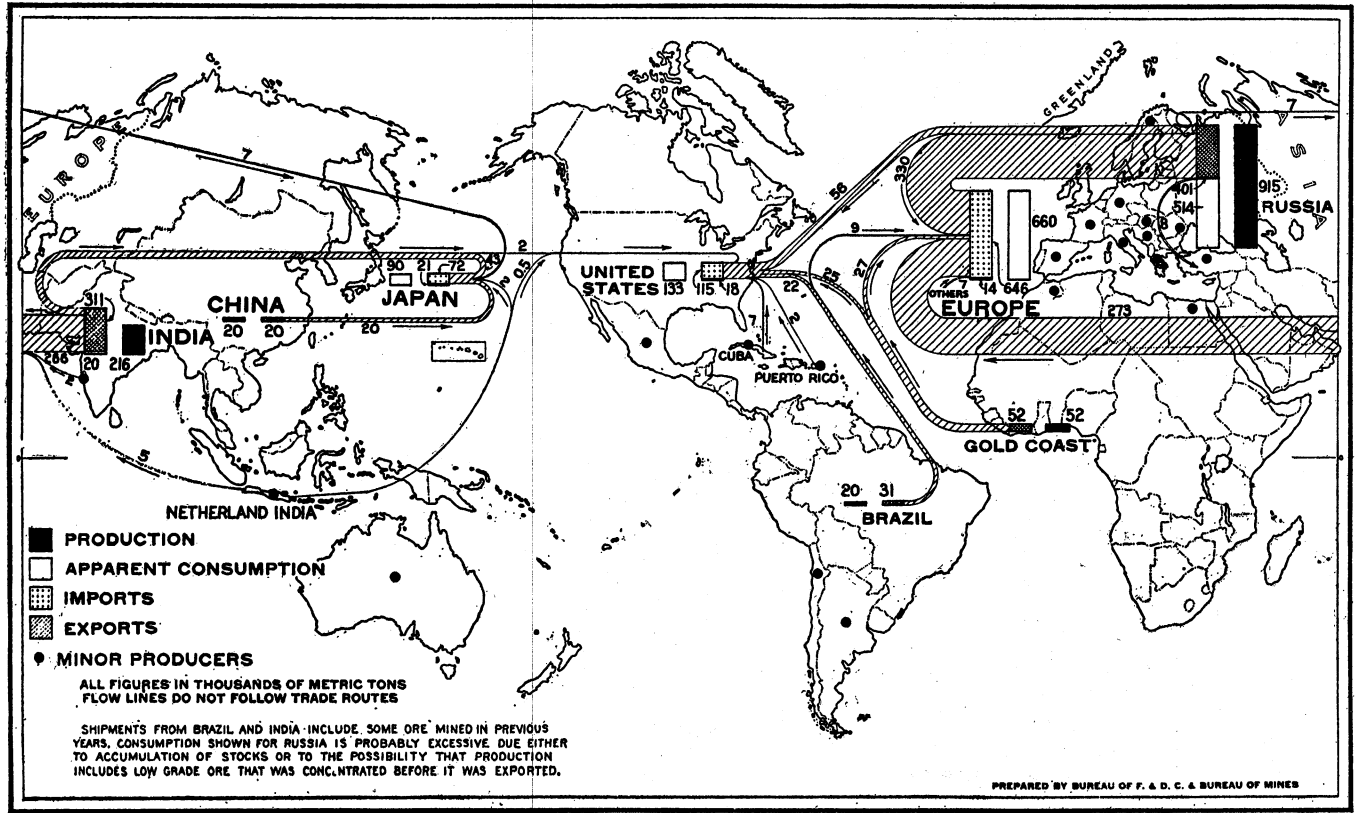

FIGURE 40.—World production and consumption of manganese ore in 1932.

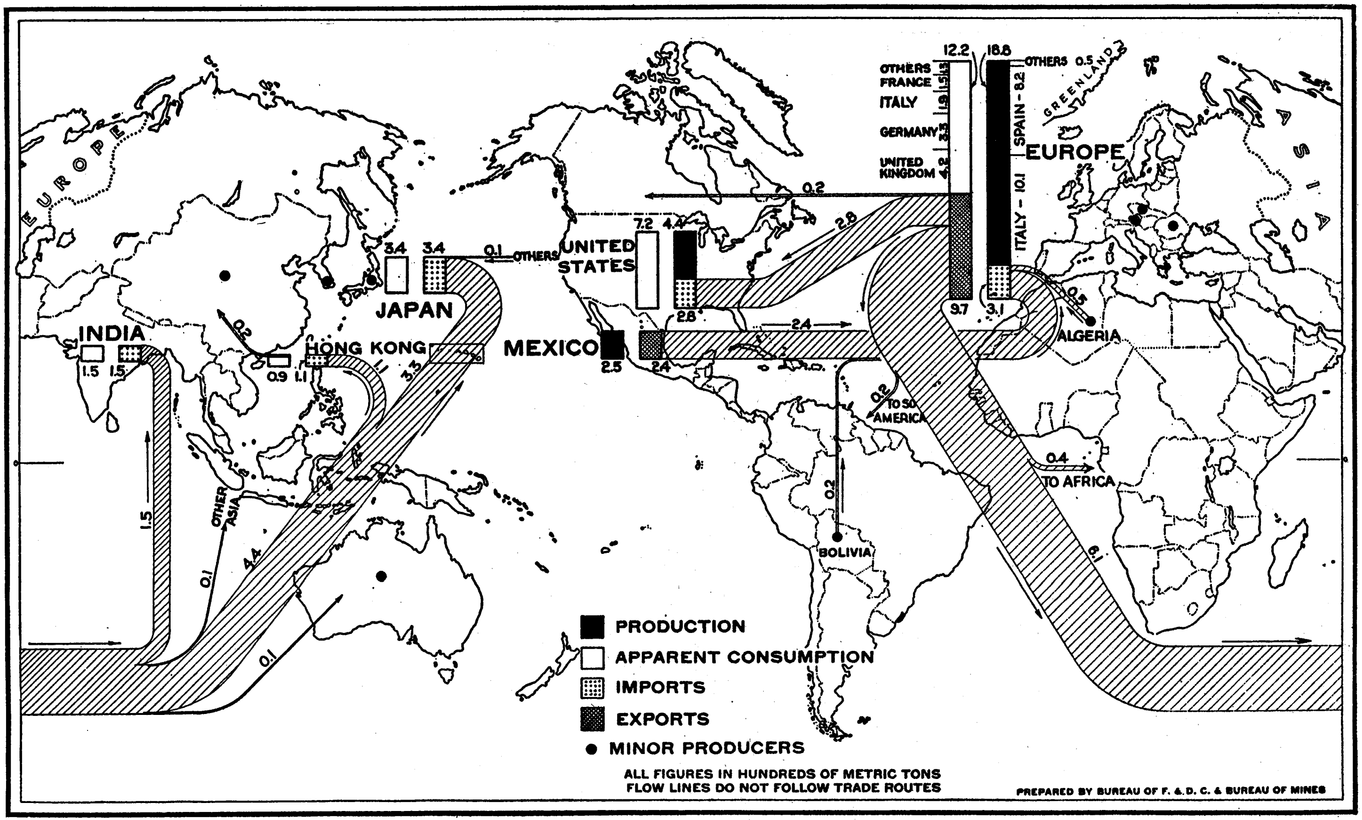

FIGURE 41.—World production and consumption of mercury in 1932.

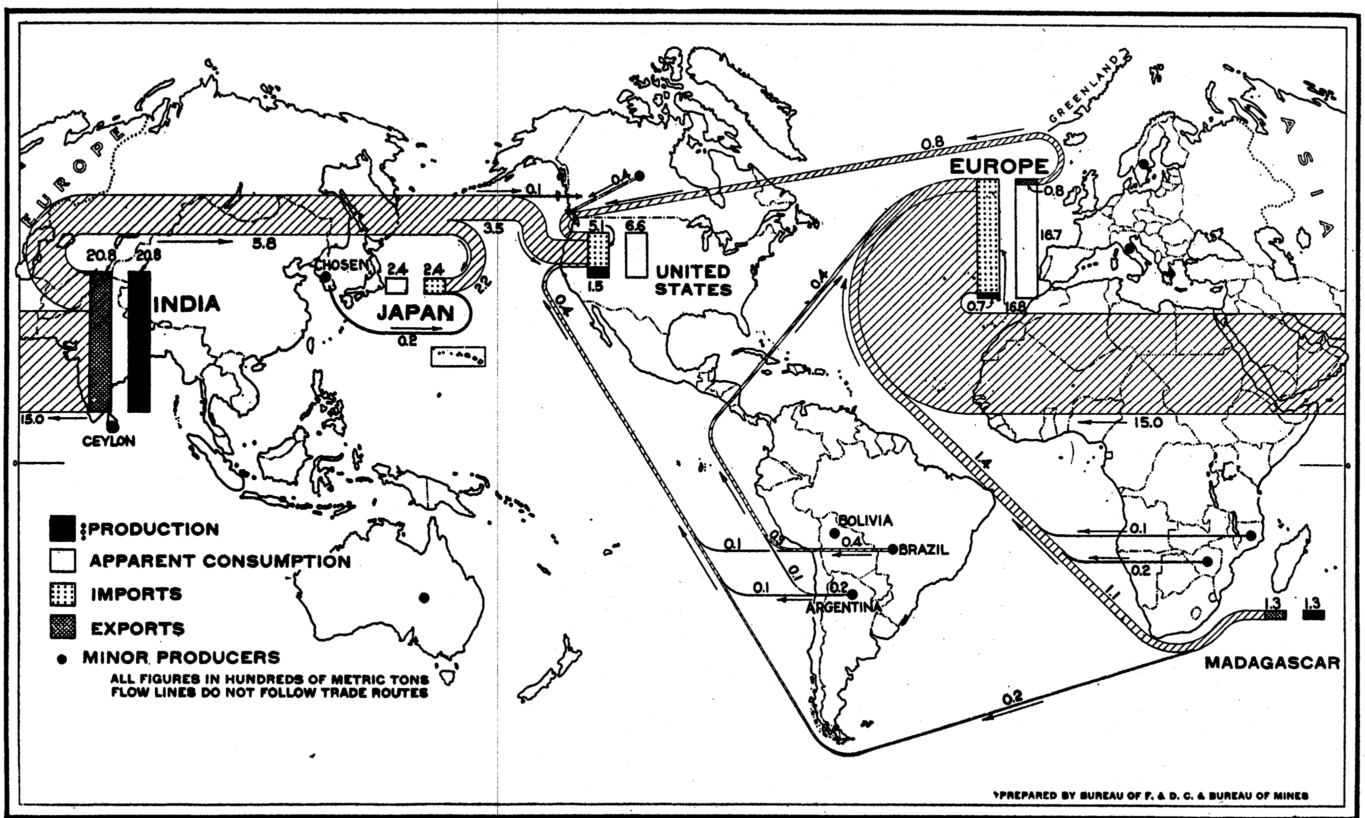

FIGURE 42.—World production and consumption of mica (sheets and splittings) in 1932.

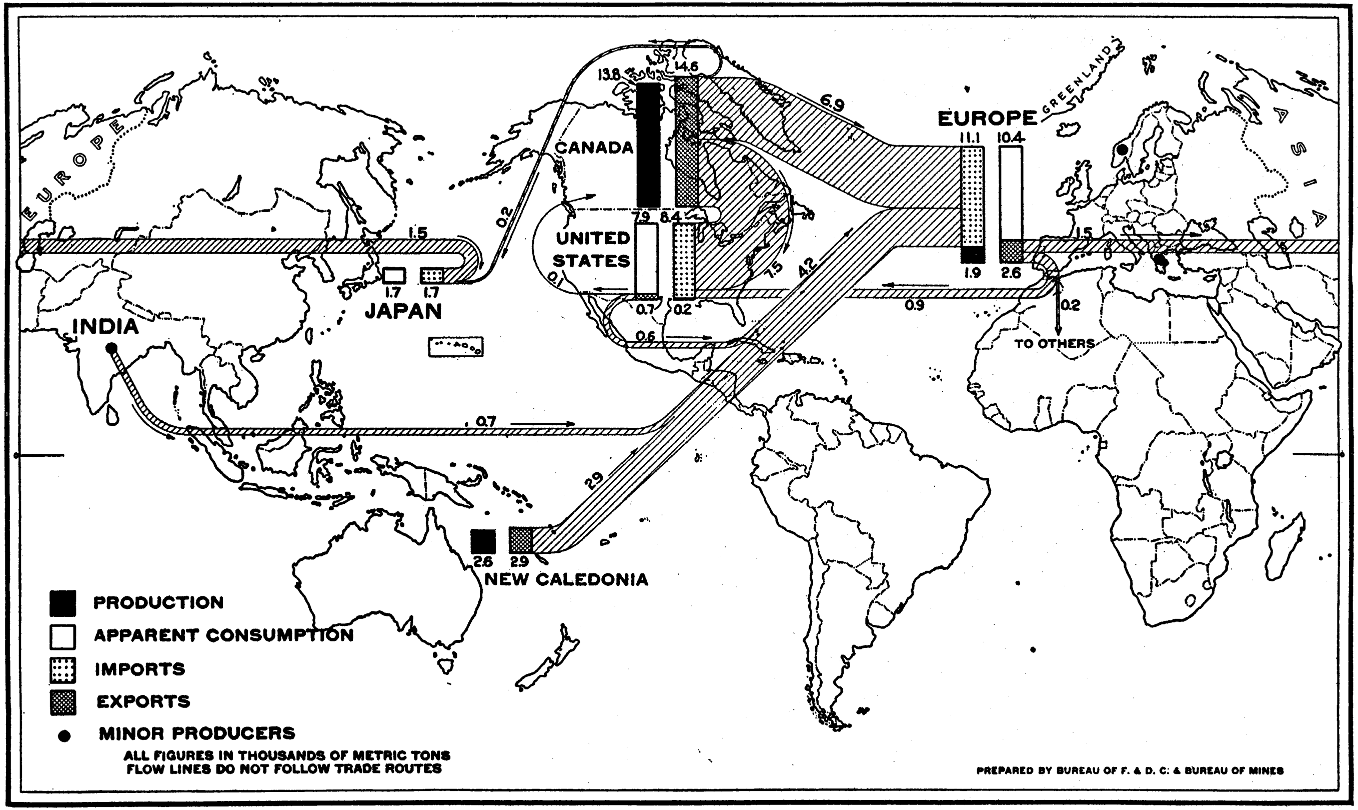

FIGURE 43.—World production and consumption of nickel in 1932.

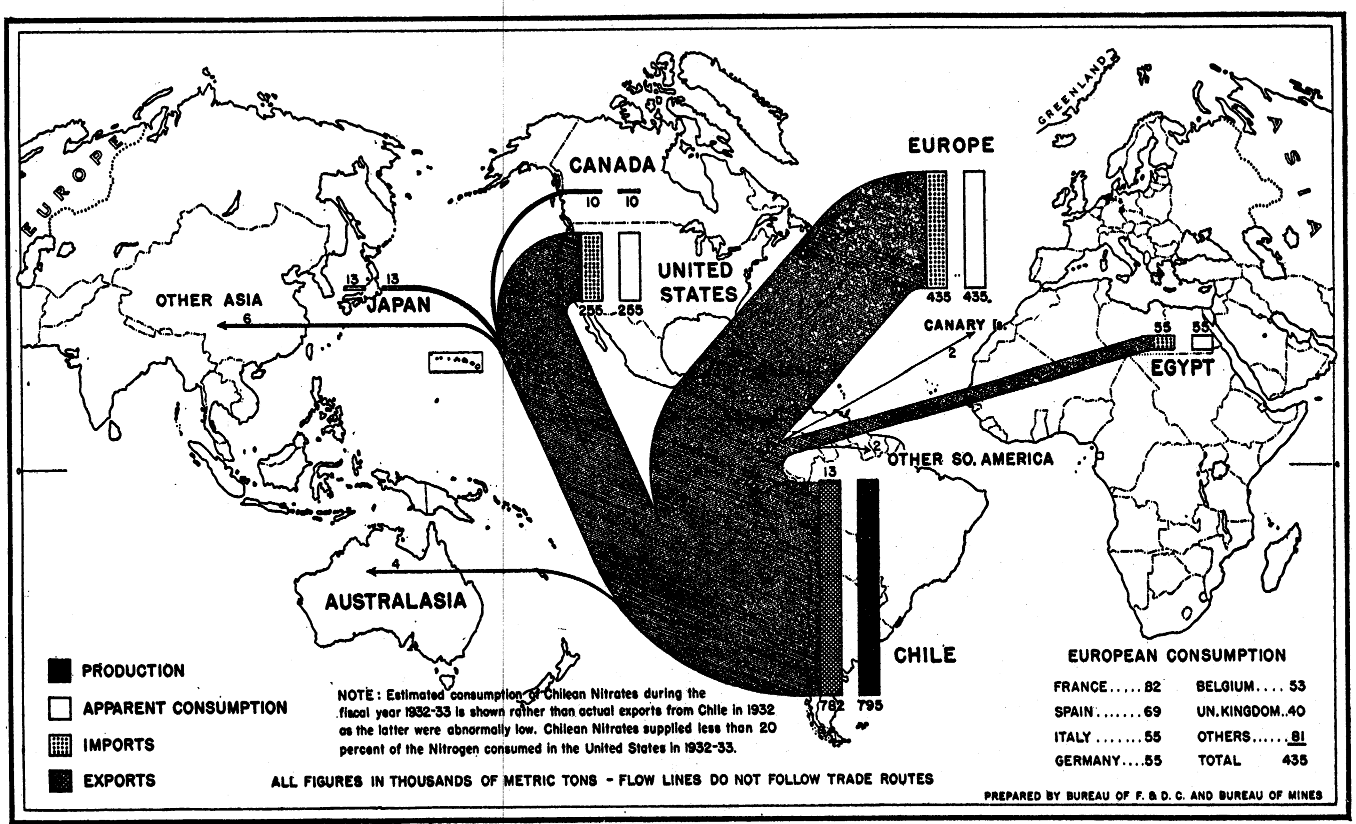

FIGURE 44.—World production and consumption of natural sodium nitrate, 1932–33.

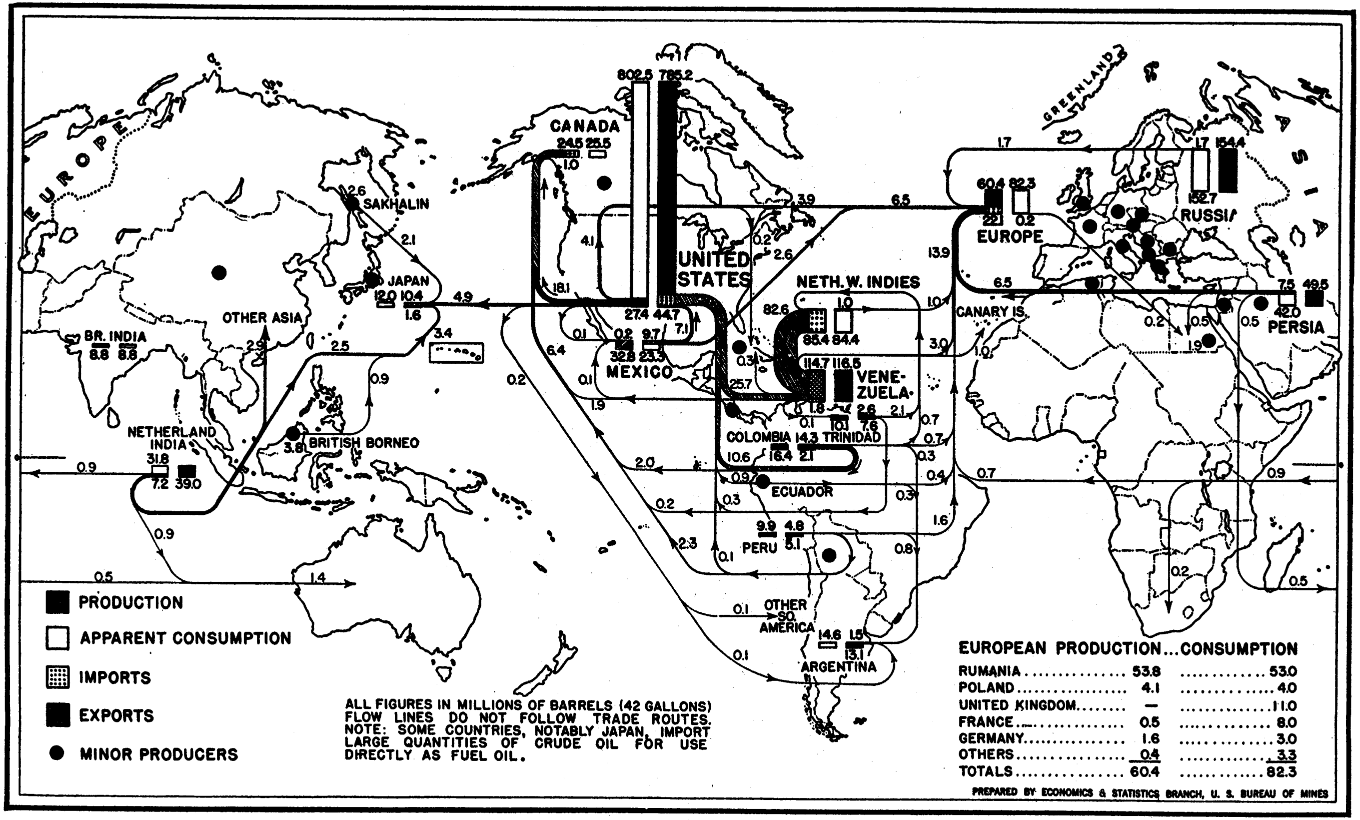

FIGURE 45.—World production and consumption of crude petroleum in 1932.

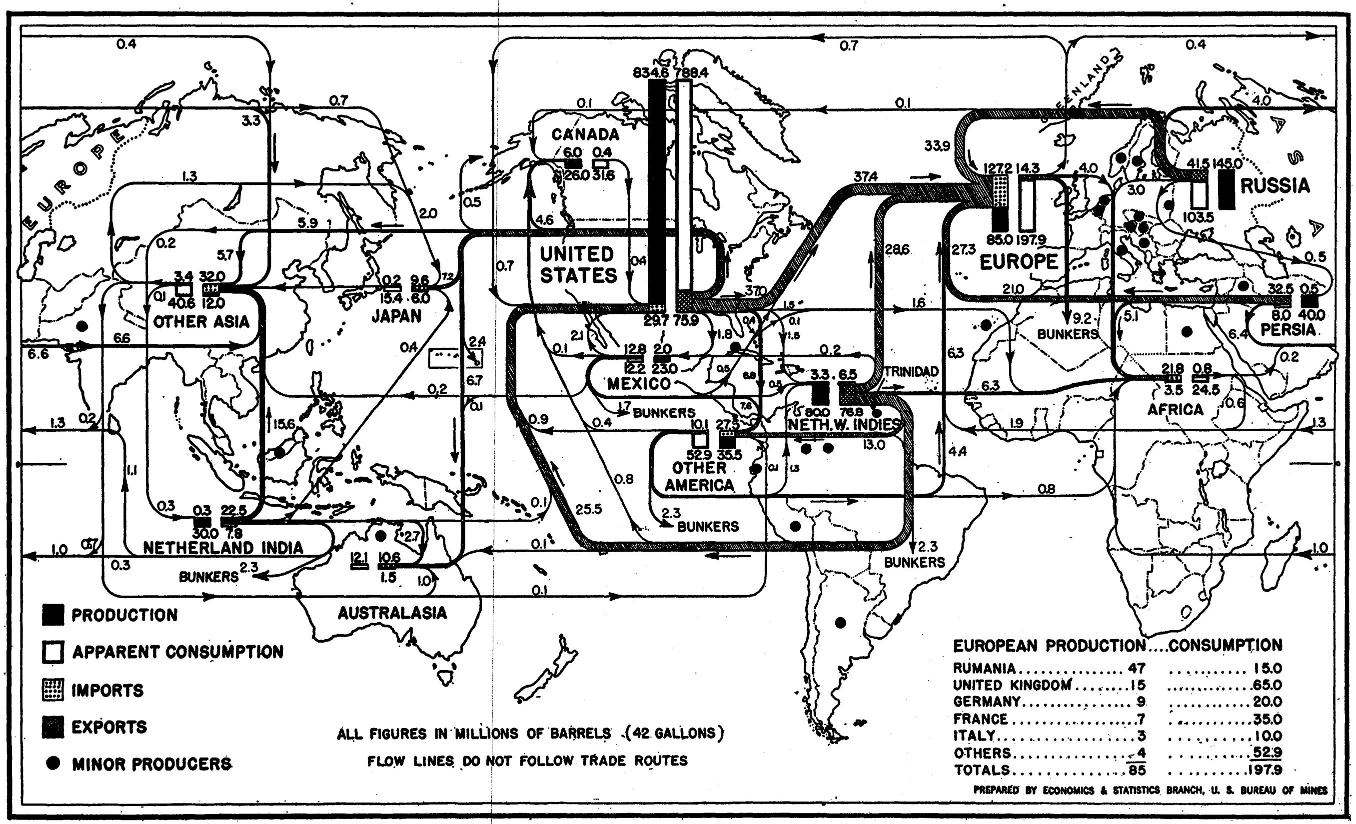

FIGURE 46.—World production and consumption of refined petroleum products in 1932.

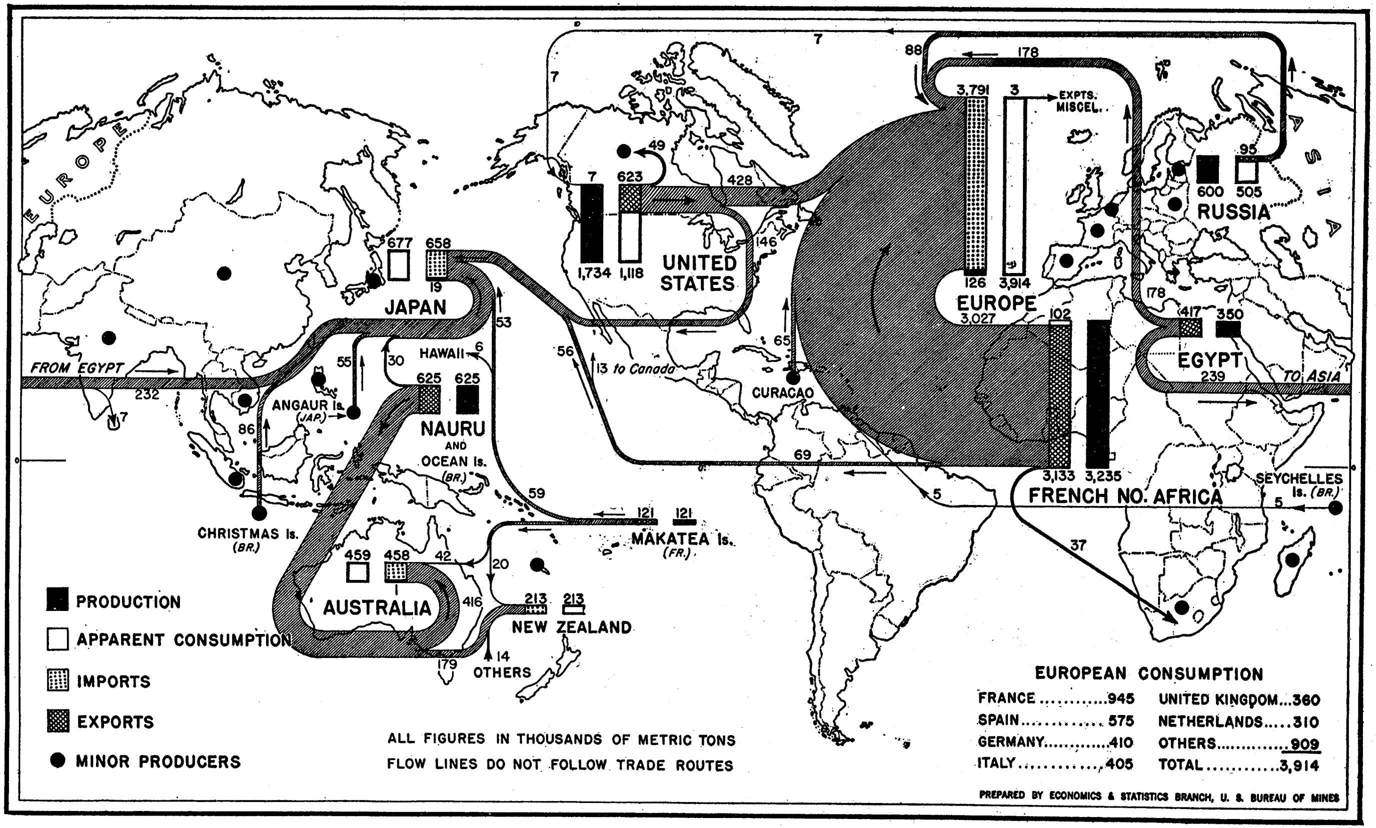

FIGURE 47.—World production and consumption of phosphate rock in 1932.

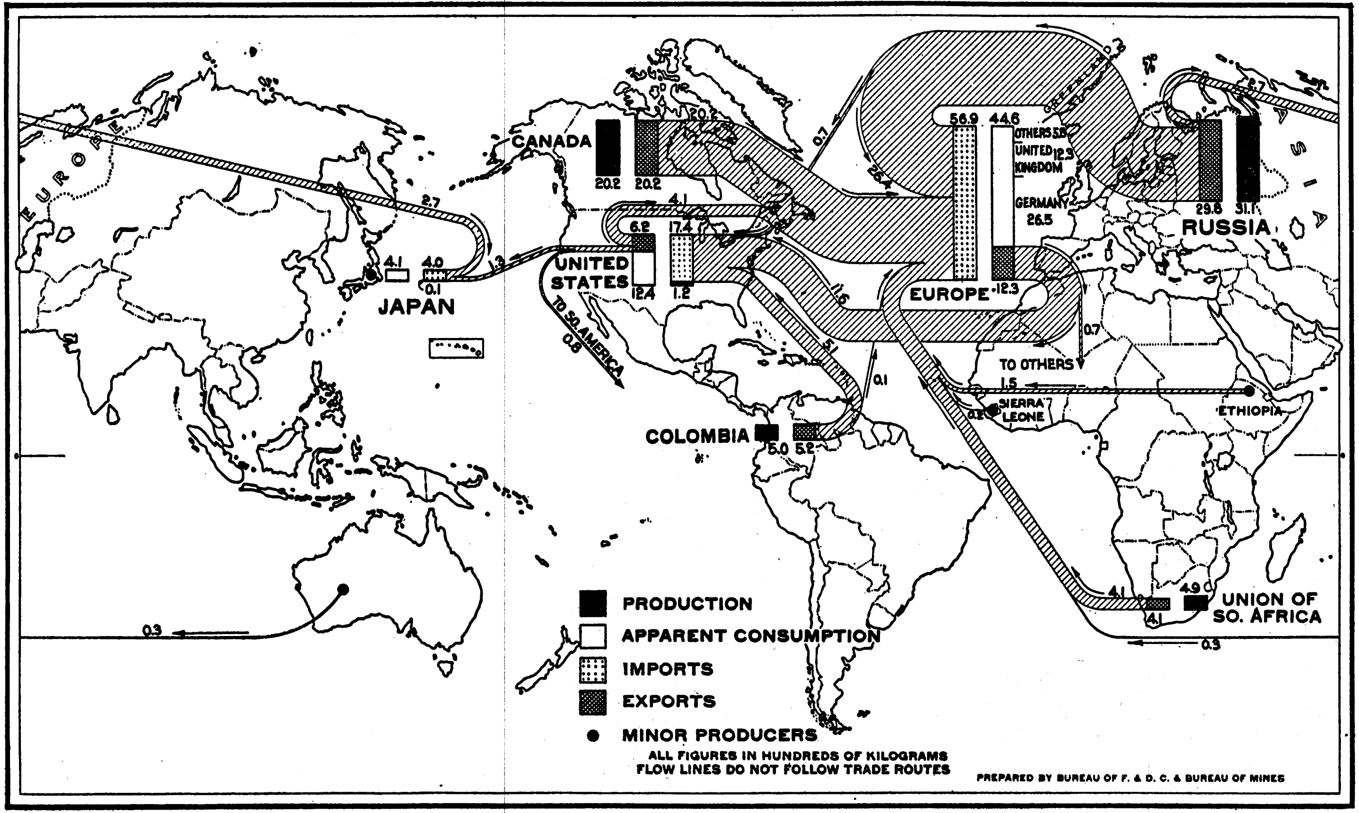

Figure 48.—World production and consumption of platinum group metals in 1932.

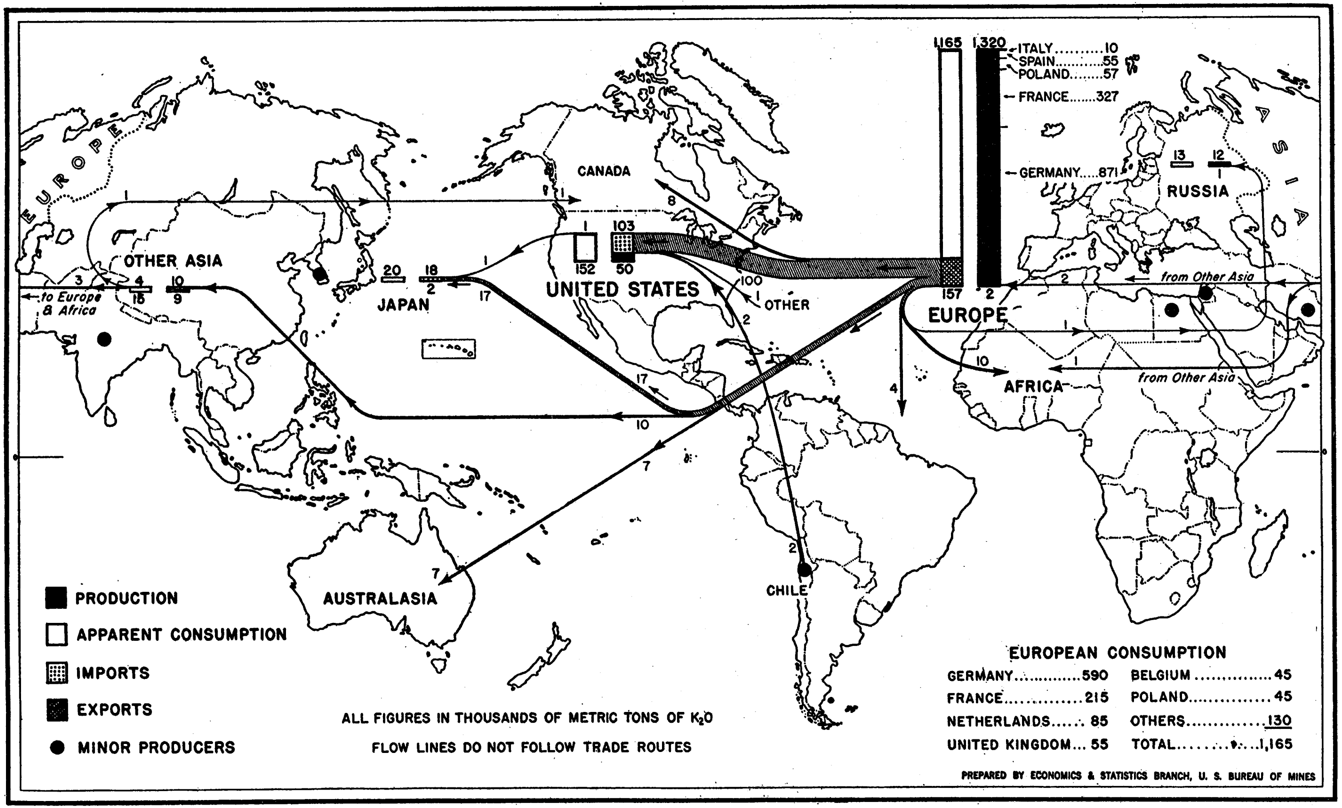

FIGURE 49.—World production and consumption of potash in 1932.

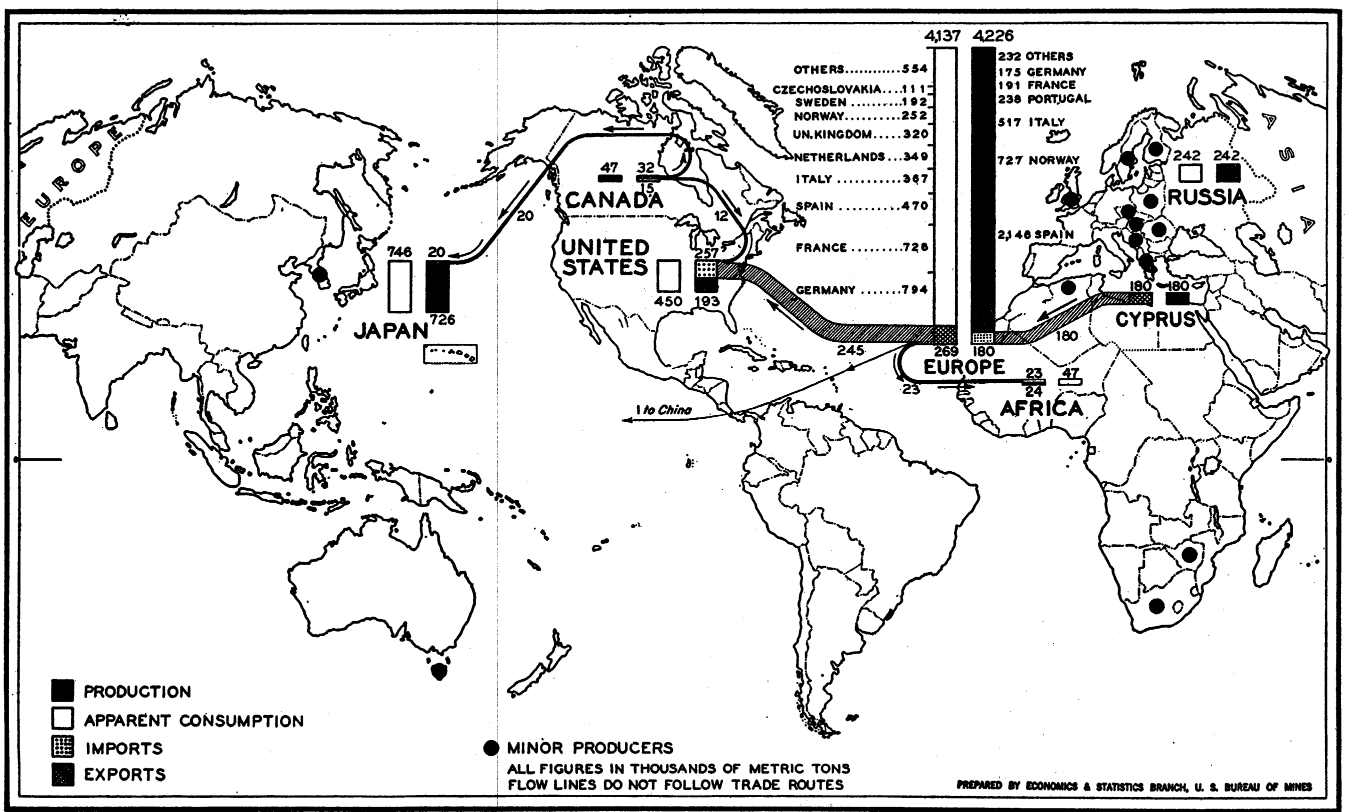

FIGURE 50.—World production and consumption of pyrites in 1932.

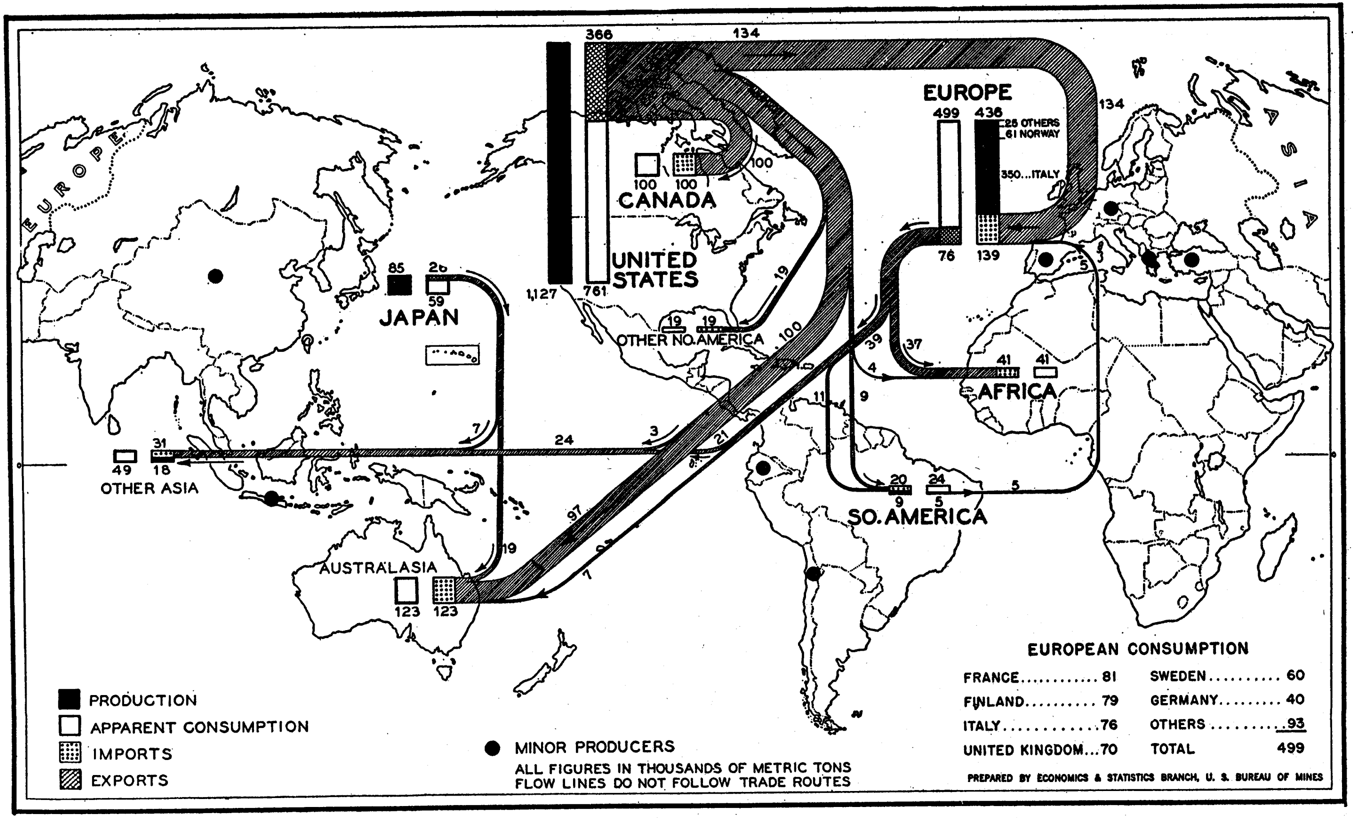

FIGURE 51.—World production and consumption of sulphur in 1932.

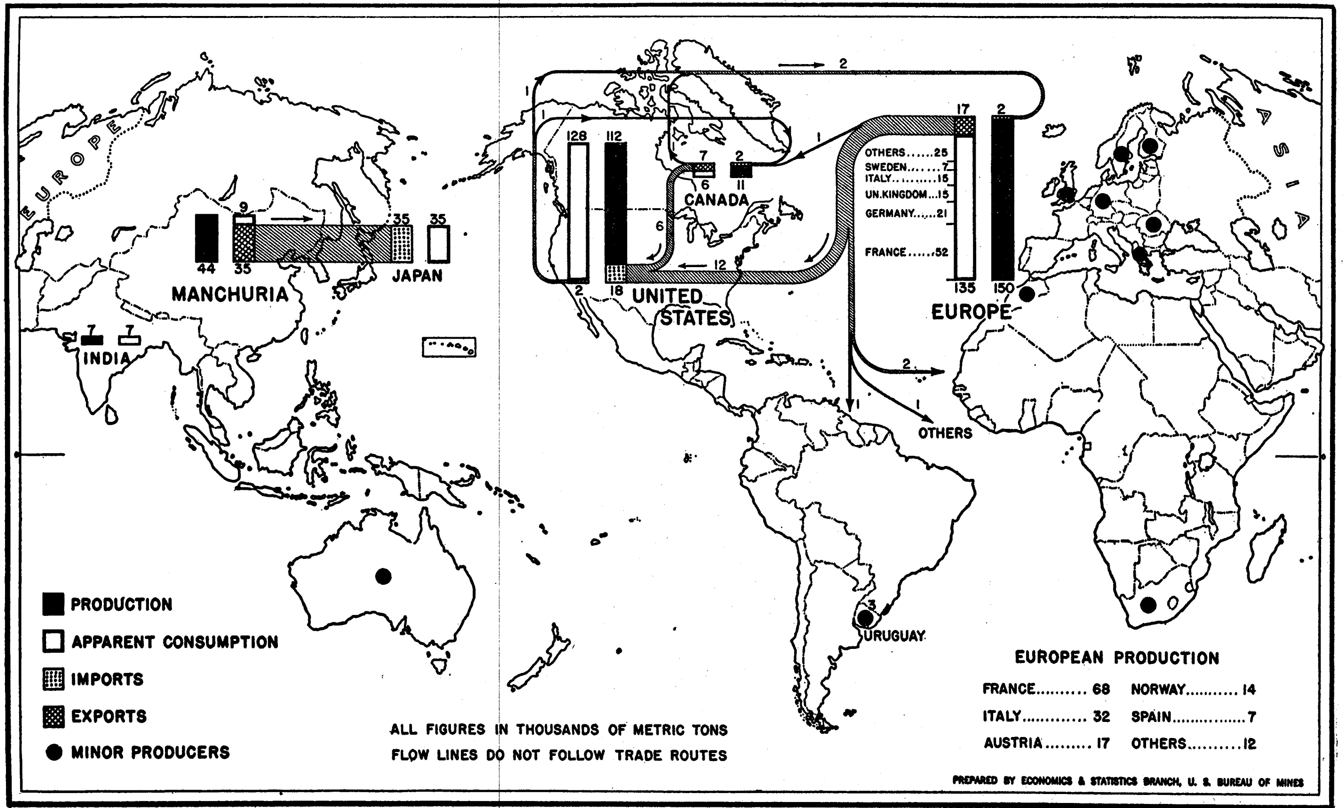

FIGURE 52.—World production and consumption of talc in 1932.

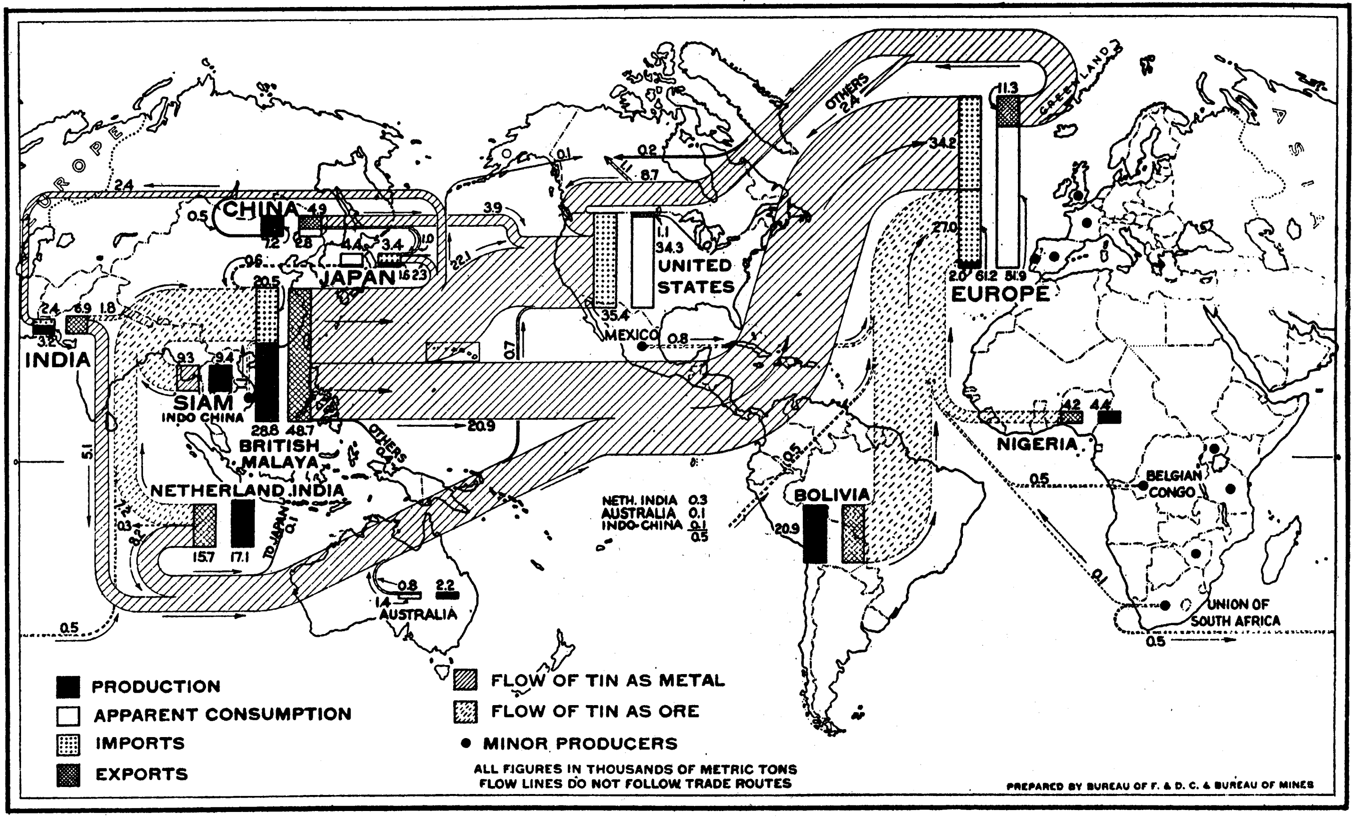

FIGURE 53.—World production and consumption of tin in 1932.

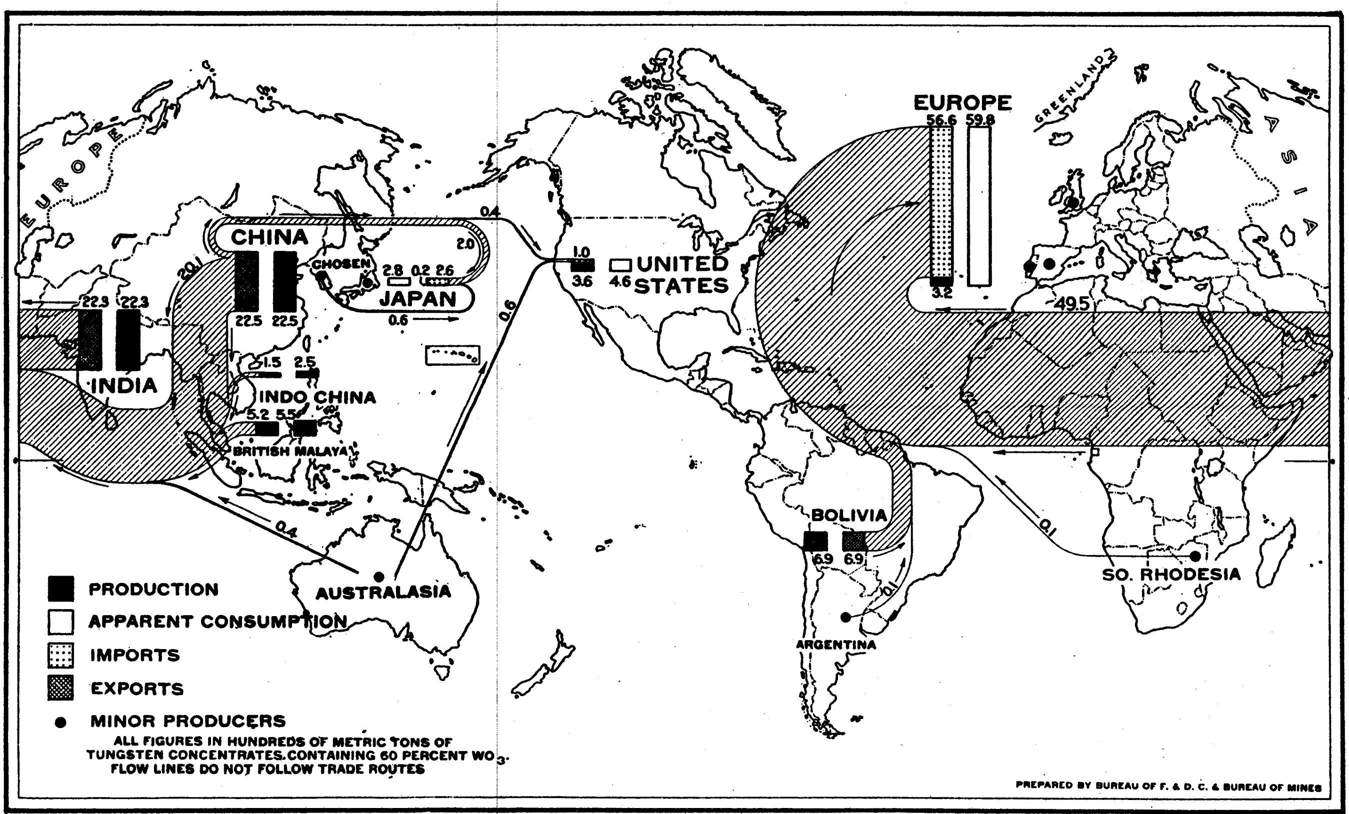

FIGURE 54.—World production and consumption of tungsten ore in 1932.

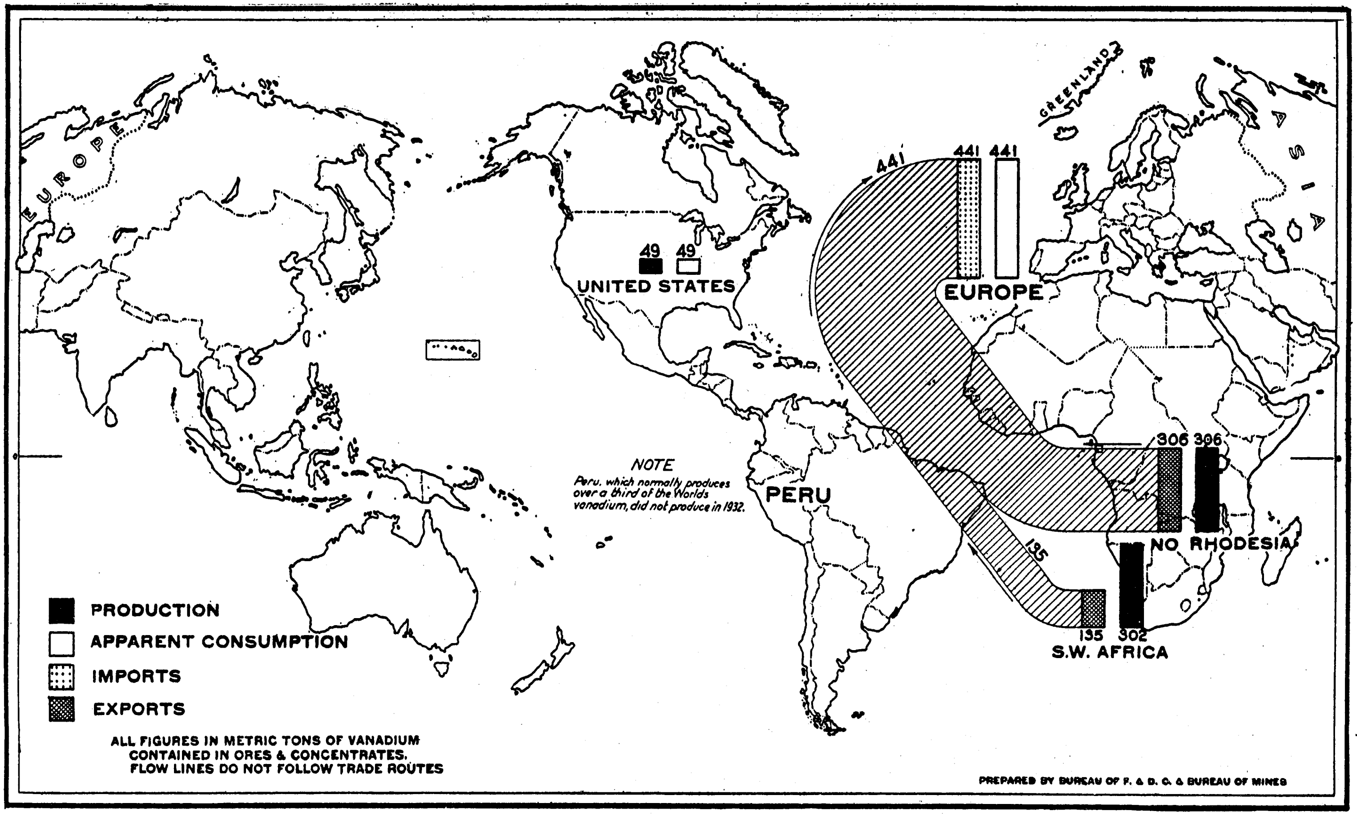

FIGURE 55.—World production and consumption of vanadium in 1932

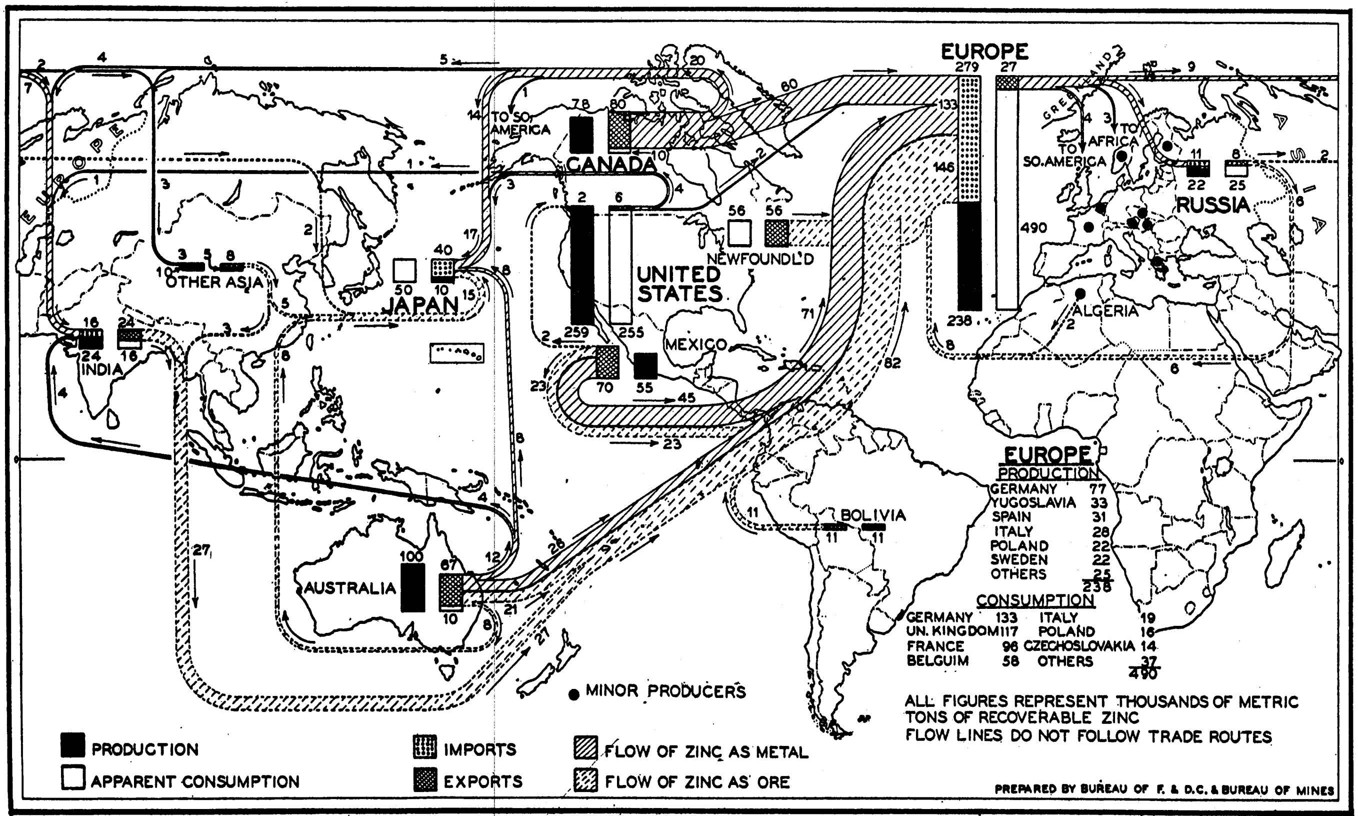

Figure 56.—World production and consumption of zinc in 1932.

PART II. METALS

GOLD AND SILVER[1]

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

SUMMARY OUTLINE

GOLD

United States price for gold in 1933–35.—Minerals Yearbook, 1934 (pp. 25–35), covers in detail the nearly world-wide increase in the currency price of gold that began in September 1931, when Great Britain went off the gold standard, the failure of this movement to affect the price for newly mined gold in the United States until August 9, 1933, and the United States Treasury regulations affecting the price of newly mined gold to June 1, 1934. The Treasury price of gold per fine ounce from January 1 to January 15, 1934, was $34.06; from January 16 to January 31 it was $34.45, and beginning February 1 it was increased to $35. The average weighted price for the calendar year 1934 was $34.95; for 1933 it was $25.56. The price throughout 1935 remained at $35.

Effect of price on gold mining.—The total mine production of gold in the United States (Territories included) was 3,676,327 fine ounces in 1935, which represented an increase of 557,167 fine ounces (18 percent) over the 1934 production of 3,119,160 fine ounces. Based on the average annual value of $35 per ounce the 1935 production was worth $128,671,384, which was $19,656,790 (18 percent) greater than the 1934 value of $109,014,594, based on the 1934 average value of $34.95 per fine ounce. Production for 1935 was 40 percent greater in quantity and 91 percent greater in value than that of 1933, and exceeded by 43 percent in quantity and 144 percent in value that in 1932. The disparity between increases in quantity and value reflects, of course, the 69-percent increase in the value of gold ($20.67+

[1] Figures for 1935 for some States are subject to revision; final detailed data will be released later.

to $35 per fine ounce) that resulted from Government decreases and legislation between August 9, 1933, and January 31, 1934.

Of the total 1935 production California contributed 24 percent, South Dakota 15 percent, Alaska 13 percent, Philippine Islands 12 percent, Colorado 10 percent, Arizona 7 percent, Utah 5 percent, Nevada 5 percent, and Montana 4 percent. In 1934 California contributed 23 percent, South Dakota 16 percent, Alaska 17 percent, Philippine Islands 11 percent, Colorado 10 percent, Arizona 5 percent, Utah 4 percent, Nevada 5 percent, and Montana 3 percent.

In 1935 California output gained 169,436 ounces over 1934, the Philippine Islands 104,341 ounces, South Dakota 81,111 ounces, Arizona 75,656 ounces, Montana 53,112 ounces, and Utah 48,077 ounces, while Alaska showed the only marked decrease—67,166 ounces.

Mine production of gold in the United States, by States, 1934–35

State or Territory	Fine ounces		Increase (+) or decrease (−)		Value	
	1934	1935	Fine ounces	Percent	1934 (at $34.95 per ounce)	1935 (at $35 per ounce)
Western States and Alaska:						
Alaska	[1] 537, 282	[1] 470, 116	−67, 166	−13	$18, 778, 000	$16, 454, 060
Arizona	167, 024	242, 680	+75, 656	+45	5, 837, 493	8, 493, 800
California	719, 064	888, 500	+169, 436	+24	25, 131, 284	31, 097, 500
Colorado	324, 923	349, 281	+24, 358	+7	11, 356, 070	12, 224, 828
Idaho	84, 817	83, 882	−935	−1	2, 964, 361	2, 935, 870
Montana	97, 446	150, 558	+53, 112	+55	3, 405, 736	5, 269, 516
Nevada	144, 275	184, 940	+40, 665	+28	5, 042, 417	6, 472, 900
New Mexico	27, 307	33, 435	+6, 128	+22	954, 380	1, 170, 225
Oregon	33, 712	52, 920	+19, 208	+57	1, 178, 220	1, 852, 200
South Dakota	486, 119	567, 230	+81, 111	+17	16, 989, 858	19, 853, 057
Texas	359	518	+159	+44	12, 538	18, 130
Utah	136, 582	184, 659	+48, 077	+35	4, 773, 524	6, 463, 051
Washington	8, 302	9, 682	+1, 380	+17	290, 149	338, 884
Wyoming	4, 871	3, 715	−1, 156	−24	170, 254	130, 025
	2, 772, 083	3, 222, 116	+450, 033	+16	96, 884, 284	112, 774, 046
Eastern States:						
Alabama	2, 781	2, 227	−554	−20	97, 186	77, 953
Georgia	970	994	+24	+2	33, 898	34, 782
North Carolina	509	2, 176	+1, 667	+327	17, 779	76, 145
Pennsylvania	623	745	+122	+20	21, 774	26, 075
South Carolina	642	2, 274	+1, 632	+254	22, 439	79, 573
Tennessee	455	423	−32	−7	15, 902	14, 805
Virginia	667	653	−14	−2	23, 315	22, 840
	6, 647	9, 492	+2, 845	+43	232, 293	332, 173
Central States:						
Michigan	59		−59		2, 049	
Philippine Islands	[1] 340, 314	[1] 444, 655	+104, 341	+31	11, 893, 975	15, 562, 925
Puerto Rico	57	64	+7	+12	1, 993	2, 240
	340, 371	444, 719	+104, 348	+31	11, 895, 968	15, 565, 165
	3, 119, 160	3, 676, 327	+557, 167	+18	109, 014, 594	128, 671, 384

[1] Refinery receipts.

GOLD MINING IN THE UNITED STATES

The following tables indicate the source of gold and silver by kinds of ore. These tables and similar ones in recent editions of Minerals Yearbook show, from 1929 through 1934, the increased tonnage of dry and siliceous ore of gradually lower gold content and fluctuating silver content, as well as the influence of copper, lead, and zinc prices on gold production.

Ore produced in the United States and average recovery in fine ounces of gold and silver per ton, 1929–34 [1]

State	Dry and siliceous ore			Copper ore			Lead ore			Zinc ore			Copper-lead and copper-lead-zinc ores			Lead-zinc ore			Total ore (short tons)
	Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton		
		Gold	Silver		Gold	Silver		Gold	Silver		Gold	Silver		Gold	Silver		Gold	Silver	
Alaska	4, 390, 000	0. 046	0. 03	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	4, 390, 000
Arizona	373, 073	. 209	1. 69	2, 845, 604	0. 027	1. 22	16, 203	0. 206	10. 43	------	------	------	47	0. 160	21. 62	35, 315	0. 075	5. 35	3, 270, 242
California	2, 299, 699	. 193	. 33	53, 357	. 001	. 002	2, 160	. 506	23. 02	864	------	------	11	. 276	154. 00	------	------	------	2, 356, 091
Colorado	1, 164, 575	. 259	1. 23	135, 082	. 041	14. 27	5, 677	. 455	12. 39	------	------	------	201	. 914	11. 49	3, 652	. 101	10. 16	1, 309, 187
Idaho	202, 784	. 275	1. 34	1, 020	. 012	4. 26	240, 465	. 002	5. 57	------	------	------	118, 927	. 001	31. 07	723, 986	. 002	2. 87	1, 287, 182
Michigan	800	. 073	. 02	(1)	------	------	------	------	------	------	------	------	------	------	------	------	------	------	800
Montana	287, 828	. 225	2. 11	458, 587	. 003	3. 94	10, 321	. 247	14. 80	[2] 65, 913	------	0. 11	------	------	------	244, 303	. 013	5. 84	1, 066, 952
Nevada	901, 454	. 132	1. 67	1, 819, 913	. 009	. 04	24, 931	. 072	11. 15	------	------	------	72	. 192	47. 19	153, 412	. 014	7. 76	2, 899, 782
New Mexico	55, 606	. 137	3. 42	1, 000, 972	. 001	. 02	807	. 268	6. 22	66, 353	------	------	1, 176	. 001	18. 58	272, 795	. 057	3. 01	1, 397, 709
Oregon	61, 842	. 185	. 69	------	------	------	3	. 803	11. 67	------	------	------	------	------	------	300	. 006	1. 92	62, 145
South Dakota	1, 520, 669	. 319	. 07	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	1, 520, 669
Texas	47, 625	. 008	17. 93	------	------	------	54	. 013	9. 61	------	------	------	1	------	19. 00	------	------	------	47, 680
Utah	478, 119	. 151	4. 10	4, 092, 303	. 011	. 09	67, 634	. 074	14. 88	------	------	------	127	. 026	44. 24	438, 552	. 035	8. 58	5, 076, 735
Washington	19, 420	. 335	1. 82	------	------	------	160	. 084	46. 21	------	------	------	------	------	------	28, 322	------	. 04	47, 902
Wyoming	8, 164	. 245	. 04	3	------	1. 33	6	. 053	5. 17	------	------	------	------	------	------	------	------	------	8, 173
Eastern States	41, 232	. 109	. 03	[3] 1, 168, 251	. 001	. 07	------	------	------	(4)	------	------	------	------	------	[5] 198, 936	------	. 13	[6] 1, 408, 419
1934: Total	11, 852, 890	. 156	. 72	11, 575, 092	. 013	. 67	368, 421	. 046	8. 53	133, 130	------	. 05	120, 562	. 003	30. 95	2, 099, 573	. 019	4. 54	26, 149, 668
Percentage	45. 33	------	------	44. 26	------	------	1. 41	------	------	0. 51	------	------	0. 46	------	------	8. 03	------	------	100. 00
1933: Total	8, 680, 376	. 180	. 42	8, 363, 586	. 013	. 70	717, 649	. 019	5. 47	122, 594	0. 002	. 58	126, 207	. 001	27. 49	1, 182, 311	. 036	5. 20	19, 192, 723
Percentage	45. 23	------	------	43. 57	------	------	3. 74	------	------	0. 64	------	------	0. 66	------	------	6. 16	------	------	100. 00
1932: Total	8, 226, 167	. 197	. 48	11, 504, 946	. 009	. 45	697, 168	. 023	7. 02	41, 410	------	. 07	167, 106	------	20. 18	815, 177	. 062	6. 49	21, 451, 974
1931: Total	8, 329, 009	. 177	. 52	30, 966, 550	. 007	. 31	894, 636	. 020	6. 84	97, 950	------	. 06	213, 245	. 006	13. 09	1, 484, 530	. 045	4. 69	41, 985, 920
1930: Total	7, 767, 289	. 163	1. 13	41, 723, 797	. 008	. 33	1, 380, 641	. 019	6. 36	249, 366	. 001	1. 80	246, 430	. 013	12. 38	2, 604, 926	. 026	5. 01	53, 972, 449
1929: Total	7, 671, 150	. 140	1. 45	62, 140, 835	. 007	. 29	1, 592, 043	. 023	7. 35	494, 372	. 003	3. 19	259, 126	. 015	10. 95	3, 496, 400	. 022	4. 47	75, 653, 924

[1] Illinois, Missouri, Philippine Islands, and Puerto Rico excluded; quantity of crude ore containing gold and silver unknown. Copper ore from Michigan also excluded, as the silver recovered at copper mine in 1934 was native silver in lumps and not recovered from copper bullion.

[2] Current slag fumed.

[3] Includes pyritiferous magnetite ore from Pennsylvania yielding 6,231 tons of copper concentrates.

[4] Zinc ore yielded no gold or silver.

[5] Figures represent New York only; lead-zinc ore from other Eastern States yielded no gold or silver.

Includes low-grade pyritiferous magnetite ore from Pennsylvania; excludes ore containing no gold or silver.

Gold produced in the United States, by percent of sources, as reported by mines, 1922–34, and total fine ounces [1]

Year	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Copper-lead and copper-lead-zinc ores	Lead zinc ore	Total: Fine ounces	Total: Percent
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		
1922	23.46	68.06	5.71	1.54	0.12	0.11	1.00	2,293,251	100
1923	22.95	62.79	11.30	1.58	.14	.16	1.08	2,404,913	100
1924	18.44	65.56	12.70	1.63	.01	.08	1.58	2,444,331	100
1925	18.91	61.30	15.08	2.18	.02	.24	2.27	2,307,374	100
1926	20.50	58.03	16.36	2.05	.05	.15	2.86	2,232,526	100
1927	21.42	55.17	17.45	1.97	.07	.12	3.80	2,107,032	100
1928	19.41	55.67	19.31	1.67	.01	.32	3.61	2,148,064	100
1929	19.83	52.17	22.24	1.81	.06	.19	3.70	2,058,993	100
1930	20.59	59.27	15.57	1.24	.02	.15	3.16	2,138,724	100
1931	20.36	66.16	9.65	.79	--------	.05	2.99	2,224,729	100
1932	23.37	69.53	4.24	.68	--------	--------	2.18	2,330,020	100
1933	25.17	67.77	4.59	.59	.01	.01	1.86	2,303,709	100
1934	25.96	66.72	5.25	.61	--------	.01	1.45	2,778,788	100

[1] Philippine Islands and Puerto Rico excluded.

Gold produced in the United States, by sources, as reported by mines, 1922–34, in fine ounces [1]

Year	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Copper-lead and copper-lead-zinc ores	Lead-zinc ore	Total
1922–30	4,151,128	12,083,444	2,999,541	350,851	11,315	33,925	505,004	20,135,208
1931	452,862	1,471,738	214,745	17,648	---------	1,175	66,561	2,224,729
1932	544,433	1,620,102	98,914	15,788	---------	48	50,735	2,330,020
1933	579,909	1,561,256	105,838	13,508	254	111	42,833	2,303,709
1934	721,380	1,853,895	145,930	16,957	---------	329	40,297	2,778,788

[1] Philippine Islands and Puerto Rico excluded.

Alabama.—In 1935 two small placers in Alabama yielded 5.09 ounces of gold and three producing lode mines 2,222.15 ounces. The only producer of any size was the Hog Mountain at Alexander City in Tallapoosa County, which operated a 150-ton flotation plant and shipped concentrates containing gold, silver, and a little copper to the Nichols Copper Co.

Alaska.—During the years 1931–35, the total gold that has reached refineries from Alaska has been 2,364,000 fine ounces, a yearly average of nearly 472,000 ounces. Much gold produced in the fall and winter of 1 year does not reach United States refineries until the next year. During this 5-year period the annual output of the Alaska Juneau lode mine has been between 120,000 and 179,000 ounces. The annual output for the United States Smelting, Refining, & Mining Co. dredges at Fairbanks and Nome has nearly equaled that of the Alaska Juneau. All other lode and placer mines have contributed the rest. In 1935, owing to a labor strike at the Alaska Juneau that resulted in a complete shut-down of the mine from May 22 to July 5, normal operations not being resumed until the latter part of July, the 12-month gross for this company was $4,176,000 (principally gold, 120,000 ounces, with some silver and lead) compared with $4,477,950 in 1934. The yield from the United States Smelting, Refining & Mining Co. dredges at Fairbanks in 1935 was about the same as in 1934, but its dredges at Nome (about to be abandoned in

1933 but renovated in 1934 with the increased price for gold) increased its output in 1935. The First National Bank of Fairbanks, the Miners & Merchants Bank of Iditarod at Flat, and the Miners & Merchants Bank of Alaska at Nome, made heavy bullion shipments to Seattle. The bullion production of the Willow Creek lode mine at Wasilla declined notably in 1935. The Chichagoff Mining Co. near Klag Bay and the Hirst-Chichagof Mining Co. at Kimshan Cove continued to be important lode producers.

Arizona.—The output of gold from Arizona mines in 1935 was the largest since 1926, when the State produced 234,000 ounces. The increase for 1935 over 1934 resulted from the reopening of copper mines (with some selective mining of gold-bearing copper ore of higher content than formerly) and the continued output from siliceous and lead-zinc ore bodies newly opened or reopened since the price of gold rose to $35 an ounce.

California.—The California gold output came chiefly from lode mines of the Grass Valley-Nevada City district and from the floating dredge boats of the Sacramento Valley, supplemented by new production from Kern County.

Colorado.—The Colorado output came chiefly from Cripple Creek, Alma, the San Juan region, Redcliff, Leadville, and Boulder, Clear Creek, and Gilpin Counties, representing a heavily increased tonnage of what would have been submarginal ore when gold was $20.67 an ounce.

Georgia.—Placer mines in Georgia yielded 332.50 ounces of gold in 1935. Many of them had a very small output. The largest shippers of bullion in 1935 were T. J. Stevenson at Sautee and the Dixie Gravel Co. at Helen, both in White County. Production by placers at Dahlonega, Lumpkin County, was small, but a good deal of development work was done. Lode mines yielded 661.28 ounces of gold, all recovered by amalgamation, most of which was from the Battle Branch mine at Dahlonega operated by the Southern Mineral Development Co.

Idaho.—Idaho, not a large producer of gold since the early sixties, produced 83,882 ounces of gold in 1935 compared with 84,817 ounces in 1934, the decrease occurring in lode mines, as the output from placers, especially dredging operations, increased slightly. There were eight floating dredges at work in Idaho in 1935 compared with five in 1934.

Montana.—Montana increased its gold output from 97,446 ounces in 1934 to 150,558 in 1935, as a result of greater lode production. The production of gold from placer mines, chiefly by dredges, which increased in 1933 and 1934, decreased slightly in 1935. Some of the lode gold increase resulted from a greater output of copper ore and lead-zinc ore from the Anaconda Copper Co. mines at Butte and from the Comet lead-zinc-copper-silver-gold mines at Basin; but most of the increase came from mines producing siliceous gold ore—the Spring Hill, Golden Messenger, Ruby Gulch, Gould, Mammoth, August, and Jardine.

Nevada.—Continuation of the $35 price per ounce of gold, increase in price of silver, and partial recovery of copper in 1935 all contributed to an increase in gold production from ores and gravels mined in Nevada from 144,275 ounces in 1934 to 184,940 in 1935. The increased scale of mining, milling, and smelting by the Nevada Consolidated Copper Corporation, Robinson district, White Pine County, were instrumental in maintaining that concern as the largest individual producer of gold in the State, despite improvements in the output of gold and silver-gold properties. The second largest individual producer of gold in the State was the Dayton Consolidated Mines Co. in the Silver City district, Lyon County, which treated 40,000 tons of ore in the company cyanide mill. Nye County was the second largest producing county in the State, with eight properties in the Manhattan, Round Mountain, and Tonopah districts producing 1,000 to 10,000 ounces of gold each. The Nevada Porphyry Gold Mines, Inc., in the Round Mountain district continued both lode and placer mining. The company was the largest producer of placer gold in the State. About 120 lessees were at work at the Tonopah Mining, Tonopah Belmont, and Tonopah Extension properties in the silver-gold Tonopah district. Esmeralda, Lyon, and Storey Counties were the next largest contributors of gold. In Esmeralda County the Bradshaw Syndicate, Inc., treated 1,300 tons a day of the old Goldfield Consolidated tailing dump in the Goldfield district. The Black Mammoth Consolidated Mining Co., operating the Mary mine in the Silver Peak district, was the other leading producer in Esmeralda County. The General Metals Recovery Corporation continued the treatment of the old Millers mill tailing dump by cyanidation and was the third largest producer of gold in the county. Prospecting and sampling were done at the old Goldfield Consolidated and Goldfield Deep Mines Co. In the Comstock district, Storey County, embracing Flowery, Gold Hill, and Virginia City, several new mills were built or enlarged and several were operated on ore from the early-day bonanza properties. The Arizona Comstock Corporation supplied its 330-ton flotation plant from an open cut in the outcrop of the Comstock lode. Humboldt, Lander, Lincoln, and Pershing Counties contributed large gold outputs. In Lincoln County a new 200-ton cyanide plant commenced operation in March on the old Delamar tailing dump.

New Mexico.—In New Mexico gold was produced chiefly from the lead-copper-silver-gold concentrates of the Pecos zinc-lead mine at Terrero, gold-silver concentrates and cyanidation bullion from Mogollon, and gold-silver ore and concentrates from Pinos Altos. Other gold-producing districts were the Mount Baldy district, Colfax County; Jicarilla and Nogal districts, Lincoln County; San Pedro district, Santa Fe County; Hillsboro and Pittsburg districts, Sierra County; and Rosedale district, Socorro County.

North Carolina.—The output of placers in North Carolina in 1935 was only 90.84 ounces of gold, about half of which was from mines in Rutherford County. The lode mines yielded 2,084.73 ounces of gold. Of this, 265.78 ounces were recovered by amalgamation, 772.33 ounces from concentrates shipped to Carteret, N. J., and the remainder from crude ore shipped to smelters. The Rudesil mine in Mecklenburg County was by far the largest producer. It shipped both crude ore and concentrates to Carteret. The Fontana Copper Mine in Swain County yielded two-thirds of the ore sold or treated. Its ore yielded most of the silver and the second largest output of gold. Other producers of gold were the Parker and Thompson mines in Stanley County, the Liberty in Davidson County, and the Long Creek in Gaston County.

Oregon.—The production of gold in Oregon increased from 33,712 ounces in 1934 to 52,920 in 1935. The value of gold produced in 1935 represented 95 percent of the total metal value of the State. The production of gold by dredging, including dragline operations, increased materially. Nine companies in Baker, Grant, Jackson, and Josephine Counties, each operating a gold dredge, produced approximately 16,000 ounces of gold in 1935. Only four dredges, with a total yield of 9,254 ounces of gold, operated in 1934. Baker County, in which the output of gold increased from 11,465 ounces in 1934 to 21,000 in 1935, again led in both placer and lode gold production. Other county productions in 1935, chiefly from placer mines, were as follows: Jackson County, 9,000 ounces; Josephine County, 11,000 ounces; Grant County, 8,000 ounces; Lane County, 1,500 ounces.

Pennsylvania.—As in former years, the only gold and silver from Pennsylvania was that recovered from copper concentrates from the pyritiferous magnetite ores at the Cornwall mine in Lebanon County. The concentrates were shipped to Nichols Copper Co.

South Carolina.—Placer mines in South Carolina yielded 143 ounces of gold, of which mines in Chesterfield County, including the Brewer, yielded over 100 ounces. Most of the placer output was derived from very small operations. Lode mines produced 2,130.51 ounces of gold and 1,109 ounces of silver. The gold ore of the Haile mine at Kershaw, Lancaster County, was recovered by amalgamation. The Dickey mine in Cherokee County, operated by C. W. Hamilton, shipped crude ore to Carteret and to the Tennessee Copper Co. Other shippers of crude ore to the Tennessee Copper Co. at Copperhill were Wm. C. Sowell, W. M. Fulton, and the Thirty-Five Mining Co. The largest output of gold and silver from South Carolina was contained in crude ore shipped by Shorey C. Guess to Carteret, N. J., from the Terry mine in York County.

South Dakota.—In 1935 South Dakota was second to California in gold production. As usual, the bulk of the output of gold from South Dakota came from the long-lived (1876 to date) and well-developed Homestake mine at Lead. It is the largest producer of gold in the United States. There were 16 other producing lode mines in 1935 compared with 7 in 1934.

Tennessee.—The entire output of 423 ounces of gold and of all but 54 ounces of the 47,151 ounces of silver produced was recovered from the copper ores of the Tennessee Copper Co. and the Ducktown Chemical & Iron Co. in the Ducktown district.

Utah.—Much of Utah's gold production—7,136,891 ounces from 1864 to 1934—has been from the small gold content of copper ore handled on a large scale (80,000 tons a day in 1929) by Utah Copper Co. In 1935 the gold output of the State increased to 184,639 ounces compared with 136,582 ounces in 1934, largely as a result of greater (and selected) output by the Utah Copper Co. and the United States Smelting, Refining, & Mining Co. in the Bingham district. The largest producers of gold in Utah in 1935 were the Utah Copper, United States and Lark, Boston, Consolidated, and Utah Delaware mines in the Bingham district; the Centennial-Beck, Eureka Standard, Mammoth, and Eureka Lilly, in the Tintic district; and the Consolidated Mercur and Manning (old Mercur tailings re-treated), in the Mercur district.

Virginia.—Placer mines in Virginia produced 153.82 ounces of gold, mostly from the property of the Powhattan Mining Corporation in Goochland County. Lode mine gold was produced mainly by the Virginia Mining Corporation of Fredericksburg, which operated the Vaucluse mine in Orange County. Its 100-ton flotation plant was operated in the latter part of 1935 only. The gold concentrates, which also contained a little copper, were shipped to Carteret. A carload of gold ore was shipped crude from a prospect in Culpeper County to Carteret.

Washington.—The production of gold in Washington increased from 8,302 ounces in 1934 to 9,682 in 1935. The largest producers were the Aurum and Blaine-Republic groups, both at Republic; the First Thought mine at Orient; the Bodie mine near Wauconda; and the Boundary Red Mountain mine in Whatcom County south of Sardis, B. C.

Wyoming.—The gold output from Wyoming, principally from lode and placer mines in the Atlantic City district, decreased from 4,871 ounces in 1934 to 3,715 in 1935.

WORLD GOLD AND SILVER PRODUCTION

Statistics taken from reports of the Director of the United States Mint on the output of gold and silver in the world from 1493 to 1934, inclusive, and an estimate for 1935 by the authors, are shown in the following table:

Production of gold and silver in the world since the discovery of America

[Data from 1493 to 1885 are from a table of averages for certain periods, compiled by Dr. Adolph Soetbeer; for subsequent years, the production represents the annual estimate of the Bureau of the Mint]

Period	Gold—total for period		Silver—total for period		Ratio by weight
	Fine ounces	Value	Fine ounces	Commercial value [1]	
1493 to 1880	334, 030, 944	$6, 905, 033, 000	6, 207, 580, 994	$8, 361, 812, 579	1 : 18. 58
1881 to 1890	51, 280, 184	1, 060, 056, 000	1, 004, 576, 877	1, 043, 927, 353	1 : 19. 59
1891 to 1900	101, 647, 521	2, 101, 241, 400	1, 616 373, 178	1, 131, 299, 109	1 : 15. 90
1901 to 1910	182, 891, 525	3 780, 703, 900	1, 826, 234, 623	1, 052, 194, 838	1 : 9. 99
1911 to 1920	206, 114, 773	4, 260, 770, 272	1, 935, 607, 379	1, 430, 510, 377	1 : 9. 39
1921 to 1930	186, 091. 278	3, 846, 848, 092	2, 387, 189, 080	1, 481, 366. 094	1 : 12. 83
1931	22, 329, 525	461, 592, 256	195, 920. 000	56, 816. 800	1 : 8. 77
1932	24, 150, 761	499, 240, 547	164, 892, 802	46, 499, 770	1 : 6. 82
1933	25, 367, 395	524, 390, 604	169, 159, 054	59, 205, 669	1 : 6, 66
1934	27, 930, 463	977, 566, 205	190, 859, 421	123, 383, 867	1 : 6. 83
Total	1, 161, 834, 369	24, 417, 442, 276	15, 698, 393, 408	14, 787, 016, 456	1 : 13. 42
1935 [2]	29, 856, 000	1, 044, 960, 000	207, 375, 000	133, 279, 913	1 : 6. 95
Grand total [2]	1, 191, 690, 369	25, 462, 402, 276	15, 905, 768, 408	14, 920, 296, 369	1 : 13. 35

[1] Valued, prior to 1701, at $1.38 per fine ounce, which corrresponds with a commercial ratio of silver to gold of approximately 15 to 1, the ratio that prevailed for over 100 years subsequent to 1687. From 1701 to 1840 the value corresponds with the average ratios of silver to gold. From 1841 the annual averages per fine ounce in London are used, except for 1915–21 and 1931, when London prices were not equivalent to gold and New York prices were used. New York prices are used for 1932–35.

[2] By Chas. W. Henderson; subject to revision.

Gold.—To June 1, 1936, with the exception of data for South Africa, Canada, Mexico, and the United States, there are no final figures representing world production of gold and silver in 1935, and it is reasonable to believe that minor changes may later be made for the four countries mentioned. The Bureau of the Mint of the United

States Treasury Department, with the help of the Secretary of State and other departments, finds that it cannot complete yearly world gold-production figures until 10 months after the end of each calendar year. The following table shows the output of gold by countries, 1930–34, as estimated by the Bureau of the Mint.

World production of gold, 1930–34, by countries, in fine ounces

Country	1930	1931	1932	1933	1934
North America:					
Canada	2,107,073	2,695,219	3,050,581	2,949,309	2,969,680
Central America and West Indies	58,050	67,725	82,238	87,075	130,000
Mexico	670,488	623,003	584,487	637,727	661,405
Newfoundland	----	----	----	15,689	12,000
United States [1]	2,100,395	2,213,741	2,219,304	2,276,711	2,741,706
South America:					
Argentina	1,000	----	964	964	1,200
Bolivia	16,479	17,328	12,281	32,889	64,301
Brazil	96,750	115,473	115,451	126,000	113,621
Chile	16,686	21,380	38,098	147,054	238,559
Colombia	158,727	194,268	248,230	298,246	344,140
Ecuador	69,998	59,616	65,629	60,667	66,427
Guiana:					
British	6,933	6,944	18,714	31,056	25,000
French	43,538	43,531	45,010	42,456	47,454
Netherland (Surinam)	3,948	4,597	8,970	12,378	11,896
Peru	90,052	73,688	55,555	84,072	98,864
Uruguay	----	----	----	18	----
Venezuela	55,946	42,309	77,087	95,710	109,055
Europe:					
Austria	----	----	257	----	----
Czechoslovakia	2,411	1,093	2,283	2,283	7,588
France	42,663	42,663	43,402	57,870	90,000
Germany	6,076	4,115	2,186	5,498	5,755
Great Britain	----	----	6	64	51
Greece	482	483	482	482	----
Hungary	----	----	----	2,861	1,833
Italy	1,723	2,165	1,832	2,565	17,201
Rumania	85,904	96,482	109,631	120,000	120,019
Spain	484	483	484	7,716	7,588
Sweden	60,000	90,000	90,000	135,930	252,480
U. S. S. R. (Russia)	1,433,664	1,700,960	1,990,085	2,667,100	4,262,770
Yugoslavia	23,148	21,862	47,582	70,344	71,342
Asia:					
China	96,750	96,750	96,751	150,000	150,000
Chosen	159,608	208,626	208,626	369,991	369,991
East Indies, Netherland	110,435	100,083	77,964	78,832	66,295
Federated Malay States	29,597	27,021	27,159	31,107	31,777
India, British	329,231	330,484	329,632	336,106	322,193
Indochina	514	289	289	161	7,073
Japan	388,740	434,037	434,037	433,800	471,394
Philippine Islands	179,204	181,981	229,728	279,535	340,316
Sarawak	1,730	5,901	8,178	18,712	28,842
Taiwan	15,576	92,430	92,430	92,430	73,180
Turkey	900	900	900	----	----
Africa	11,749,557	11,927,961	12,735,979	12,448,275	[2] 12,340,549
Australasia	621,858	783,934	998,267	1,157,712	1,256,918
Total	20,836,318	22,329,525	24,150,761	25,367,395	27,930,463

[1] Philippine Islands excluded.
[2] Comprises Transvaal, Cape Colony, and Natal, 10,479,857 ounces; Rhodesia, 693,265 ounces; British West Africa, 384,268 ounces; Belgian Congo, 337,390 ounces; Egypt and Egyptian Sudan, 206,340 ounces; French Africa and Madagascar, 142,846 ounces; Tanganyika, 42,606 ounces; and other countries, 53,977 ounces.

An estimate for 1935 world production follows:

World production of gold (1935) in fine ounces

Country	Fine ounces	Country	Fine ounces
Africa	12,640,000	Canada	3,280,000
Australasia	1,300,000	Mexico	670,000
Asia	1,600,000	South America	1,300,000
Europe	5,390,000		
United States (including Philippines)	3,676,000	Total	29,856,000

Silver.—The following table shows the output of silver by countries, 1930–34, as estimated by the Bureau of the Mint:

Country	1930	1931	1932	1933	1934
North America:					
Canada	26, 435, 900	20, 558, 200	18, 356, 393	15, 187, 063	16, 441, 361
Central America and West Indies	3, 900, 000	4, 000, 000	4, 300, 000	4, 800, 000	3, 500, 000
Mexico	105, 410, 900	86, 064, 500	69, 303, 054	68, 101, 062	74, 145, 012
Newfoundland	(1)	(1)	(1)	1, 208, 280	1, 150, 000
United States [2]	50, 627, 200	30, 822, 000	23, 831, 642	22, 821, 257	32, 486, 879
South America:					
Argentina	15, 000	-----------	50, 154	50, 154	60, 000
Bolivia	7, 091, 100	5, 772, 300	4, 115, 200	5, 469, 069	5, 216, 297
Brazil	20, 000	10, 000	10, 000	10, 000	10, 000
Chile	732, 400	320, 200	103, 780	256, 621	1, 053, 097
Colombia	60, 000	40, 000	50, 000	107, 992	127, 461
Ecuador	106, 100	104, 800	114, 167	113, 200	110, 815
Guiana	7, 500	6, 000	6, 000	6, 000	6, 000
Peru	15, 500, 400	10, 942, 500	6, 735, 360	6, 760, 534	10, 381, 314
Venezuela	4, 200	4, 200	6, 000	6, 000	7, 000
Europe:					
Austria	10, 200	10, 200	27, 938	-----------	14, 017
Czechoslovakia	890, 600	899, 300	947, 139	947, 139	971, 370
France	652, 000	652, 000	643, 000	643, 000	500, 000
Germany	5, 485, 400	5, 784, 600	5, 993, 499	6, 320, 690	5, 944, 029
Great Britain	41, 000	34, 000	16, 043	37, 551	138, 955
Greece	241, 100	192, 900	192, 900	192, 900	255, 000
Hungary	-----------	-----------	-----------	15, 593	9, 163
Italy	571, 700	719, 300	801, 499	377, 592	1, 290, 820
Norway	337, 800	297, 400	292, 565	241, 125	196, 120
Poland	558, 700	558, 700	69, 283	41, 377	21, 155
Rumania	142, 000	155, 800	173, 031	173, 031	388, 027
Spain	2, 659, 200	3, 098, 700	3, 374, 335	2, 929, 508	1, 788, 289
Sweden	75, 000	80, 000	80, 000	244, 822	519, 717
U. S. S. R. (Russia)	300, 000	350, 000	400, 000	981, 000	1, 322, 000
Yugoslavia	100, 300	94, 700	133, 230	1, 624, 000	1, 748, 000
Asia:					
Burma	7, 047, 000	5, 898, 000	6, 001, 000	6, 050, 000	5, 787, 524
China	50, 000	60, 000	60, 000	60, 000	80, 000
Chosen	68, 800	203, 500	209, 332	702, 976	702, 976
East Indies, Netherland	2, 094, 200	1, 473, 100	842, 362	860, 463	771, 361
India, British	25, 000	25, 000	25, 737	30, 241	30, 000
Indochina	3, 200	1, 600	2, 724	1, 607	3, 601
Japan	5, 628, 600	6, 183, 300	6, 360, 643	5, 958, 842	6, 882, 156
Philippine Islands	110, 300	97, 100	149, 131	181, 372	212, 613
Taiwan	15, 200	17, 200	17, 713	17, 713	16, 075
Turkey	220, 000	200, 000	200, 000	-----------	-----------
Africa:					
Algeria	167, 000	150, 000	58, 899	128, 139	100, 000
Bechuanaland	400	700	1, 672	622	957
Belgian Congo	13, 000	15, 000	18, 000	2, 646, 713	3, 399, 619
British West Africa (Gold Coast, Ashanti, Nigeria, Sierra Leone)	200	252, 900	86, 402	117, 480	82, 400
East Africa, Portuguese	40	100	257	224	763
Eritrea	-----------	-----------	-----------	96	96
Rhodesia	73, 360	76, 500	114, 893	112, 459	128, 568
Tanganyika, Uganda, Kenya Colony	1, 400	1, 900	4, 431	5, 505	7, 228
Transvaal, Cape Colony, Natal	1, 050, 000	1, 063, 000	1, 120, 668	1, 065, 011	1, 002, 203
Australasia	10, 165, 000	8, 628, 800	9, 492, 726	11, 553, 031	11, 849, 383
Total	248, 708, 400	195, 920, 000	164, 892, 802	169, 159, 054	190, 859, 421

[1] Some production. Not recorded in report of Bureau of the Mint.
[2] Philippine Islands excluded.

An estimate for 1935 world production follows:

World production of silver (1935) in fine ounces

Country	Fine ounces	Country	Fine ounces
Mexico	70, 000, 000	Europe	16, 000, 000
United States (including Philippines)	48, 825, 000	Asia	17, 000, 000
Canada	16, 500, 000	Australasia	12, 400, 000
Central America and West Indies	3, 500, 000	Africa	5, 000, 000
Newfoundland	1, 150, 000		
South America	17, 000, 000	Total	207, 375, 000

SILVER

Newly mined silver jumps from 64.6464+ cents to 71.11+ cents on April 10 and to 77.57+ cents on April 24, 1935.—Producers of newly mined silver in the United States in 1935 began the year under the stimulus of the Government price of $0.64646464+ (one-half of the coinage value of $1.2929292929+). Acting under the President's proclamation of December 21, 1933, and the Silver Purchase Act of 1934, the Secretary of the Treasury on April 10 raised the price paid to $0.7111+ (55 percent of $1.292929+), and on April 24 to $0.7757+ (60 percent of $1.29292929+), where it remained throughout the year. The same price was in effect when this report was written (June 1, 1936). The average New York and London prices of silver for 1935, by months, had been as follows:

Silver prices, high, low, and average, New York and London spot, 1935, by months, per fine ounce (from American Metal Market)

Month	New York			London spot
	High	Low	Average	
	Cents	*Cents*	*Cents*	*Pence*
January	55	53⅞	54.42	24.584
February	56½	53½	54.60	24.818
March	61¼	56⅞	59.05	27.380
April	81	61¼	67.79	30.992
May	77	71¼	74.36	33.865
June	74	69½	71.94	32.346
July	69¾	67¾	68.22	30.500
August	67¾	65⅜	66.37	29.476
September	65⅜	65⅜	65.37	29.255
October	65⅜	65⅜	65.37	29.368
November	65⅜	65⅜	65.37	29.668
December	65⅜	49¾	58.42	25.921
Average for 1935	81	49¾	64.27	29.014

Silver produced in the United States and the Philippine Islands increased 48 percent, from 32,995,015 ounces in 1934 to 48,825,549 ounces in 1935. The value of the 1934 output at $0.646+ per ounce was $21,330,111, and the value of the 1935 product at the weighted average of $0.71875 was $35,093,363, an increase of $13,763,252 or 65 percent. Production of silver in the United States and the Philippines in 1933 was 23,317,159 ounces valued, at $0.35 per ounce, at $8,161,006. The increase in 1935 over 1933 was 109 percent in quantity and 330 percent in value.

Mine production of silver in the United States, by States and regions, 1934–35, in terms of recovered metal

State or territory	Fine ounces		Increase or decrease		Value	
	1934	1935	Fine ounces	Percent	1934 (at $0.646+ per ounce)	1935 (at $0.71875 per ounce)
Western States and Alaska:						
Alaska	[1] 168,868	[1] 251,269	+82,401	+49	$109,167	$180,600
Arizona	4,448,474	6,622,000	+2,173,526	+49	2,875,781	4,759,563
California	844,413	1,199,479	+355,066	+42	545,883	862,125
Colorado	3,475,661	4,696,064	+1,220,403	+35	2,246,892	3,375,296
Idaho	7,394,143	10,241,778	+2,847,635	+39	4,780,052	7,361,278
Montana	4,006,468	9,355,854	+5,349,386	+134	2,590,040	6,724,520

[1] Refinery receipts.

Mine production of silver in the United States, by States and regions, 1934–35, in terms of recovered metal—Continued

State or territory	Fine ounces		Increase or decrease		Value	
	1934	1935	Fine ounces	Percent	1934 (at $0.646+ per ounce)	1935 (at $0.71875 per ounce)
Western States and Alaska—Continued.						
Nevada	3,057,114	4,359,300	+1,302,186	+43	1,976,316	3,133,242
New Mexico	1,061,775	1,061,902	+127		686,400	763,247
Oregon	46,560	110,100	+63,540	+136	30,099	79,134
South Dakota	99,741	151,047	+51,306	+51	64,479	108,565
Texas	854,442	1,000,960	+146,518	+17	552,367	719,440
Utah	7,111,417	9,206,368	+2,094,951	+29	4,597,280	6,617,077
Washington	44,120	52,320	+8,200	+19	28,522	37,605
Wyoming	710	1,152	+442	+62	459	828
	32,613,906	48,309,593	+15,695,687	+48	21,083,737	34,722,520
Eastern States:						
Alabama	361	401	+40	+11	233	288
Georgia	48	74	+26	+54	31	53
New York	26,406	21,750	−4,656	−18	17,071	15,633
North Carolina	9,710	7,584	−2,126	−22	6,277	5,451
Pennsylvania	6,230	5,843	−387	−6	4,027	4,200
South Carolina	487	1,117	+630	+129	315	803
Tennessee	61,148	47,151	−13,997	−23	39,530	33,890
Virginia	103	55	−48	−47	67	39
	104,493	83,975	−20,518	−20	67,551	60,357
Central States:						
Illinois	310	3,149	+2,839	+915	200	2,263
Michigan	529	4,219	+3,690	+697	342	3,032
Missouri	63,066	110,551	+47,485	+75	40,770	79,459
	63,905	117,919	+54,014	+85	41,312	84,754
Philippine Islands	[1] 212,700	[1] 314,054	+101,354	+48	137,503	225,726
Puerto Rico	11	8	−3	−27	8	6
	212,711	314,062	+101,351	+48	137,511	225,732
	32,995,015	48,825,549	+15,830,534	+48	21,330,111	35,093,363

[1] Refinery receipts.

SILVER MINING IN THE UNITED STATES

Silver production in the United States depends mainly on complex ores, as shown by the following table:

Silver produced in the United States, by sources, as reported by mines, 1922–34, and total fine ounces [1]

Year	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Copper-lead and copper-lead-zinc ores	Lead-zinc ore	Total	
								Fine ounces	Percent
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		
1922	0.10	46.78	16.95	27.38	2.74	1.09	4.96	61,207,989	100.00
1923	.08	39.28	20.87	28.62	3.09	1.92	6.14	70,355,674	100.00
1924	.08	31.82	25.50	29.43	.04	1.86	11.27	64,070,744	100.00
1925	.08	25.63	27.06	28.15	.27	1.45	17.36	66,710,080	100.00
1926	.08	21.71	27.27	24.85	.50	2.27	23.32	62,487,219	100.00
1927	.08	19.75	24.41	26.44	2.83	3.64	22.85	59,625,682	100.00
1928	.08	19.25	25.46	23.18	.20	3.82	28.01	57,872,443	100.00
1929	.07	18.25	29.49	19.23	2.59	4.66	25.71	60,860,011	100.00
1930	.09	18.32	28.53	18.40	.94	6.39	27.33	47,724,903	100.00
1931	.16	14.63	32.07	20.48	.02	9.35	23.29	29,856,628	100.00
1932	.28	17.29	22.78	21.53	.01	14.83	23.28	22,739,669	100.00
1933	.28	15.62	25.23	16.96	.31	15.00	26.60	23,130,596	100.00
1934	.29	26.00	23.64	9.59	.02	11.38	29.08	32,782,304	100.00

[1] Philippine Islands and Puerto Rico excluded.

Alaska.—Silver produced in Alaska in 1934 was a byproduct of lode and placer gold, but in 1935 the output was augmented by the silver contained in the copper concentrates from the Kennecott copper mine, idle throughout 1933–34 but operated one shift from June through the year 1935. The Kennecott Copper Co. reports that ore reserves are small.

Arizona.—Silver production in Arizona increased from 4,448,474 ounces in 1934 to 6,622,000 in 1935. From 1929 to 1933, inclusive, about 89 percent of the silver produced in Arizona came from copper ores. In 1934, with increased outputs of lead-zinc, lead, and siliceous ore and an increase in copper ore over 1933, 77 percent of the silver still came from copper ore from the Copper Queen branch of the Phelps Dodge Corporation at Bisbee, the Magma mine at Superior, the United Verde Extension mine at Clemenceau, and the New Cornelia mine at Ajo. Lead, lead-zinc, and siliceous silver and gold ore made up the remaining 23 percent. In 1935, with an increase in all kinds of ore over 1934, 70 percent of the silver produced in Arizona came from copper ore from the Copper Queen Branch, United Verde at Jerome, Magma, United Verde Extension, and New Cornelia; most of the remainder came from lead-zinc, siliceous, and lead ore. Seven mines in Arizona produced more than 200,000 ounces of silver each in 1935—the Copper Queen Branch, United Verde, Eagle-Picher (lead-zinc ore) at Ruby, United Verde Extension, Tombstone Development Co. (lead and siliceous ore) at Tombstone, and the New Cornelia. Other large producers of silver were the Hillside property (gold-silver ore) near Hillside, the Shattuck-Denn (copper ore) at Bisbee, the Swastika (silver ore) near Cleator, the Golden Turkey (gold-silver ore) at Cordes, and the Belmont (gold-silver) mine at Superior.

California.—Most of the silver produced in California has always been a byproduct of gold quartz mines. In 1935 some properties in California were worked for silver and lead, silver and copper, and silver-gold. Leading silver producers, in order of output, were the Banner-Central of the Lava Cap Gold Mining Corporation, Empire Star group, and Spanish mine in Nevada County; Walker Copper mine in Plumas County; Golden Queen (Silver Queen) in Kern County; Empress in Nevada County; Silverado in Mono County; and Coyote in San Bernardino County.

Colorado.—In 1935 Eagle County produced 2,792,270 ounces of silver (60 percent of the State total) almost entirely from iron-copper-silver-gold ore. Other important silver-producing counties were Mineral, 499,680 ounces (11 percent); San Juan, 282,418 (6 percent); Ouray, 226,183 (5 percent); Pitkin, 174,208 (4 percent); San Miguel, 172,932 (4 percent); Lake, 114,766 (2 percent); and Clear Creek, 100,935 (2 percent). From 1858 to 1935 Colorado produced 672,346,106 ounces of silver, the largest quantity mined in any State.

Eastern States.—Noteworthy producers of silver in the Eastern States were New York with 21,750 ounces (recovered from lead concentrates from the Balmat mine at Edwards) and Tennessee with 47,151 ounces (chiefly from the copper ores of the Ducktown district). Other producing Eastern States were Alabama 401 ounces, Georgia 74 ounces, North Carolina 7,584 ounces, Pennsylvania 5,843 ounces, South Carolina 1,117 ounces, and Virginia 55 ounces.

Idaho.—Idaho produced 10,241,778 ounces of silver in 1935 compared with 7,394,143 ounces in 1934 and was again the largest silver-producing State, followed in 1935 by Montana and in 1934 by Utah. Mines in the Coeur d'Alene region in Shoshone County produced about 9,894,308 ounces of silver in 1935 (97 percent of the State total) compared with 7,062,640 ounces (95 percent of the State total) in 1934. The Sunshine mine east of Kellogg produced 5,876,908 ounces in 1935 compared with 3,456,568 ounces in 1934 and was again the largest producing silver mine in the United States. Other large producers of silver were the Hecla, Bunker Hill and Sullivan, Morning, Crescent, Page, and Gold Hunter mines, all in the Coeur d'Alene region.

Illinois.—Production of silver from Illinois ores in 1935 was 3,149 ounces recovered from lead concentrates obtained in milling fluorspar ore by the Hillside Flourspar Co. in southern Illinois.

Michigan.—Copper ores of Michigan yielded 4,219 ounces of silver in 1935.

Missouri.—Production of silver from Missouri ores in 1935 was 110,551 ounces, recovered from lead concentrates.

Montana.—The Anaconda Copper Co. was, as usual, the producer of 75 percent and upwards of the silver in Montana; the increase of its silver output in 1935 from its copper and lead-zinc properties at Butte represented two-thirds of the State increase from 4,006,468 ounces in 1934 to 9,355,854 in 1935. Substantial increases in silver production also were made at the Trout, Emma, Flathead, Comet, Quartz Hill, and Granite Bimetallic properties. The output of these properties and the Anaconda Copper Co. represented 90 percent of the State silver total.

Nevada.—Silver production in Nevada increased from 3,057,114 ounces in 1934 to 4,359,300 in 1935, chiefly due to the increased output of zinc-lead-silver ores of the Treadwell Yukon Co., Ltd., in Nye County and similar type ores of the Combined Metals Reduction Co. in Lincoln County and to leasing operations at Tonopah, Nye County. Other important silver producers were the Arizona Comstock Corporation, Comstock district, Storey County; the General Metals Recovery Corporation, cyaniding the old Millers tailing dump, and the Tonopah Belmont mine, both in Nye County. Siliceous ore mined in the Robinson district and sold to the McGill smelter for fluxing material yielded a substantial quantity of silver.

New Mexico.—New Mexico mines in 1935 yielded 1,061,902 ounces of silver compared with 1,061,775 ounces in 1934. The Pecos zinc-lead-copper-silver-gold mine in the Willow Creek district, San Miguel County, produced 41 percent of the total in 1935. Zinc-lead-copper-silver ore from Hanover and siliceous silver-gold ore from Mogollon constituted most of the remainder.

Oregon.—Forty-six thousand five hundred and sixty ounces of silver were produced in Oregon in 1934 and 110,100 ounces in 1935. About 85 percent of the 1935 product came from three lode mines in Baker County.

South Dakota.—Silver produced in South Dakota is a byproduct of the gold mines.

Texas.—Following the President's proclamation of December 21, 1933, establishing \$0.64646464+ as the price for newly mined silver, the American Metal Co., on January 1, 1934, reopened its Presidio mine at Shafter, closed since June 30, 1930. Operation was continuous in 1935, with a step-up in mill capacity on December 1 from 175 tons a day to 275 tons, and another step-up probable before the end of 1936. Crude silver-copper ore from the Hazel mine near Van Horn was shipped to a custom plant at Deming, N. Mex. Shipments of silver ore were made from properties near Allamoore and Van Horn to the El Paso smelter.

Utah.—In Utah 7,111,417 ounces of recoverable silver were produced in 1934 and 9,206,368 ounces in 1935. Increases in silver output were recorded in all the large mining districts, and important increases were reported at the United States & Lark, Tintic Standard, Park City Consolidated, and Utah Copper properties. About one-half of the silver came from lead-zinc ore of milling grade, and most of the remainder came from lead ore and siliceous ore of smelting grade. The United States & Lark property of the United States Smelting, Refining, & Mining Co. at Bingham was again the largest silver producer in Utah, followed by the Tintic Standard, Silver King Coalition, Park City Consolidated, and Utah Copper.

Washington.—In Washington 44,120 ounces of silver were produced in 1934 and 52,320 ounces in 1935, about one-half of the 1935 output having been derived from gold ore mined at Republic, and most of the rest having come from silver ore from Stevens County.

COPPER

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

SUMMARY OUTLINE

All phases of the copper industry of the United States improved in 1935. Consumption of old and new copper was 21 percent higher than in 1934, refinery production from domestic ores increased 45 percent, and mine production increased 56 percent. Stocks of refined copper at refineries declined 110,000 tons and were the lowest since the close of 1930. As data are not available on consumers' stocks it is not known whether the reduction noted above represents a net decline in total supply. Sales were heaviest during the latter half of the year, a period of rising prices, which suggests that fabricators were stocking up at that time. The average price for 1935, f. o. b. refinery, was 8.649 cents per pound compared with 8.428 cents in 1934, but the quotation at the end of the year was 9.025 cents, a substantial gain from the low of 7.775 cents during July and August.

In contrast with predepression averages, however, 1935 was again a subnormal year. Consumption was only 60 percent, domestic refinery output 38 percent, and mine output 42 percent of the average from 1925 to 1929. Stocks totaled 175,000 tons at the end of 1935 compared with 86,000 tons at the close of 1929. The average price of 8.649 cents was equivalent to only 59 percent of the average prevailing from 1925 to 1929—14.687 cents. Nevertheless, the liquidation of stocks that has been accomplished since the close of 1933 leaves the domestic industry in a position to realize further gains if the widely predicted improvement in industry materializes in the next few years. Figure 57 presents graphically outstanding features of the American copper industry for the past 25 years.

Consumption of copper abroad again exceeded all previous records. A large part of the increase can be accounted for in electrification and building projects, but the critical political situation in Europe undoubtedly has been a contributing factor. To meet the growing demand for copper foreign producers increased their output considerably during the latter part of 1934 and early in 1935. This proved to be ill-advised, as a temporary recession in foreign purchases precipitated a rise in stocks that adversely affected foreign prices. At the beginning of 1935, the New York quotation for export copper was 6.7 cents—2.1 cents below the domestic price. By the latter part of February the differential had increased to 2.6 cents, and

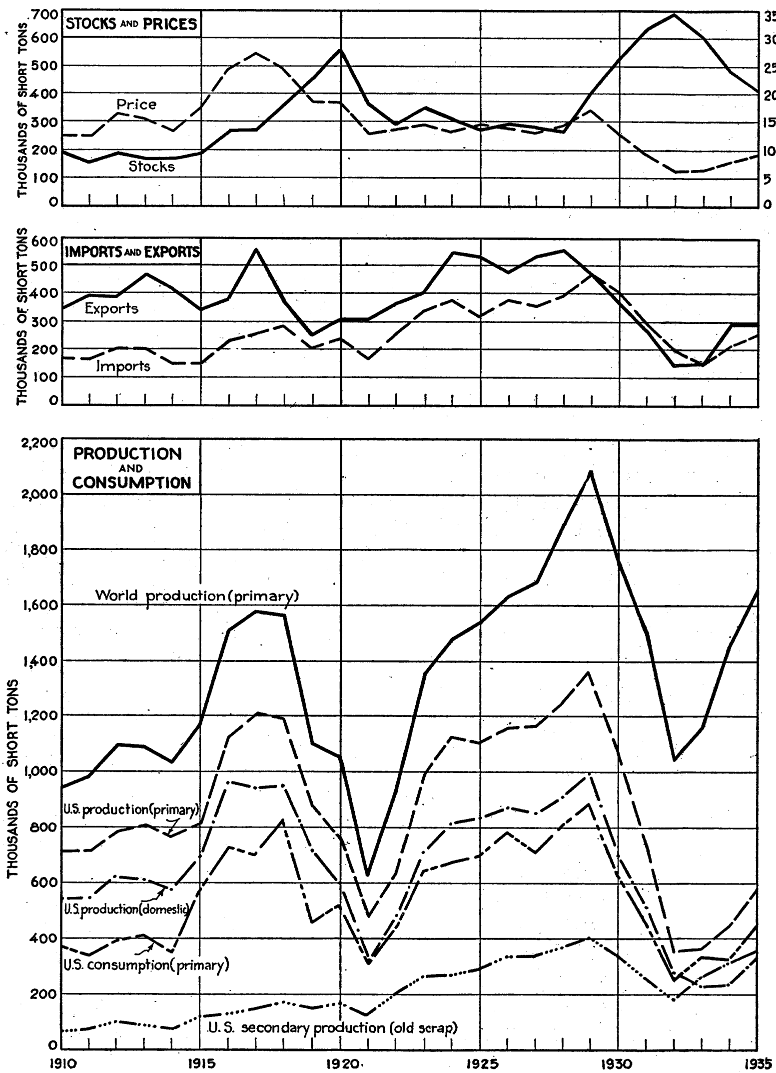

FIGURE 57.—Salient features of the copper industry in the United States, 1910–35.

competition for foreign sales had become severe. In March foreign producers meeting in New York reached an agreement whereby production was to be curtailed by 240,000 tons per year, effective June 1. Other provisions covered trade practices, exchange of statistical data, and methods for maintaining a balance between production and consumption in the foreign market. Following this agreement the differential between the domestic and export price of copper narrowed and virtually disappeared for a short time in the latter part of August. At the close of the year the export price was 8.375 cents compared to the domestic quotation of 9.025 cents. The organization apparently functioned to the satisfaction of its members, as in April 1936 it was announced that the agreement had been extended until July 1, 1938.

Compared with 1929 production and consumption of copper abroad have increased much more than in the United States. Smelter production of copper in the United States in 1935 was 62 percent less than the 1929 total, whereas elsewhere it was 24 percent greater. Domestic consumption was 48 percent less than in 1929, although foreign consumption exceeded 1929 by 27 percent. In 1929 the United States consumed more copper than all the rest of the world but in 1935 used only half as much. Whether or not the United States will resume its former position in copper consumption is problematical. The recent rate of increase in European consumption may be expected to taper off, but examination of predepression per-capita use of copper indicates that there is greater opportunity for permanent expansion of consumption abroad than in the United States. That producers are becoming more conscious of the effects of price on consumption is indicated by the statement of Sir Edmund Davis that the Rhodesian producers favored a larger output sold at a moderate price (£40 per long ton or approximately 9 cents per pound) rather than restricted production at higher prices.

World production and salient domestic statistics of copper, 1925–29 and 1932–35

[All tonnage figures in short tons]

	Average, 1925–29	1932	1933	1934	1935
World smelter production, new copper	1,761,000	1,045,000	1,157,000	1,458,000	[1] 1,650,000
United States production:					
New copper—					
From domestic ores, as reported by—					
Mines	885,826	238,111	190,643	237,405	[2] 382,290
Ore produced:					
Copper ore	59,505,871	[3] 12,320,194	[3] 8,387,612	[3] 11,723,638	(4)
Average yield of copper, percent	1.44	1.83	2.11	1.92	(4)
Smelters	892,730	272,005	225,000	244,227	381,294
Percent of world total	51	26	19	17	23
Refineries	890,767	222,539	240,669	233,029	338,321
From foreign ores, matte, etc., refinery reports	317,287	117,895	130,120	212,331	250,484
Total new refined, domestic and foreign	1,208,054	340,434	370,789	445,360	588,805
Secondary copper recovered from old scrap only	347,512	180,980	260,300	310,900	361,700
Copper content of copper sulphate produced by refiners	4,601	3,173	3,240	3,167	3,376
Total production, new and old and domestic and foreign	1,560,167	524,587	634,329	759,427	953,881
Imports (unmanufactured)	391,212	195,996	143,717	[5] 213,286	[5] 257,182
Refined	59,236	83,897	5,432	[5] 27,417	[5] 18,071
Exports of metallic copper [6]	522,616	147,678	151,913	296,359	295,198
Refined (ingots, bars, rods, etc.)	482,868	125,029	132,371	272,138	275,006
Stocks at end of year	307,200	691,000	600,500	479,000	411,000
Refined copper	86,100	502,000	406,500	284,500	175,000
Blister and materials in solution	221,100	189,000	194,000	194,500	236,000
Withdrawals from total supply on domestic account:					
Total new copper	778,123	259,602	339,350	322,638	441,371
Total new and old copper	1,288,700	508,000	677,500	700,000	890,000
Price, average cents per pound	14.7	6.3	6.4	8.0	8.3

[1] Approximate. [2] Subject to revision. [3] Includes old tailings. [4] Figures not yet available.
[5] Data for 1934 and 1935 include copper imported for immediate consumption plus material entering the country under bond.
[6] 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.

N. R. A.—The code of fair competition established on April 26, 1934, terminated on May 27, 1935, when the Supreme Court announced the unconstitutionality of the enabling act. By the end of June the price of copper, which had been fixed by the Code Authority during the first part of the year, dropped 1 cent a pound. There was also a temporary recession in demand but by the latter part of the year all the losses had been regained. In June the United States Copper Association announced that it would liquidate the unfinished business of the Copper Code Authority at the time it ceased to function, and that it would cooperate in maintaining existing standards and practices insofar as it was able to do so legally.

Tariff.—The 4-cent excise tax on imports of copper was extended to June 30, 1937, by legislative action at the close of June 1935. Reciprocal trade agreements concluded up to the end of 1935 did not specify any reductions in existing tariffs on copper products.

Domestic reserves and capacity for production.—Leith and Liddell [1] give the following summary of copper reserves and capacity for production in the United States:

> The known copper reserves of the United States, minable at prices at or near 10 cents per pound metallic copper, are estimated by Barbour to be some 30,000,000 to 35,000,000 tons, with perhaps 3 to 4 million tons additional, which could be mined at 12 cents. This amount represents a supply that would last for 40 years at the rate of consumption equal to the average of the last 10 years.
>
> An estimate made by Ira B. Joralemon, W. W. Lynch, and C. K. Leith in connection with Arizona tax legislation in 1935 shows a total of 17,602,000 tons of metallic copper, minable at a cost below 10 cents per pound from equipped properties, and an additional 4,210,000 tons, minable above 10 cents. Besides this tonnage, they estimate that some 4,310,000 tons, of which the cost of mining is uncertain, exist in unequipped properties. This brings the total amount of copper existing in the United States, in the opinion of this group, minable at prices at and below 12 cents per pound, to 26,122,000 tons, a total which would last, according to their trend predictions, for some 32 years at a rate of production of 725,000 tons per year. * * *
>
> The United States has overcapacity in every department of activity in copper—mining, smelting, and refining. New foreign discoveries and additional foreign facilities seem to render it impossible to regain our 1929 foreign markets, and they also render improbable future use of American refining capacity to refine foreign copper for reexport, on any such scale as in the past. Outstanding statistics are as follows:

		Tons
Copper-refining capacity	metal	1, 689, 000
Copper-smelting capacity	ore	11, 974, 800
Mine capacity	do	60, 000, 000
1929 copper production	metal	1, 026, 346
1933 copper production	do	233, 649

Effects of selective mining on average yield of copper ores.—One result of the extremely low prices prevalent during the depression has been the selective mining of the higher-grade portions of copper deposits in an endeavor to reduce costs of production. This practice is reflected in the sharp increase in the yield of copper ores mined in recent years, as indicated in figure 58, which shows the quantity of copper, silver, and gold recovered per ton of ore treated from 1907 to 1934. From 1907 to 1928 the average yield of copper from copper ores declined from 42.2 to 28.2 pounds per ton. This was largely associated with the increasing production of porphyry copper, which rose from only 6 percent of the total output in 1907 to nearly 50

[1] Leith, Kenneth, and Liddell, Donald M., The Mineral Reserves of the United States and Its Capacity or Production; Prepared for the Planning Committee for Mineral Policy, National Resources Committee, Washington, D. C., March 1936.

percent in 1928. By 1933 the average yield again had increased to 42.2 pounds, but all of this rise cannot be ascribed to selective mining because production at porphyry mines had been curtailed more than at the higher-grade vein and massive deposits. Nevertheless, the grade of ore extracted from most of the important deposits has shown a marked increase. In Michigan, for example, the average yield of copper per ton of ore mined underground rose from 33 pounds in 1931 to 69 pounds in 1934. In Butte the average was 78 pounds in 1929 and about 120 pounds in 1934. Bisbee's underground mines in 1928 produced 92 pounds of copper per ton of ore treated whereas in 1934 the yield was 137 pounds. Even the porphyry producers have favored the richer portions of their ore bodies, as is evidenced by the increased yield at Bingham from 17 pounds in 1928 to 20 pounds in

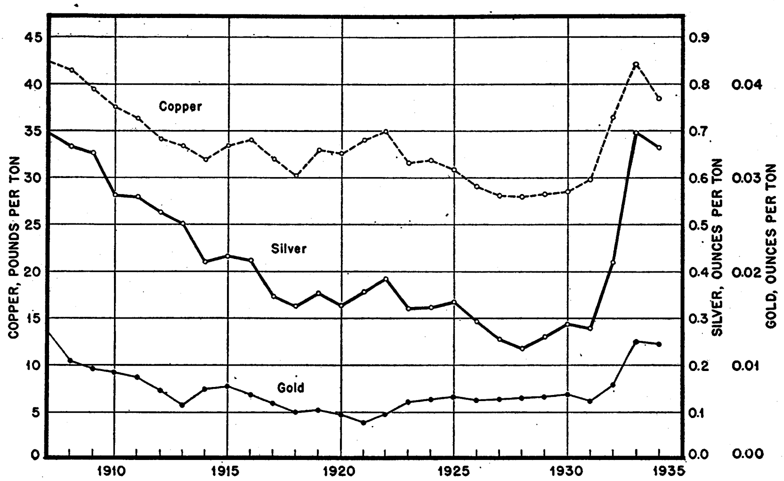

FIGURE 58.—Yield of copper, silver, and gold per ton of copper ore mined in the United States, 1907–35.

1935. The decrease in average yield shown on the chart for 1934 was due to the fact that a larger proportion of the total output was derived from porphyry deposits.

This tendency toward selective mining, if prolonged, will result in a substantial reduction in the average grade of remaining reserves, which, in turn, means higher production costs in the future. Moreover, much of the lower-grade ore now being passed up will ultimately be lost, as the cost of new development after the present mine workings have caved will probably be prohibitive.

Copper resources of the world.—The report on this subject undertaken by the Sixteenth International Geological Congress was completed in 1935. This excellent work was published in two volumes (855 pp.) and contains the most complete summary of the copper resources of the world ever compiled. A brief introduction covering the economic background of the copper industry is followed by detailed geologic descriptions of virtually all of the important copper deposits of the world, most of which were prepared by men personally familiar with the districts concerned. The report concludes that the total known world reserves are of the order of 100,000,000 tons of copper and that at the average rate of consumption during the last 13 years the reserves would last 69 years. In addition, most of the proved districts contain many more millions of tons of the metal in material too low in grade for profitable exploitation in the past but ready at any time for extraction when costs can be reduced or demand has increased to a point beyond the ability of the cheaper sources of supply to satisfy the needs.

DOMESTIC PRODUCTION

Considering certain qualifying factors, statistics on the production of copper may be obtained by taking mine, smelter, or refinery production. If mine output is considered, data on secondary copper would not appear. If smelters are considered, only part of the secondary copper would be accounted for. If refinery figures are taken, part of the blister copper, as well as copper sulphate, would not be included. For these and other reasons it is desirable to maintain three sets of statistics.

Copper produced from domestic ores, as reported by mines, smelters, and refineries, 1931–35, in pounds

Year	Mine	Smelter	Refinery
1931	1,057,749,350	1,042,711,178	1,074,606,041
1932	476,221,076	544,009,948	445,077,874
1933	381,285,194	449,999,143	481,338,031
1934	474,810,458	488,454,107	466,058,360
1935	[1] 764,580,000	762,587,340	676,642,866

[1] Subject to revision.

PRIMARY COPPER

Smelter production.—The copper output of United States smelters from domestic ores in 1935 was 762,587,340 pounds, an increase of 274,133,233 pounds (56 percent) over the output in 1934. This production was 23 percent of the world copper output, although it had averaged 51 percent from 1925 to 1929. The origin of smelter production is shown below by States.

Copper produced in the United States from domestic ores, 1931–35

[Smelter output, in pounds fine]

State	1931	1932	1933	1934	1935
Alabama				10,972	10,061
Alaska	23,233,034	13,297,443	1,575,936	130,284	14,601,603
Arizona	400,310,634	201,136,276	122,697,035	168,408,450	278,519,397
California	8,344,901	5,514,045	632,049	232,845	1,629,735
Colorado	9,028,517	8,976,169	8,882,397	13,046,759	14,340,744
Idaho	1,626,541	662,957	2,183,284	1,717,895	2,124,725
Michigan	105,222,177	63,898,656	72,340,852	51,681,901	73,811,562
Missouri			181,703	46,276	85,166
Montana	173,910,101	97,918,141	94,262,651	67,005,217	157,760,435
Nevada	71,233,352	32,616,050	42,507,400	41,922,506	72,818,792
New Mexico	66,776,267	32,914,883	24,948,272	26,994,219	4,559,874
North Carolina	(1)	(1)	(1)	(1)	(1)
Oklahoma				10,723	
Oregon	9,332	36,890	9,301	41,422	372,093
Pennsylvania	843,956	(1)	(1)	(1)	(1)
South Carolina			408	421	7,796
Tennessee	(1)	(1)	(1)	(1)	(1)
Texas	514	8,588	2,137	32,956	17,995
Utah	161,023,199	76,402,502	65,655,914	96,223,463	120,972,668
Virginia				384	683
Washington	71,426	2,521	87,199	33,393	81,482
Wyoming	9,545	607	46	3,390	1,749
Undistributed	21,067,682	10,624,220	14,032,559	20,910,631	20,870,780
	1,042,711,178	544,009,948	449,999,143	488,454,107	762,587,340

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

The figures for smelter production in 1935 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 also 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. The data are summarized for comparison with those of 1931, 1932, 1933, 1934, and 1935 in the following table.

Copper produced (smelter output) in the United States, 1845–1935

[Values rounded]

Period	Quantity		Total value
	Total (short tons)	Average per year (short tons)	
1845–80	363,996	10,111	$175,490,000
1881–1900	2,994,764	149,738	796,355,000
1901–10	4,281,716	428,172	1,273,911,000
1911–20	7,160,559	716,056	2,850,306,000
1921–30	7,423,403	742,340	2,117,235,000
1931	521,356	521,356	94,887,000
1932	272,005	272,005	34,273,000
1933	225,000	225,000	28,800,000
1934	244,227	244,227	39,076,000
1935	381,294	381,294	63,295,000
1845–1935	23,868,320	262,289	7,473,628,000

Mine production.—The figures for mine production are based on reports furnished to the Bureau of Mines by all domestic mines producing 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 ore production by calendar years more exactly because additional time is required for smelting and refining. Mine production in 1935 was 764,580,000 pounds, an increase of 61 percent over that in 1934 but still 57 percent below the average for 1925–29.

Production by States and districts.—The following tables show mine and smelter production by States for 1934 and 1935 and by districts for 1929–35. In 1935 Arizona, Montana, Utah, Michigan, and Nevada led in the production, with 92 percent of the smelter output.

From 1845 through 1935 Arizona, Montana, Michigan, and Utah, in the order named, were the principal producers, contributing 84 percent of the total output. Butte, Lake Superior, Bingham, and Bisbee, in the order named, were the principal districts.

Details of production by districts and companies in 1935 are available in other chapters of this volume dealing with production of gold, silver, copper, lead, and zinc in the various States.

Copper produced in the United States, according to smelter and mine returns, by States, 1934, 1935, and 1845–1935, in short tons

	1934		1935			1845–1935, smelter output	
	Smelter returns	Mine returns	Smelter returns		Mine returns [1]	Total quantity	Percent of total
			Percent of total	Quantity			
Alabama	5	6	----------	5	5	(2)	(2)
Alaska	65	61	1.92	7,301	[1] 7,739	623,407	2.61
Arizona	84,204	89,041	36.52	139,260	[1] 139,850	7,828,470	32.80
California	116	285	.21	815	[1] 983	548,349	2.30
Colorado	6,524	5,647	1.88	7,170	7,327	203,286	.85
Idaho	859	766	.28	1,062	[1] 1,048	75,264	.31
Michigan	25,841	24,108	9.68	36,906	32,054	4,374,619	18.33
Missouri	23	23	.01	43	34	(2)	(2)
Montana	33,503	31,632	20.69	78,880	[1] 77,460	5,397,045	22.61
Nevada	20,961	20,805	9.55	36,409	[1] 38,122	1,035,029	4.34
New Mexico	13,497	11,815	.60	2,280	2,253	771,699	3.23
North Carolina	(3)	(3)	(3)	(3)	(3)	(2)	(2)
Oklahoma	5	----------	----------	----------	----------	(2)	(2)
Oregon	21	19	.05	186	[1] 199	10,540	.04
Pennsylvania	(3)	(3)	(3)	(3)	(3)	(2)	(2)
South Carolina	(4)	(4)	----------	4	(4)	(2)	(2)
Tennessee	(3)	(3)	(3)	(3)	(3)	[5] 259,508	[5] 1.09
Texas	16	15	----------	9	14	(2)	(2)
Utah	48,112	43,012	15.86	60,487	[1] 64,758	2,537,677	10.63
Virginia	(4)	(4)	----------	(4)	(4)	(2)	(2)
Washington	17	7	.01	41	[1] 43	14,310	.06
Wyoming	2	2	----------	1	(4)	15,863	.07
Undistributed	10,456	10,161	2.74	10,435	10,401	[6] 173,254	.73
	244,227	237,405	100.00	381,294	[1] 382,290	23,868,320	100.00

[1] Subject to revision.
[2] Included under "Undistributed." Figures not separately recorded.
[3] Included under "Undistributed." Bureau of Mines not at liberty to publish figures.
[4] Less than 1 ton.
[5] Approximate production through 1928. Figures for 1929–35 are confidential and are included under "Undistributed."
[6] Includes Tennessee for 1929–35.

Mine production of copper in the principal districts,[1] 1930–35, in terms of recovered copper, in short tons

District or region	State	1930	1931	1932	1933	1934	1935
Bingham	Utah	87,535	73,853	31,234	35,818	41,793	[2] 63,060
Butte	Montana	97,736	92,181	42,300	32,618	31,428	(3)
Bisbee (Warren)	Arizona	63,950	47,664	23,702	(6)	35,555	(3)
Lake Superior	Michigan	84,691	59,030	27,198	23,427	24,108	32,054
Yavapai County (mostly Jerome district).	Arizona	58,845	22,288	17,904	16,629	13,199	(3)
Ely (Robinson)	Nevada	52,693	35,667	15,442	14,094	20,467	(3)
Pioneer	Arizona	16,193	14,052	11,026	10,915	16,367	(3)
Central (including Santa Rita)	New Mexico	28,622	28,159	13,256	12,571	10,895	(3)
Globe-Miami	Arizona	79,060	63,222	14,224	129	7,161	(3)
Battle Mountain	Colorado	2,925	3,324	2,810	4,082	4,910	(3)
Tintic	Utah	1,431	784	473	428	573	[2] 882
Willow Creek	New Mexico	719	548	510	877	867	614
Park City	Utah	839	409	451	366	278	[2] 349
Shasta County	California	1,981	155	148	428	194	(3)
Lordsburg	New Mexico	2,429	1,996	429	11	14	(3)
Morenci-Metcalf	Arizona	21,572	(6)	11,931	4	6	(3)
Banner	do	3,775	1,303	124	20	1	(3)
Ray (Mineral Creek)	do	18,059	12,219	7,202	1,376	----------	(3)
Bonanza	Colorado	617	3	----------	2	----------	(3)
Plumas County	California	9,765	6,227	522	(4)	(4)	(3)
Copper River [5]	Alaska	(6)	(6)	[7] 4,369	(8)	(6)	(3)
Prince William Sound [5]	do	(6)	(6)	----------	(8)	----------	(3)
Ajo [5]	Arizona	25,102	(6)	(6)	----------	(6)	(3)
Swain County [5]	North Carolina	(6)	(6)	(6)	(6)	(6)	(6)
Lebanon (Cornwall mine) [5]	Pennsylvania	1,430	(6)	(6)	(6)	(6)	(6)
Ducktown [5]	Tennessee	(6)	(6)	(6)	(6)	(6)	(6)

[1] Districts producing 1,000 short tons or more in any year of the period, 1930–35.
[2] Subject to revision.
[3] Data not yet available.
[4] Less than 1 ton.
[5] Not listed in order of output.
[6] Bureau of Mines not at liberty to publish figures.
[7] Includes a small quantity produced elsewhere in State.
[8] Total for Alaska was 15 tons; data by districts not available.

New Cornelia Mine, Ajo, Ariz.—The following description of this famous mine of the Phelps Dodge Corporation prepared by James Gilluly of the United States Geological Survey is published by permission of the Director of that agency.

The New Cornelia mine, at Ajo, is one of the great copper mines of Arizona, having produced over 800,000,000 pounds of copper since 1916 and having reserves adequate to insure further production at the rate of 50,000,000 pounds a year for at least 40 years.

Ajo is in southern Arizona, in Pima County, about 43 miles south of Gila Bend, on the Southern Pacific Railroad, and 125 miles west of Tucson. The climate is extremely arid, with rainfall averaging less than 10 inches a year. Altitudes in the district range from 1,700 to 2,500 feet; the country is hilly but not mountainous.

The existence of copper at Ajo has been known from the time of the Spanish Padres, and desultory attempts to work the deposit were made as early as the 1850's. Owing to the low grade of the ore and costly transportation these attempts were unsuccessful and it was not until 1911 that active development of the deposit began. At that time the Calumet & Arizona Mining Co., under J. C. Greenway, General Manager, took an option on the property, reorganized it as the New Cornelia Copper Co., and after extensive sampling demonstrated the existence of a huge tonnage of low-grade copper ore. The ore body was later found to extend laterally somewhat, so that outlying properties were added till the present block of ground was consolidated in 1917. Meantime experiments had demonstrated a feasible process for recovering the copper from the carbonate capping over the sulphide ore body, a railroad was built from Gila Bend and a leaching plant erected. Production began in 1916 and in a large way by open-cut methods, in 1917. Sulphide ore was reached in 1924 and a concentrator erected for its treatment. By 1930 most of the carbonate ores were exhausted and the leaching plant was closed; in the meantime the sulphide concentrator was enlarged to a present capacity of 16,000 tons a day.

In 1929 the New Cornelia was absorbed by the Calumet & Arizona Mining Co., and in 1931 this in turn was consolidated with the Phelps Dodge Corporation.

GEOLOGY

The New Cornelia deposit lies at the south end of a body of monzonite and monzonite porphyry that injects a diversified series of lavas. The ore consists of stringers and blebs of chalcopyrite, bornite, and subordinate chalcocite that impregnate the mass of the monzonite and its host volcanic rocks. Most of the ore is in the monzonite but it is not confined to that formation. A thin zone of chalcocite-bearing ore lies at the south of the ore body and is tilted steeply. It has been followed by the drill to well below sea level, and, in association with other geologic features, shows the whole block of country containing the ore body to have been tilted at a high angle to the south after the mineralization. This chalcocite zone is richer than the average ore but is small compared to the rest of the ore body. No similar enriched zone occurred over the mass of the ore body. Apparently, during the erosion cycle that was interrupted by the beginning of mining, the ore minerals merely altered in place to carbonates, for the tenor of the weathered zone was essentially identical with that of the underlying sulphides. There was a slight change of the sulphides near the carbonate zone in the direction of producing more bornite and chalcocite at the expense of the dominant chalcopyrite, but apparently no migration of copper accompanied the mineralogic change.

The carbonate zone ranged from 20 to 190 feet thick; its bottom was essentially a plane at the water table. The sulphide ore body averages about 425 feet thick and has a maximum thickness of nearly 1,000 feet. It is shaped somewhat like a tilted funnel, with a broad flare at the surface and a steep pipe extending to considerable depths at the south end. This part of the ore body will presumably be exploited by underground methods after the economic limit of the open pit is reached.

FACTORS AFFECTING MINING

On the average the ore is highly siliceous and feldspathic, with resulting higher costs for steel and explosives than are usual for the disseminated copper ores of the Southwest. This item is to some extent counterbalanced by the fact that little stripping of waste has been needed—only 0.21 ton of waste having been moved per ton of ore up to 1932. This proportion will increase in future but is low compared with that in most other open cut mines.

Prior to 1932 there was an offset for gold and silver of about five-sixths cent per pound of copper in the sulphide ore. With present prices of the precious metals this figure is notably higher. A small amount of molybdenite occurs in the ore. This is not now saved but conceivably might add to the byproduct recovery.

On a full production basis the mine is capable of producing copper at a very low unit cost. There is every probability that it will have a long and productive future.

Quantity and estimated recoverable content of copper-bearing ores.—The following tables show the quantity and the estimated recoverable copper content of the ore produced by United States mines in 1934. Of the total copper produced from copper ores in the United States in that year, 73 percent was obtained from ores concentrated before smelting and 27 percent from direct smelting ore. In 1933 the figures were 69 percent from concentrated ore and 31 percent from direct smelting ore.

Close agreement between the output as reported by the smelters and the recoverable quantity as reported by the mines indicates that the estimated recoverable tenor is very close to the actual recovery. Classification of some of the complex western ores is difficult and more or less arbitrary. Under copper ores are grouped 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. Under copper-lead and copper-lead-zinc ores are classed complex ores in which copper is a valuable constituent. Mines report considerable copper from ores mined primarily for other metals. These include siliceous gold and silver ores, lead and zinc ores, and pyritic sulphur ores.

Copper ore, old tailings, etc., sold or treated in the United States in 1934, 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	2,845,604	[1] 177,057,423	3.11	76,092.34	3,459,138	$1.72
California	[2] 53,357	[1] 309,668	.29	36.31	108	.03
Colorado	135,082	9,834,150	3.64	5,582.37	1,927,335	10.67
Idaho	[3] 1,020	5,160	.25	12.66	4,349	3.19
Michigan	700,055	48,215,859	3.44		516	(4)
Montana	458,587	[1] 56,670,063	6.18	1,396.18	1,808,104	2.66
Nevada	1,819,913	41,015,015	1.13	16,138.79	74,225	.34
New Mexico	1,000,972	19,529,550	.98	1,223.92	23,082	.06
Utah	4,092,303	[1] 76,637,148	.94	44,169.71	375,137	.44
Wyoming	3	2,700	45.00		4	1.00
Eastern States	[5] 616,742	20,322,800	1.65	1,278.00	76,878	.15
	11,723,638	449,599,536	1.92	145,930.28	7,748,876	.86

[1] Excludes copper recovered from precipitates as follows: Arizona 345,475 pounds, California 80,619 pounds, Montana 5,167,305 pounds, and Utah 2,453,490 pounds.
[2] Includes 53,328 tons of pyrites roasted for the manufacture of sulphuric acid (residue leached).
[3] Mostly copper-tungsten ore.
[4] Not available.
[5] Includes copper concentrates from pyritiferous magnetite ore from Pennsylvania.

Copper ore, old tailings, etc., concentrated in the United States in 1934, with content in terms of recovered copper

State	Ore, old tailings, etc., concentrated (short tons)	Concentrates produced (short tons)	Copper produced (pounds)	Percent of copper from ore, etc.
Arizona	2, 131, 164	177, 723	73, 691, 546	1. 73
Idaho	1, 003	24	2, 260	. 11
Michigan	700, 055	35, 051	48, 215, 859	3. 44
Montana	458, 113	113, 963	56, 619, 958	6. 18
Nevada	1, 818, 921	65, 762	40, 928, 215	1. 13
New Mexico	1, 000, 400	26, 302	19, 470, 000	. 97
Utah	4, 086, 800	117, 958	75, 267, 278	. 92
Eastern States	[1] 485, 511	33, 334	12, 375, 900	[2] 1. 26
	10, 681, 967	570, 117	326, 571, 016	1. 53

[1] Pyritiferous magnetite ore yielding copper concentrates not included with copper ore.
[2] Obtained by using copper concentrates for Pennsylvania and copper ore for other Eastern States.

Copper ore leached and smelted in the United States in 1934, with content in terms of recovered copper

State	Ore leached			Ore smelted		
	Short tons	Copper produced (pounds)	Percent of copper	Short tons	Copper produced (pounds)	Percent of copper
Arizona				714, 412	103, 276, 648	7. 23
California	(1)	(1)	(1)	29	2, 093	3. 61
Colorado				135, 082	9, 834, 150	3. 64
Idaho				13	2, 460	9. 46
Montana				474	50, 105	5. 29
Nevada				992	86, 800	4. 38
New Mexico				572	59, 550	5. 21
Utah				519	58, 972	5. 68
Wyoming				3	2, 700	45. 00
Eastern States				125, 000	7, 946, 900	3. 18
	(1)	(1)	(1)	977, 096	121, 320, 378	6. 21

[1] Residue from 53,328 tons of pyrites roasted for the manufacture of sulphuric acid was leached, and 307,575 pounds of copper were recovered.

Copper-lead ores sold or treated in the United States in 1934, with content in terms of recovered copper

State	Copper-lead ores (short tons)	Copper produced (pounds)	Percent of copper
Arizona	47	4, 683	4. 98
California	11	452	2. 05
Colorado	201	11, 600	2. 89
Idaho	118, 927	769, 991	. 32
Nevada	72	7, 216	5. 01
New Mexico	1, 176	114, 400	4. 86
Texas	(1)	(1)	(1)
Utah	127	17, 371	6. 84
	120, 561	925, 713	. 38

[1] Small quantity; Bureau of Mines not at liberty to publish.

Ores, old tailings, etc., classed as copper-bearing (copper and copper-lead) sold or treated in the United States in 1934, with copper content, and copper produced from all sources, in terms of recovered copper

State	Copper from copper and copper-lead ores, old tailings, etc.			Copper from all sources, including old slags, smelter cleanings, and precipitates (pounds)
	Ores, old tailings, etc., sold or treated (short tons)	Copper produced (pounds)	Percent of copper	
Alaska				121,000
Arizona	2,845,651	177,062,106	3.11	178,082,213
California	53,368	310,120	.29	569,068
Colorado [1]	135,283	9,845,750	3.64	11,294,000
Idaho	119,947	775,151	.32	1,531,625
Michigan	700,055	48,215,859	3.44	48,215,859
Missouri				46,276
Montana [2]	458,587	56,670,063	6.18	63,265,000
Nevada	1,819,985	41,022,231	1.13	41,611,119
New Mexico [3]	1,002,148	19,643,950	.98	23,630,000
Oregon				38,373
Texas	(4)	(4)	(4)	29,000
Utah [5]	4,092,430	76,654,519	.94	86,024,925
Washington				13,900
Wyoming	3	2,700	45.00	3,500
Eastern States	[6] 616,742	20,322,800	1.65	20,334,600
	11,844,199	450,525,249	1.90	474,810,458

[1] Considerable copper was derived from ores classed as siliceous ores.
[2] Considerable copper was recovered from precipitates.
[3] Considerable copper was derived from ores classed as lead-zinc and zinc ores.
[4] Small quantity of copper-lead ore. Bureau of Mines not at liberty to publish.
[5] Considerable copper was derived from precipitates and from ores classed as gold ores and as lead-zinc ores.
[6] Includes copper concentrates from pyritiferous magnetite ores from Pennsylvania.

Copper ores produced in the United States, 1925–34, and average yield in copper, gold, and silver

Year	Smelting ores		Concentrating ores		Total				
	Short tons	Yield in copper (percent)	Short tons	Yield in copper (percent)	Short tons	Yield in copper (percent)	Yield per ton in gold (ounce)	Yield per ton in silver (ounce)	Value per ton in gold and silver
1925	3,876,733	4.90	48,186,769	1.28	53,103,014	1.54	0.0065	0.338	$0.37
1926	3,767,947	4.75	52,083,784	1.24	57,181,894	1.46	.0064	.293	.31
1927	3,407,610	4.67	49,179,035	1.23	56,725,460	1.41	.0065	.255	.28
1928	3,766,368	4.44	54,214,485	1.24	62,097,132	1.41	.0067	.236	.28
1929	4,235,192	4.60	[1] 59,727,536	1.22	[1] 68,421,853	1.41	.0067	.262	.28
1930	2,983,912	4.57	[1] 41,327,237	1.23	[1] 47,381,509	1.43	.0070	.287	.26
1931	1,519,915	5.38	[1] 30,056,857	1.33	[1] 34,050,961	1.50	.0063	.281	.21
1932	758,623	6.98	[1] 10,964,749	1.51	[1] 12,320,194	1.83	.0080	.421	.28
1933	872,033	6.30	[1] 7,475,988	1.63	[1] 8,387,612	2.11	.0126	.696	.57
1934	977,096	6.21	[1] 10,681,967	1.53	[1] 11,723,638	1.92	.0124	.661	.86

[1] Includes old tailings, etc.

REFINERY PRODUCTION

The refinery output of copper in the United States in 1935 was made by 10 plants; 8 of these employed the electrolytic method, and 2 employed 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 plants 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 plants, 14 in number, constitute what is commonly referred to as "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 1,624,000 tons of refined copper per annum. Since they produced only 699,867 tons in 1935, only 43 percent electrolytic refining capacity was utilized.

Refined copper is marketed in various grades, such as casting copper, lake copper, and electrolytic copper, and in various forms, such as wire bars, cathodes, cakes, etc. The differences in these various grades were explained on page 739 of the Copper chapter of Mineral Resources, 1930. The following tables show the production of refined copper at regular refining plants, classified according to source, grade, and form in which it was cast.

Primary and secondary copper produced by regular refining plants in the United States and imported, 1931–35, in pounds

	1931	1932	1933	1934	1935
Primary:					
Domestic:[1]					
Electrolytic	947, 065, 977	[2] 373, 492, 550	[2] 421, 318, 802	414, 020, 483	[2] 602, 826, 051
Lake	105, 222, 177	[2] 53, 815, 281	[2] 59, 497, 370	51, 681, 901	[2] 73, 605, 212
Casting	22, 317, 887	17, 770, 043	521, 859	355, 976	211, 603
	1, 074, 606, 041	445, 077, 874	481, 338, 031	466, 058, 360	676, 642, 866
Foreign:[1]					
Electrolytic	426, 307, 093	235, 240, 651	260, 048, 594	424, 523, 995	500, 878, 984
Casting and best select	529, 199	549, 209	191, 927	137, 510	88, 947
Refinery production, new copper	1, 501, 442, 333	680, 867, 734	741, 578, 552	890, 719, 865	1, 177, 610, 797
Imports refined copper	174, 449, 893	167, 793, 988	10, 863, 358	[3] 54, 833, 436	[3] 36, 142, 671
Total new refined copper made available	1, 675, 892, 226	848, 661, 722	752, 441, 910	945, 553, 301	1, 213, 753, 468
Secondary:					
Electrolytic	156, 099, 339	120, 397, 873	170, 878, 078	243, 189, 320	296, 028, 315
Casting	28, 914	56, 654	160, 214	720, 514	927, 450
	156, 128, 253	120, 454, 527	171, 038, 292	243, 909, 834	296, 955, 765
Grand total	1, 832, 020, 479	969, 116, 249	923, 480, 202	1, 189, 463, 135	1, 510, 709, 233

[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 for 1934 and 1935 include copper imported for immediate consumption plus material entering the country under bond.

Copper cast in different forms in the United States in 1934–35

Form	1934		1935	
	Pounds	Percent	Pounds	Percent
Wire bars	432,000,000	38.06	642,000,000	43.53
Cathodes	369,000,000	32.51	374,000,000	25.36
Cakes	182,000,000	16.04	261,000,000	17.69
Ingots	59,000,000	5.20	71,000,000	4.81
Other forms	93,000,000	8.19	127,000,000	8.61
	1,135,000,000	100.00	1,475,000,000	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 statement of refined copper production shown in the preceding tables but is included in the statement of secondary copper production given below.

Copper sulphate.—The production of hydrous copper sulphate or bluestone by copper refineries in the United States in 1935 was 26,507,-526 pounds having a copper content of 6,752,000 pounds compared with 24,862,944 pounds having a copper content of 6,333,000 pounds in 1934.

The production of copper sulphate by plants other than the regular primary refineries was 35,887,265 pounds with a reported copper content of 9,136,000 pounds in 1935 compared with the revised figure of 31,242,205 pounds with a reported copper content of 7,971,000 pounds in 1934.

SECONDARY COPPER

Secondary copper includes material recovered from remelting old copper and copper scrap and from treatment of copper alloys or alloys treated without separation of the copper. The following table summarizes the production of secondary copper during the past 6 years. Further details can be found in the chapter on Secondary Metals.

Secondary copper produced in the United States, 1930–35, in short tons

	1930	1931	1932	1933	1934	1935
Copper as metal	244,800	188,300	140,500	193,100	220,400	270,000
Copper in alloys	222,400	158,700	107,680	145,000	157,000	178,900
Total secondary copper	467,200	347,000	248,180	338,100	377,400	448,900
From new scrap	125,000	85,700	67,200	77,800	66,500	87,200
From old scrap	342,200	261,300	180,980	260,300	310,900	361,700
Percent of domestic mine output	66	66	104	177	159	117

The production of secondary copper in 1935 increased 19 percent over the previous years, but as the mine output was 61 percent higher the ratio of secondary to primary production declined from 159 percent in 1934 to 117 in 1935. Further declines may be expected in this ratio when copper consumption returns to predepression proportions, but the long-time trend indicates that secondary copper is supplying a steadily increasing proportion of our total copper output. In 1910 secondary copper was equivalent to less than 20 percent of the domestic mine output, whereas in 1929 it was 63 percent. Further details of secondary copper production are given in the chapter on Secondary Metals.

CONSUMPTION AND USES

New supply.—The total available supply of new copper consists of the total output of primary copper by refineries plus imports of refined copper. In 1935 it amounted to 1,213,753,468 pounds, an increase of 28 percent over 1934. (See table on p. 119.) 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 which 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 published data are not available.

New refined copper withdrawn from total year's supply on domestic account, 1931–35, in pounds

	1931	1932	1933	1934	1935
Total supply of new copper	1,675,892,226	848,661,722	752,441,910	945,553,301	1,213,753,468
Stock at beginning of year	615,000,000	924,600,000	1,004,000,000	813,000,000	569,000,000
Total available supply	2,290,892,226	1,773,261,722	1,756,441,910	1,758,553,301	1,782,753,468
Copper exported [1]	464,227,033	250,058,954	264,742,586	544,276,582	550,012,320
Stock at end of year	924,600,000	1,004,000,000	813,000,000	569,000,000	350,000,000
	1,388,827,033	1,254,058,954	1,077,742,586	1,113,276,582	900,012,320
Withdrawn on domestic account	902,065,193	519,202,768	678,699,324	645,276,719	882,741,148

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

The quantity of new copper withdrawn on domestic account in 1935, as shown in the foregoing table, was 37 percent above that in 1934 and 50 percent below the record year 1929.

Total supply.—Adding 897,800,000 pounds of secondary copper and copper in alloys produced during the year to the 882,741,148 pounds of new refined copper withdrawn on domestic account gives a total supply of 1,780,541,148 pounds of new and old copper available for domestic consumption in 1935. 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, which was 723,400,000 pounds. The total available for consumption by this calculation would be 1,606,000,000 pounds in 1935 compared with 1,267,000,000 pounds in 1934 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. These data for the past 6 years are shown in the following table.

Estimated use of copper in the United States, 1930–35, in short tons

	1930	1931	1932	1933	1934	1935
Electrical manufactures [1]	221,000	162,000	90,000	90,000	101,000	128,000
Telephones and telegraphs	122,000	70,000	27,000	18,000	18,000	18,000
Light and power lines [2]	130,000	85,000	49,000	33,000	40,000	55,500
Wire cloth	9,200	4,900	4,200	5,000	4,600	5,600
Other rod and wire	93,700	55,000	30,000	46,000	40,000	48,000
Ammunition	5,100	5,000	3,900	10,500	13,500	13,700
Automobiles [3]	87,000	61,600	32,300	49,000	63,000	90,000
Buildings [4]	50,000	45,000	29,000	36,000	36,000	49,000
Castings, n. e. s.[5]	55,400	36,000	27,000	36,000	36,000	36,000
Clocks and watches	2,600	2,000	1,500	2,800	2,200	2,100
Coinage	850	100	100	100	900	1,500
Copper-bearing steel	1,900	1,200	800	1,500	2,100	2,300
Fire-fighting apparatus	1,700	1,300	1,000	1,100	1,000	1,200
Radiators, heating	3,000	1,700	1,000	2,400	1,000	1,100
Radio receiving sets	13,000	10,000	7,000	11,500	12,500	14,200
Railway equipment [6]	8,600	1,800	700	800	2,100	1,400
Refrigerators	15,000	13,000	9,000	11,400	15,700	15,400
Shipbuilding	5,000	3,200	2,100	1,800	3,200	1,100
Washing machines	1,200	1,600	1,500	1,000	1,400	1,300
Water heaters, household	1,800	1,400	1,000	1,500	1,500	1,500
Air conditioning [7]					3,800	4,600
Other uses	57,000	40,000	27,300	40,000	42,000	46,000
Manufactures for export	71,100	48,200	22,600	15,600	25,500	29,500
Total	956,150	650,000	368,000	415,000	467,000	567,000

[1] Generators, motors, electric locomotives, switchboards, light bulbs, etc.
[2] Transmission and distribution wire and bus bars.
[3] Does not include starter, generator, and ignition equipment.
[4] Excludes electrical work.
[5] Bearings, bushings, lubricators, valves, and fittings.
[6] Includes air conditioning, beginning with 1933.
[7] Other than railway.

According to the foregoing table, the use of copper in 1935 increased 21 percent over 1934 but was 51 percent below 1929. The principal uses in 1935 and the percentage of the total taken by each were as follows: Electrical manufactures, 23; automobiles, 16; light and power lines, 10; other rod and wire, 8; buildings, 9; castings, 6; telephones and telegraphs, 3; refrigerators, 3; radio receiving sets, 3; and ammunition, 2. There was no change in the quantity of copper used in castings and telephones and telegraphs, but most of the other important uses showed substantial increases. Consumption of copper in all of the above uses except ammunition was considerably below the 1929 level. The largest declines since 1929 have been in the uses associated with electric power, telephones, and telegraphic equipment.

STOCKS

The following table gives domestic stocks of copper reported by smelters and refineries.

Stocks of copper in the United States, Jan. 1, 1929–36, in pounds

Year	Refined copper	Blister and materials in process of refining	Year	Refined copper	Blister and materials in process of refining
1929	114,000,000	423,000,000	1933	1,004,000,000	378,000,000
1930	306,000,000	500,000,000	1934	813,000,000	388,000,000
1931	615,000,000	450,000,000	1935	569,000,000	389,000,000
1932	924,600,000	348,000,000	1936	350,000,000	472,000,000

Stocks of refined copper in the United States declined again in 1935 and were the lowest since the end of 1929, according to reports submitted to the Bureau of Mines. The decline in 1935 was due to large increases in shipments to domestic consumers and an increase of about 15,000,000 pounds in net exports of refined copper. Consumer's stocks are believed to be excessively high, but published data on this point are not available. Stocks of copper in blister and in process of refining increased 21 percent in 1935.

The Mining Journal, London (Feb. 29, 1936), citing figures credited to the Copper Institute, states that world stocks of copper declined from 587,131 short tons at the beginning of 1935 to 485,328 at the close of the year. The former figure comprised 354,436 tons held in the United States and 232,695 tons held elsewhere. At the end of 1935 the United States held 231,415 and the rest of the world 253,913 tons. Thus, according to this authority, stocks of refined copper in the United States declined 25 percent whereas those of the rest of the world increased 9 percent. The figures for the United States presumably include some metal held by or for consumers, as reports to the Bureau of Mines from refineries indicate that producers' stocks of refined copper, as shown in the preceding table, were 284,500 tons and 175,000 tons, respectively, at the beginning and end of 1935.

PRICES

Reports to the Bureau of Mines from copper-selling agencies in the United States indicate that 973,728,838 pounds of copper were delivered to domestic and foreign purchasers in 1935 at an average price (f. o. b. refinery) of 8.3 cents per pound. These deliveries are exclusive of copper produced and delivered outside of the United States. The average price for 1935 was 0.3 cent higher than that received in 1934 and 2 cents higher than that for 1932, the lowest on record.

According to the Engineering and Mining Journal, the quotation for electrolytic copper (domestic refinery basis) averaged 8.649 cents per pound in 1935 compared with 8.428 cents in 1934, 5.555 cents in 1932, and 18.107 cents in 1929. From the first of the year until the disbanding of the N. R. A. following the Supreme Court decision on May 27 the price for "blue eagle" copper was fixed by the code authority at 9 cents, f. o. b. Connecticut Valley (8.775 cents f. o. b. refinery, according to the Engineering and Mining Journal). This same level was maintained for some time after the demise of the N. R. A.; but during the latter part of June weakness developed, and before the end of the month the quotation dropped to 7.775 cents. This level was held until the latter part of August. Meanwhile the London market had reacted to the heavy demand for copper abroad, so that the differential between the domestic and export prices, which amounted to over 2 cents at the beginning of the year, virtually disappeared. The foreign market was strengthened further by the announcement in July that the international copper agreement had been extended to the end of 1938. These favorable developments, together with active buying in the United States in July and August, resulted in a half-cent increase in price to 8.275 cents on August 20. The price again was raised on September 18 to 8.775 and on October 8 to 9.025 cents, where it held for the balance of the year. The latter quotation was the highest since May 1931.

The quotation for copper for export, f. o. b. United States refineries, was 6.700 cents on January 2, compared with a domestic price of 8.775 cents. By August 19 it had risen to 7.675 cents while the domestic price had declined to 7.775 cents. It reached a peak for the year of 8.750 cents on October 8, which was 0.275 cent under the domestic price. At the close of the year the export price stood at 8.375 cents, 0.650 cent under the United States quotation.

Average monthly quoted prices of electrolytic copper for domestic and export shipments, f. o. b. refineries, United States, and for spot copper at London, 1934–35, in cents per pound

Month	1934				1935			
	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	8.06	7.890	7.831	8.028	8.87	8.775	6.583	6.828
February	7.87	7.777	7.844	8.081	8.87	8.775	6.341	6.580
March	7.87	7.775	7.837	8.076	8.87	8.775	6.526	6.739
April	8.27	8.173	8.053	8.291	8.87	8.775	7.328	7.506
May	8.37	8.275	7.913	8.151	8.87	8.775	7.794	8.015
June	8.68	8.594	7.705	7.965	8.77	8.634	7.307	7.499
July	8.87	8.775	7.146	7.376	7.87	7.775	7.350	7.583
August	8.87	8.775	6.885	7.119	8.10	7.979	7.738	7.982
September	8.87	8.775	6.586	6.812	8.65	8.504	8.146	8.354
October	8.87	8.775	6.315	6.502	9.07	8.967	8.514	8.678
November	8.87	8.775	6.513	6.731	9.12	9.025	8.414	8.662
December	8.87	8.775	6.619	6.864	9.12	9.025	8.414	8.650
Average for year	8.53	8.428	7.271	7.496	8.76	8.649	7.538	7.753

[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, 1926–35, in cents per pound

	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935
Domestic f. o. b. refinery [1]	13.93	13.05	14.68	18.23	13.11	8.24	5.67	7.15	8.53	8.76
Domestic f. o. b. refinery [2]	13.795	12.920	14.570	18.107	12.982	8.116	5.555	7.025	8.428	8.649
Export f. o. b. refinery [2]	(3)	(3)	(3)	(3)	(3)	(3)	(3)	6.713	7.271	7.538
London spot [2] [4]	14.200	13.468	15.040	18.413	13.355	8.522	5.629	6.877	7.496	7.753

[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-three percent by weight of the copper imported in 1935 was contained in ore, concentrates, and unrefined furnace products. Much of the remainder—probably most of it—though already refined was ingots to be remelted and recast in the United States. On the

[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.

contrary, 94 percent of the exports consisted of refined copper and primary manufactures therefrom.

Normally the exports of copper greatly exceed the imports, but in some recent years this has not been the case. For instance, in 1932 exports were only 84 percent of imports, although in addition an unrecorded quantity of copper was exported in manufactures, such as electrical machinery. In 1933, 1934, and 1935, however, a more normal relation recurred, exports being 20, 47, and 20 percent, respectively, greater than imports.

Imports.—Total imports of unmanufactured copper into the United States in 1935 were 514,364,526 pounds, an increase of 88 million pounds (21 percent) over 1934 but a decrease of 47 percent from the record imports of 1929.

The increase in imports in 1935 was all due to larger shipments of ores, blister, and other unrefined copper which more than offset a marked decrease in imports of refined copper, chiefly from Chile. Large increases in shipments of blister copper from Canada, Chile, Peru, and Yugoslavia were partly offset by smaller tonnages from Africa and Mexico, but total imports of this class increased 28 percent. Imports of copper in the form of ore, concentrates, matte, etc., increased 29 percent.

Imports of scrap brass totaled 195 tons in 1935 compared with 243 tons in 1934 and 7,031 in 1929.

Copper (unmanufactured) imported into the United States, 1935, 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				499,777		
Other South		362,703				
Mozambique	41,106	3,851,985		2,489,815		
Australia	160,312	2,487,892	60,801			8,079
Canada	18,873	16,890,519	2,601,916	68,720,124	634	654,571
Chile	5,908,796	9,309,124	30,836	115,169,168	36,141,787	17,456
Cuba	30,900	11,600,000				
France			424,831	666,954		
Germany			343,882	120,784		1,081
Mexico	1,081,420	878,957	12,596	91,800,508		249,955
Peru	938,390	1,024,511	53,238	72,479,362		7,020
Spain			110,006			
United Kingdom			570,647	640,749	250	
Venezuela						92,429
Yugoslavia				43,361,766		
Other	7,140,931	13,989,934	1,257,731	346		59,074
Total	15,320,728	60,395,625	5,466,484	395,949,353	36,142,671	1,089,665

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

Copper (unmanufactured) imported into the United States, 1930–35, in pounds

1930	817,154,236	1933	287,433,540
1931	585,892,098	1934	[1] 426,571,568
1932	391,991,342	1935	[1] 514,364,526

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

Exports.—Exports of copper of all classes totaled nearly 606,000,000 pounds in 1935, a decrease of 20,000,000 pounds (3 percent) over 1934 and 46 percent from 1928. The large decrease from 1934 was due largely to smaller shipments of unrefined copper to France and Italy.

Our export trade in copper in 1935 was featured by large increases in shipments to Italy and the United Kingdom and marked falling off in purchases by France and Germany. Japan, Belgium, Sweden, and the Netherlands continued as large customers. The following table shows copper exports to the principal importers of United States copper during the past 6 years.

Copper exported from the United States (all forms), by principal countries of destination, 1930–35, in millions of pounds

Country	1930	1931	1932	1933	1934	1935
Belgium	36	36	18	33	27	31
Canada	44	19	2	1	1	1
France	148	120	75	104	131	65
Germany	110	97	50	44	83	65
India (British)	8	6	2	2	12	12
Italy	81	44	49	30	55	91
Japan	5	3	3	36	119	110
Netherlands	39	32	13	15	27	21
Sweden	31	29	16	12	29	25
U. S. S. R. (Russia)	15	9				
United Kingdom	175	124	73	29	84	110
Others	61	39	27	43	57	75
Total	753	558	328	349	625	606

Copper exported from the United States, 1935, 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						
Belgium	1,065,725	25,739,883	3,695,895	822,818	16,543	----------	240	57,207	
Canada	----------	208,394	377,001	1,303	263,565	225,929	35,024	234,028	
China	----------	3,485,214	150	----------	4,093	2,700	265,824	233,955	
Denmark	----------	4,462,249	----------	----------	7,044	----------	----------	14,052	
France	----------	64,345,561	506,796	550,347	9,541	61,964	----------	11,353	
Germany	3,245,438	49,832,842	----------	11,701,869	----------	46,483	----------	344	
India (British)	----------	2,469,955	3,442,426	23,922	2,692	5,681,398	123,144	415,381	
Italy	----------	90,493,875	33,600	13,331	432	5,769		3,636	(1)
Japan	----------	106,265,391	20,341	3,243,049	139	2,282	----------	28,440	
Netherlands	----------	16,715,953	3,448,505	440,509	22,294	4,300	----------	32,283	
Norway	----------	1,966,048	5,985,087	----------	5,703	----------	----------	3,437	
Spain	----------	22,603	----------	1,539,527	7,757	----------	----------	28,393	
Sweden	----------	25,148,229	400	4,034	4,114	----------	1,173	39,011	
United Kingdom	448,282	109,043,443	67,258	382,469	17,955	18,707	3,360	25,189	
Other	10,590,499	21,271,317	10,963,904	359,839	854,181	1,127,035	2,726,117	8,626,558	
	15,349,944	521,470,957	28,541,363	19,083,017	1,216,053	7,176,567	3,154,882	9,753,267	(1)
Total value	$1,078,583	$40,258,179	$2,522,394	$1,291,401	$245,042	$723,600	$327,006	$1,917,098	$570,061

[1] Figures for quantity not recorded.

Copper [1] exported from the United States, 1930–35

Year	Pounds		Total value	Year	Pounds		Total value
	Metallic [2]	Total			Metallic [2]	Total	
1930	753, 114, 927	753, 294, 022	$104, 316, 175	1933	303, 825, 790	349, 253, 716	$24, 639, 027
1931	557, 574, 235	557, 873, 744	54, 230, 992	1934	592, 718, 891	625, 485, 074	49, 263, 566
1932	295, 356, 719	328, 222, 700	20, 998, 816	1935	590, 396, 106	605, 746, 050	48, 363, 303

[1] Exclusive of "Other copper manufactures" valued at $1, 025,875 in 1930, $516,818 in 1931, $237,004 in 1932, $278,229 in 1933, $500,974 in 1934, and $570,061 in 1935; 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 sulphate (blue vitriol) exported from the United States, 1930–35

Year	Pounds	Value	Year	Pounds	Value
1930	5, 061, 554	$252, 614	1933	2, 749, 299	$92, 964
1931	7, 190, 919	276, 575	1934	3, 858, 629	128, 756
1932	4, 132, 529	114, 579	1935	4, 508, 271	142, 467

Brass and bronze exported from the United States, 1934–35

	1934		1935	
	Pounds	Value	Pounds	Value
Ingots	77, 172	$8, 562	202, 302	$17, 979
Scrap and old	60, 392, 875	3, 286, 523	59, 584, 959	3, 299, 546
Bars and rods	1, 250, 412	209, 147	1, 582, 491	250, 682
Plates and sheets	527, 721	109, 976	544, 560	114, 020
Pipes and tubes	708, 036	142, 729	995, 106	188, 379
Pipe fittings and valves	1, 283, 821	720, 212	1, 435, 895	818, 042
Plumber's brass goods	600, 089	306, 236	752, 526	384, 776
Wire of brass or bronze	416, 808	98, 745	375, 053	96, 853
Brass wood screws	(1)	21, 218	(1)	20, 258
Hinges and butts of brass or bronze	(1)	26, 494	(1)	37, 832
Other hardware of brass or bronze	(1)	234, 503	(1)	265, 680
Other brass and bronze manufactures	(1)	1, 057, 569	(1)	1, 144, 016
		6, 221, 914		6, 638, 063

[1] Weight not recorded.

Unmanufactured brass exported from the United States, 1930–35

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

Year	Pounds	Value	Year	Pounds	Value
1930	6, 575, 452	$1, 230, 558	1933	1, 164, 709	$180, 155
1931	3, 896, 002	525, 170	1934	1, 855, 305	327, 685
1932	1, 843, 358	242, 167	1935	2, 329, 353	382, 681

WORLD ASPECTS OF COPPER INDUSTRY

International cooperation.—With the collapse of Copper Exporters, Inc., in 1932, international cooperation in the copper industry ended. During 1933 and part of 1934 several attempts were made to establish some measure of control, but all failed. However, by the latter part of 1934 the foreign copper situation had become so chaotic and the London prices had declined so sharply that the need for cooperative action became imperative. Accordingly, negotiations between foreign producers were resumed, and at a conference in New York in March 1935, an agreement was consummated. The official public statement of the conference (reproduced in full in Minerals Yearbook, 1935) stated that the agreement pertained only to the industry outside of the United States and that it provided for control of production, exchange of statistical data, and uniform trade practices. Unofficially it was reported in the press that exports of copper from the United States were limited to 8,000 tons per month and that Canadian producers of byproduct copper were to keep their output at a minimum commensurate with the demand for their other products. On April 8, 1936, it was announced in London that the agreement had been renewed, under the same general terms and conditions, until July 1, 1938.

World smelter production.—World smelter production of copper in 1935 increased 13 percent over 1934 but was 21 percent below the record output in 1929. Smelter production in the United States from domestic and foreign ores increased 51 percent over 1934, whereas that of the rest of the world increased only 5 percent. Curtailment of foreign production under the international agreement did not begin until May 1. As the rate of production in the first part of 1935 was much higher than the average for 1934 most countries produced more in 1935 despite the reduction in the last half of the year. The United States made considerably more progress in 1935 than the rest of the world; but compared with predepression levels it was still far behind, the 1935 domestic output being 62 percent less than that of 1929, whereas foreign production was 24 percent more. The better showing of foreign copper in this comparison is due primarily to the large increases in production in Canada and Northern Rhodesia.

The principal producers and the percentage of the total output each contributed in 1935 were as follows: United States 25.2, Chile 17.3, Canada 11.7, Northern Rhodesia 9.6, Belgian Congo 7.2, Japan 4.6, and U. S. S. R. (Russia) 4.4. All these countries except Belgian Congo produced more copper in 1935 than in 1934, the largest increases being in the United States, Canada, and Chile. The United States produced 25 percent of the world total in 1935 compared with 19 percent in 1934 and 52 percent in 1929.

World smelter production of copper, 1931–35, in metric tons

[Compiled by M. T. Latus]

Country [1]	1931	1932	1933	1934	1935
North America:					
Canada [2]	110,588	95,710	118,109	151,818	175,893
Mexico	43,738	[3] 34,000	39,600	47,100	[3] 42,100
United States [4]	537,175	278,997	227,223	251,225	378,626
	691,501	408,707	384,932	450,143	596,619
South America:					
Chile	215,715	97,517	157,232	247,721	259,800
Peru	45,381	22,531	24,679	28,033	30,387
	261,096	120,048	181,911	275,754	290,187
Europe:					
Austria	3,235	1,987	1,000	597	(5)
Belgium [6]	31,400	26,950	35,360	61,100	(5)
Czechoslovakia	1,215	936	779	633	(5)
France	1,000	995	710	1,000	(5)
Germany [7]	55,500	50,900	49,800	53,000	56,000
Italy	721	427	120	303	(5)
Norway	4,352	5,416	6,694	7,989	(5)
Rumania [9]	(10)	109	453	202	(5)
Spain	25,734	15,555	17,268	13,777	(5)
Sweden [11]	2,854	3,138	6,638	7,854	(5)
United Kingdom [8]	16,000	13,000	11,300	11,380	(5)
U. S. S. R. (Russia) [12]	40,600	46,600	45,300	53,600	66,000
Yugoslavia	24,351	30,159	40,318	44,390	43,000
	[12] 206,962	[12] 196,172	[12] 215,740	[12] 255,825	(5)
Asia:					
China [13]	157	16	36	(10)	(5)
Chosen	698	694	785	1,434	(5)
India, British	4,134	4,514	4,900	6,400	7,000
Japan	75,848	71,877	69,033	67,002	69,407
U. S. S. R. (Russia) [12]	(12)	(12)	(12)	(12)	(5)
	[12] 80,837	[12] 77,101	[12] 74,754	[12] 74,836	(5)
Africa:					
Belgian Congo	[2] 120,000	[2] 54,000	66,596	110,085	108,000
Rhodesia:					
Northern	9,070	68,977	105,877	140,110	143,911
Southern	538	6			
Union of South Africa	10,225	9,387	8,378	8,328	11,633
	139,833	132,370	180,851	258,523	263,544
Oceania: Australia	13,144	13,521	11,418	8,098	(5)
	1,393,000	948,000	1,050,000	1,323,000	[14] 1,500,000

[1] In addition to the countries listed, copper is smelted in Turkey, but data of output are not available.
[2] Copper content of blister produced.
[3] Approximate production.
[4] Smelter output from domestic and foreign ores, exclusive of scrap. The production from domestic ores only, exclusive of scrap, was as follows: 1931, 472,963 tons; 1932,246,757 tons; 1933,204,115 tons; 1934, 221,558 tons; 1935, 345,902 tons.
[5] Data not available.
[6] 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.
[7] Exclusive of material from scrap. (Metallgesellschaft, Stat. Zusammenstell.)
[8] Approximate production. (Imp. Inst., London.)
[9] Smelter output from ores.
[10] Less than 1 ton.
[11] Exclusive of material from scrap.
[12] Output from U. S. S. R. in Asia included under U. S. S. R. in Europe. Figures probably include secondary material.
[13] Exports of ingots and slabs.
[14] Approximate production, based on the output of the countries shown, which in 1934 contributed nearly 91 percent of the total world output.

World mine production.—Statistics of mine production are of interest, as they show the original sources of the world's supply of copper more accurately than do statistics of smelter output. The following table, which shows mine production during the past 5 years, is compiled largely from official data, many of which are not yet available for 1935.

World mine production of copper, 1931–35, in metric tons

[Compiled by M. T. Latus]

Country	1931	1932	1933	1934	1935
North America:					
Canada	132,586	112,345	136,069	165,452	190,451
Cuba	13,507	5,927	8,957	6,192	6,960
Mexico	54,212	35,213	39,825	44,268	39,373
Newfoundland	1,459	2,153	3,162	3,859	2,956
United States	479,785	216,010	172,948	215,369	346,806
	681,549	371,648	360,961	435,140	586,546
South America:					
Bolivia [1]	2,049	2,017	1,849	1,622	1,913
Chile	223,513	103,173	163,395	254,863	(2)
Peru	44,753	22,890	24,874	27,735	29,889
Venezuela	746	----------	----------	----------	(2)
	271,061	128,080	190,118	284,220	(2)
Europe:					
Austria	1,313	171	133	83	(2)
Bulgaria	[3] 1,000	2	----------	4	(2)
Czechoslovakia	1,252	----------	----------	----------	(2)
Finland	6,396	6,649	11,362	10,123	(2)
France	337	435	226	[3] 200	(2)
Germany	29,827	30,741	29,434	25,970	(2)
Greece	----------	----------	2	(2)	(2)
Hungary	167	278	315	228	(2)
Italy	438	381	329	394	(2)
Norway	8,708	16,944	19,879	21,122	(2)
Portugal [3]	3,000	2,000	2,000	2,000	2,000
Rumania [4]	(5)	109	453	202	(2)
Spain	54,000	35,000	44,000	30,000	(2)
Sweden	1,634	4,309	6,871	5,099	(2)
U. S. S. R. (Russia)	[6] 31,100	[6] 32,000	[6] 32,700	[6] 44,100	(2)
United Kingdom	67	62	41	14	(2)
Yugoslavia	28,562	18,946	35,304	43,000	(2)
	[6] 167,801	[6] 148,027	[6] 183,000	[6] 183,000	(2)
Asia:					
China [7]	157	16	36	(5)	(2)
Cyprus	3,900	3,300	4,300	5,100	(2)
India, British	11,600	11,400	10,900	11,700	(2)
Japan:					
Japan proper [4]	75,848	71,877	69,033	67,002	69,407
Chosen [4]	698	694	785	1,434	(2)
Taiwan	4,117	4,417	[3] 4,000	[3] 4,000	(2)
U. S. S. R. (Russia)	(6)	(6)	(6)	(6)	(2)
	[6] 96,320	[6] 91,704	[6] 89,054	[6] 89,236	(2)
Africa:					
Algeria	----------	18	17	140	(2)
Belgian Congo [4]	[8] 120,000	[8] 54,000	66,596	110,085	108,000
French Equatorial Africa	80	150	(2)	(2)	(2)
French West Africa	200	(2)	(2)	(2)	(2)
Morocco, French	----------	----------	(5)	(2)	(2)
Rhodesia:					
Northern	32,923	88,639	131,500	160,128	(2)
Southern [4]	538	6	----------	----------	(2)
South-West Africa [9]	8,400	2,400	----------	----------	----------
Union of South Africa	10,206	9,403	8,383	7,862	10,726
	172,347	155,000	207,000	278,000	(2)
Oceania:					
Australia	13,749	14,893	14,644	12,205	(2)
	1,403,000	909,000	1,045,000	1,282,000	(2)

[1] Copper content of exports.
[2] Data not available.
[3] Approximate production.
[4] Smelter product.
[5] Less than one-half ton.
[6] Output from U. S. S. R. in Asia included under U. S. S. R. in Europe.
[7] Exports of ingots and slabs.
[8] Fine copper content of smelter output.
[9] Year ended Mar. 31 of year following that stated.

World consumption.—World consumption of copper in 1935 is estimated by the American Bureau of Metal Statistics at 1,628,900 metric tons, an increase of 20 percent over 1934; it was only 14 percent below the record year 1929. According to this authority, consumption in the United States increased 39 percent in 1935, whereas that of the rest of the world increased only 12 percent. Nevertheless, the quantity of copper used in the United States in 1935 was 48 percent less than in 1929, whereas that used by the rest of the world set a new record and exceeded the 1929 total by 27 percent.

The principal consumers in 1935 and the proportion of the total each consumed were as follows: United States 32 percent, Great Britain 15, Germany 13, Japan 8, France 6, U. S. S. R. (Russia) 6, and Italy 5. The consumption of all of these countries except Germany increased substantially in 1935.

REVIEW BY COUNTRIES

Belgian Congo.—Union Minière decreased its copper production from 110,000 metric tons in 1934 to 108,000 tons in 1935 as a result of the international agreement. The company quota was established at 84,000 tons per year compared with an annual capacity of 200,000 tons. A new 700-ton-per-day concentrator at Kipushi was completed during 1935.

Canada.—Smelter production of copper increased 16 percent over 1934 and was the largest ever recorded. Mine production amounted to 210,000 short tons, of which 194,000 were converted into blister copper or anodes, 10,000 exported in ore and matte, and 6,000 exported in nickel-copper matte. Of the 1935 mine output, Ontario contributed 60 percent, Quebec 19 percent, British Columbia 9 percent, Manitoba 9 percent, and Saskatchewan 3 percent. British Columbia was the only Province that decreased production in 1935. All the Ontario output is derived from the nickel-copper ores of the Sudbury district. International Nickel increased its output of refined copper at its Copper Cliff plant from 95,600 to 110,000 tons and in addition shipped larger quantities of blister to the United States for refining. The company intends to increase its milling and smelting capacity 40 percent during 1936 and has inaugurated a research program to find new uses for copper. The Quebec output is derived largely from Noranda, which increased its production from 35,100 to 37,200 tons. The production of Manitoba and Saskatchewan comes entirely from the Flin Flon mine, which lies on the boundary of the two Provinces. Production of this property in 1935 was 24,500 tons compared with 18,700 tons in 1934. The decline in British Columbia production in 1935 was due to cessation of operations at the Anyox property of the Granby Consolidated Mining, Smelting & Power Co. At the close of the year the property and smelter at Anyox were acquired by the Consolidated Mining & Smelting Co. of Canada, Ltd. This company announced that if enough ore could be obtained to warrant operation of the smelter it would be restored and put in commission. A copper smelter on Pacific tidewater has always been an objective of the company. The Britannia mine on Howe Sound operated on a curtailed basis of 500 tons of copper per month.

Canada exports a large part of its copper. In 1935, shipments included 19,000 tons of copper in ore, matte, etc., 37,000 tons in blister, 122,000 tons of refined, and 18,000 tons of rolled products. The United States was the principal recipient of the ore, matte, and blister. The United Kingdom took 68 percent of the refined copper.

Chile.—Copper production was increased 5 percent in 1935. During the first quarter of the year the rate of production exceeded 300,000 metric tons per annum, but following the copper agreement in March it was reduced to approximately 218,000 tons. Braden decreased its output from 115,100 tons in 1934 to 101,600 in 1935. Chile increased from 97,700 to 119,700 tons and Andes from 24,200 to 26,000 tons. Exports of copper from Chile increased from 239,000 to 260,000 tons; 89,000 tons came to the United States in 1935, and most of the balance went to Europe. Japanese interests are now purchasing considerable quantities of copper ore and concentrates for shipment to Japanese smelters.

Cuba.—Nearly 181,000 short tons of ore containing an average of 4.41 percent copper, from which 27,600 tons of 27.78 percent concentrates were obtained, were treated in 1935. The concentrates are exported to the United States.

France.—France ranks fifth in copper consumption, having used 105,600 metric tons or 6 percent of the world total in 1935, an increase of 17 percent over the quantity used in 1934. France produces very little copper, so domestic requirements are purchased abroad. In 1935, imports of unmanufactured copper totaled 105,000 tons compared with 93,700 tons in 1935. Of the 1935 total, 26,000 tons were unrefined and 79,000 tons refined. It was reported that the Government had concluded an agreement with Chilean producers whereby a stock of 30,000 tons of copper would be maintained in France.

Germany.—Apparent consumption of copper in Germany declined from 221,000 to 208,000 metric tons and reflected the substitution of aluminum and iron alloys that is being forced by the Government. Domestic deposits are unable to meet German copper requirements so that large imports are needed. In view of the stringent foreign credit in recent years the Government has issued drastic regulations restricting the use and importation of copper. During 1935 imports of metal were curtailed from 180,000 to 153,000 tons, whereas purchases of foreign ores and scrap were increased, respectively, from 325,000 to 401,000 tons and from 14,000 to 20,000 tons. The domestic mining industry supplied only 26,000 tons of copper in 1934, most of which was derived from the Mansfeld mines. These mines are operated at a loss, which is made good by the Government.

Japan.—Japan formerly was self-sufficient with respect to its copper requirements, but due to the increased demand of the munitions industry in recent years imports have increased from less than 300 metric tons in 1932 to over 65,000 in 1935. The latter figure represents an increase of 38 percent over 1934. Japan began importing considerable quantities of copper ore from Chile in 1935. The Government of Manchukuo has provided 1,500,000 yuan for the erection of a smelter with capacity to treat 80,000 tons of copper ore per year.

Mexico.—Labor troubles affected the copper production adversely in 1935. Boleo decreased its output from 8,200 to 7,865 metric tons. Cananea (Anaconda) produced only 19,100 tons in 1935 compared with 27,400 in 1934. The property was shut down 3 months early in 1936 as a result of a strike. The Moctezuma mine (Phelps Dodge) has been idle since 1932.

Peru.—Cerro de Pasco produced 29,020 metric tons of copper in 1935 compared with 27,213 in 1934. This company was a party to the copper agreement on special terms not requiring reduction in output, according to press reports. Silver production was increased from 7,028,000 to 11,892,000 ounces, the increase being derived from silver-pyrite ores in order to maintain copper production at a reasonably low level.

Northern Rhodesia.—Copper production again broke all previous records, but the relatively small increase in 1935 was due to curtailment of production resulting from the copper agreement in March.

During the year ended June 30, 1935, Rhokana produced 69,234 long tons of copper at a cost of £22.2 per ton, including all charges except depreciation and debenture interest. Virtually all the ore came from the Nkana mine, and the average grade for the year was 3.78 percent. First shipment of refined copper from the new electrolytic refinery at Nkana was made in March 1935. Development of the Mindola mine and other construction designed to increase the company production capacity to 107,000 tons per annum was continued throughout the year.

Roan Antelope produced 67,316 tons of copper in the 12 months ended June 30, 1935. The average cost was £19.6 per long ton, including all charges except depreciation and debenture interest. The average grade of ore mined was 3.24 percent. The riot of the native laborers in May was investigated by the Government, but no report had been issued by the end of the year. Production was not interrupted.

Mufulira produced 20,723 tons of blister copper at an average cost, exclusive of debenture interest and depreciation, of £27.3 per long ton during the year ended June 30, 1935. The average grade of ore mined was 6.3 percent and all of it came from the Mufulira mine. Concentrates formerly smelted by Rhokana will be treated by Roan Antelope at cost during the period of curtailment under the copper agreement. Mufulira's new smelter was to be completed by the end of 1935. Upon completion of construction now under way production capacity will be 75,000 tons per annum.

Under the international copper agreement, annual production quotas subsequent to June 1, 1935, were established at 50,400 tons for Rhokana and Roan Antelope and 27,972 tons for Mufulira.

R. J. Parker and Anton Gray in the February (1935) issue of the Bulletin of the Institution of Mining and Metallurgy give the following summary of copper reserves of Northern Rhodesia.

Area:	*Ore reserves, short tons*	*Average percent Cu.*
Nchanga and extensions	143, 780, 000	4. 66
Nkana	127, 000, 000	4. 00
Mufulira	116, 000, 000	4. 41
Roan Antelope	108, 000, 000	3. 44
Chambishi	25, 000, 000	3. 46
Baluba	21, 000, 000	3. 47
Kansanshi	10, 925, 000	4. 34
Total	551, 705, 000	4. 11

In commenting on the above table the authors state that one of the significant features is that none of the deposits has been entirely developed; consequently the tonnages shown represent only a part of what will eventually be mined, and other deposits which do not outcrop may be found in the future.

U. S. S. R. (Russia).—Russian copper consumption increased 67 percent in 1935. This was met by increasing domestic output from 53,600 to 66,000 metric tons and by raising imports from 11,600 to 29,600 tons. Development of new deposits and construction of additional smelting facilities indicate further expansion of production in 1936. Total copper reserves are now estimated at 17,500,000 tons of metal.

Yugoslavia.—Mines de Bor decreased its output from 44,370 metric tons in 1934 to 39,000 in 1935. The plant was closed down during May owing to difficulties with local peasants over smelting fumes. The capacity of the plant is being increased to 5,000 tons of copper per month. A large part of Yugoslav copper is refined in the United States.

LEAD

By Elmer W. Pehrson and H. M. Meyer

SUMMARY OUTLINE

The lead industry of the United States progressed substantially in 1935. For the first time since the depression began production of refined pig lead was held below deliveries to consumers, with a resultant decline in producers' stocks and a substantial increase in price. Total consumption of pig lead increased 11 percent, largely due to a better demand in the lead-pigments and storage-battery industries. Cable coverings and building gained somewhat in 1935 but were still at extremely low levels. As a considerable part of the increase in consumption was met by withdrawals from stocks and by larger output of secondary metal, production of primary refined metal increased only 4 percent. Mine production of lead increased 15 percent, indicating, that there was some increase in stocks of lead concentrates. Apparently higher gold and silver prices have affected lead production to a minor extent only, as the increase in mine output in the Western States, where the precious metal yield is most important, was less than in the other lead-producing areas. Stocks of refined lead at refineries decreased from 234,000 tons on January 1 to 222,000 tons on December 31, the latter amount representing a 6-month supply at the current rate of consumption.

The New York quotation rose from 3.70 cents per pound at the beginning of the year to 4.50 cents at the close. The average for 1935 was 4.06 cents compared with 3.86 cents in 1934 and 6.83 cents in 1929.

Outside the United States consumption increased only 3 percent, production (smelter basis) increased 7 percent, and evidently there was a decrease in stocks of refined metal, although reliable data on this point are not available. The London quotation for lead averaged 3.12 cents per pound (United States exchange basis) compared with 2.46 cents in the previous year. The differential between New York and London thus fell from 1.4 cents in 1934 to 0.9 cent in 1935.

Foreign lead producers met in London in July; and while no formal cartel was organized, it was reported in the press that some of the producers agreed informally not to increase production without due notice to one another. On August 27 the British import duty on lead was reduced from about 32 shillings (10 percent ad valorem), to 7½ shillings per long ton.

The recovery in the lead industry outside the United States is in striking contrast to the recovery in the domestic industry. In 1935 consumption of lead in the United States equaled only 53 percent of the 1929 total, whereas elsewhere in the world it exceeded the 1929 level by 4 percent. Likewise, domestic production was only 46 percent of the 1929 total, while foreign production was 96 percent.

Salient statistics of the lead industry in the United States, 1925–29 and 1931–35

	1925–29 average	1931	1932	1933	1934	1935
Production of refined primary lead:						
From domestic ores______short tons__	660, 525	390, 260	255, 337	259, 616	299, 841	310, 505
From foreign ores and base bullion short tons__	123, 104	52, 504	33, 024	13, 963	11, 395	14, 055
	783, 629	442, 764	288, 361	273, 579	311, 236	324, 560
Recovery of secondary lead:						
As pig lead____________________do____	126, 600	128, 800	128, 000	131, 800	124, 500	156, 800
In alloys______________________do____	153, 400	105, 900	70, 300	92, 700	83, 900	113, 600
	280, 000	234, 700	198, 300	224, 500	208, 400	270, 400
Total production of pig lead (primary and secondary)________________short tons__	910, 229	571, 564	416, 361	405, 379	435, 736	481, 360
Imports: [1]						
Lead in base bullion___________do____	95, 747	32, 320	13, 462	1, 587	[1] 2, 450	[1] 2, 692
Lead in ore____________________do____	40, 096	20, 888	21, 001	5, 958	[1] 10, 611	[1] 20, 025
Exports of refined pig lead_________do____	98, 048	21, 665	23, 516	22, 831	5, 906	6, 976
Refined primary lead available for consumption__________________short tons__	677, 322	410, 606	257, 669	244, 349	298, 141	309, 911
Estimated consumption of primary and secondary lead_____________short tons__	900, 250	567, 700	416, 200	452, 700	491, 300	543, 200
Prices:						
New York:						
Average for year cents per pound__	7. 47	4. 24	3. 18	3. 87	3. 86	4. 06
Quotation at end of year___do____	6. 25	3. 75	3. 00	4. 15	3. 70	4. 50
London average_______________do____	5. 87	2. 64	1. 86	2. 21	2. 46	3. 12
Mine production of recoverable lead short tons__	664, 230	404, 622	292, 968	272, 677	287, 432	[2] 331, 720
World smelter production of lead__do____	1, 850, 000	1, 528, 000	1, 287, 000	1, 282, 000	1, 452, 000	[3] 1,550,000

[1] Data for 1934 and 1935 include lead imported for immediate consumption plus material entering the country under bond.
[2] Subject to revision.
[3] Approximate production.

N. R. A.—The code of fair competition established on June 4, 1934, became inoperative when the Supreme Court declared the enabling act unconstitutional on May 27, 1935. The uncertainty following this action was responsible for a sharp decline in domestic shipments, which was reflected in increased stocks and falling prices. This proved to be temporary, however, for by the end of August all of the losses had been regained.

Lead reserves and capacity for production.—Kenneth Leith and Donald M. Liddell, in a report on the Mineral Reserves of the United States and Its Capacity for Production prepared for the Planning Committee for Mineral Policy, state:

The measured and published lead-ore reserves show a total of 3,302,158 short tons of metallic lead. Finlay [1] says of the four most important districts—Southeastern Missouri, the Coeur d'Alenes, the Tri-State field, and Utah, "I believe it is difficult to see how all these districts can produce more than about 8,000,000 tons more. The amount actually in sight can hardly be half that much. It is equally difficult to see how the whole country can produce more than 10,000,000 tons. * * *"

The projection of a curve of apparent consumption of domestic primary lead indicates a normal demand of the order of 500,000 tons per year. On the basis of Finlay's estimate of outside probabilities, this would indicate 16 years of life remaining. On the basis of lead definitely in sight, 3,300,000 tons, the life would only be a little more than 6 years.

This time of exhaustion may and probably will be prolonged, but the fact remains that our reserves are not large and we will probably have a deficiency of this metal within this or the next generation. * * *.

The United States' lead-smelting capacity (annual) is now apparently equivalent to about 4,000,000 tons of ore and concentrates, and its refining capacity is about 895,000 tons of metal.

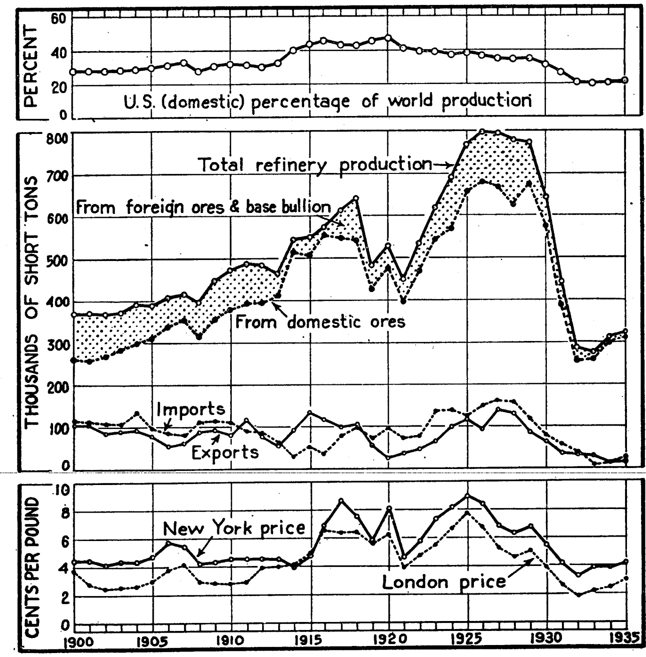

FIGURE 59.—Trends in the lead industry in the United States, 1900–1935. Imports include lead in ore base bullion, and refined lead; exports include refined lead and lead exported in manufactures with benefit of draw-back.

Reciprocal trade agreements.—Trade agreements concluded up to the end of 1935 include the following changes in United States import duties on lead products:

White lead.—Duty reduced from 2.5 cents per pound to 2.1 cents, effective May 1, 1935.

Suboxide of lead.—Duty changed from 30 percent ad valorem to "3 cents per pound, but not less than 15 percent nor more than 30 percent ad valorem."

[1] Finlay, J. R., Mining and Metallurgical Society of America, Bull. 229, April 1934, p. 45.

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 shows the production from each of these sources from 1926 to 1935.

Total pig lead produced in the United States, 1926–35, short tons

Year	From domestic ores and base bullion	From foreign ores and base bullion	From secondary materials	Total
1926	680, 685	118, 256	125, 000	923, 941
1927	668, 320	128, 210	119, 000	915, 530
1928	626, 202	154, 869	138, 000	919, 071
1929	672, 498	102, 135	138, 500	913, 133
1930	573, 740	69, 293	129, 000	772, 033
1931	390, 260	52, 504	128, 800	571, 564
1932	255, 337	33, 024	128, 000	416, 361
1933	259, 616	13, 963	131, 800	405, 379
1934	299, 841	11, 395	124, 500	435, 736
1935	310, 505	14, 055	156, 800	481, 360

PRIMARY LEAD

Refinery production.—Production of refined primary lead in 1935 increased 4 percent and was equivalent to the normal production at the close of the nineteenth century. Production from foreign ores and base bullion increased 23 percent but was equivalent to only 14 percent of the 1929 output; it accounted for only 4 percent of the total refined primary lead output. Lead derived from domestic ores increased less than 4 percent in 1935.

Refined primary lead produced in the United States, 1929–35

Year	Production (short tons)				Sources (short tons)			Value	
	Desilverized lead [1] [2]	Desilverized soft lead	Soft lead [2]	Total production [1]	From domestic ores and base bullion	From foreign ores	From foreign base bullion	Average per pound	Total
1929	483, 622	55, 666	235, 345	774, 633	672, 498	29, 675	72, 460	$0. 063	$97, 604, 000
1930	396, 094	45, 578	201, 361	643, 033	573, 740	34, 348	34, 945	. 050	64, 303, 000
1931	263, 919	40, 456	138, 389	442, 764	390, 260	22, 254	30, 250	. 037	32, 765, 000
1932	189, 707	35, 524	63, 130	288, 361	255, 337	21, 747	11, 277	. 030	17, 302, 000
1933	165, 791	22, 210	85, 578	273, 579	259, 616	7, 677	6, 286	. 037	20, 245, 000
1934	186, 468	22, 744	102, 024	311, 236	299, 841	10, 241	1, 154	. 037	23, 031, 000
1935	192, 544	35, 233	96, 783	324, 560	310, 505	13, 659	396	. 040	25, 965, 000

[1] The lead content of antimonial lead is excluded (see p. 142).
[2] Desilverized soft lead is excluded.

Source of primary lead.—Of the total refined lead produced in 1935, 95.7 percent was derived from domestic ores, 4.2 percent from foreign ores, and 0.1 percent from foreign base bullion. Production from foreign ores increased 33 percent in 1935 owing to greater tonnages received from Mexico. The production of refined lead from foreign base bullion decreased 66 percent in 1935. In 1928, over 128,000 tons of foreign bullion were refined in the United States; in 1935 less than 400 tons were treated. Details of the sources of lead derived from domestic ores are given in the section on mine production.

Refined primary lead produced in the United States, 1929–35, by sources, in short tons

Source	1929	1930	1931	1932	1933	1934	1935
Domestic ore	672,498	573,740	390,260	255,337	259,616	299,841	310,505
Foreign ore:							
Australia	5	3		30		115	
Canada	9,499	14,369	3,816	3,797	3,472	2,514	1,039
Europe	28	41	43	4,491	2,600	45	1,086
Mexico	16,807	14,949	6,420	334	257	1,011	5,809
South America	3,285	3,476	2,299	2,631	1,348	4,028	2,872
Other foreign	51	1,510	9,676	10,464		2,528	2,853
	29,675	34,348	22,254	21,747	7,677	10,241	13,659
Foreign base bullion:							
Mexico	51,295	18,592	30,072	11,164	6,021	703	396
South America	21,165	16,353	178	113	265	451	
	72,460	34,945	30,250	11,277	6,286	1,154	396
Total foreign	102,135	69,293	52,504	33,024	13,963	11,395	14,055
Grand total	774,633	643,033	442,764	288,361	273,579	311,236	324,560

Soft lead.—Nonargentiferous lead ores of high purity, from which soft lead can be produced without elaborate refining processes, are known as soft-lead ores. Most of the soft-lead ores produced in the United States are smelted into pig lead, but a substantial quantity is used each year in the manufacture of lead pigments, principally sublimed lead and leaded zinc oxide. Usually about one-fifth of the pig lead produced from soft-lead ores is desilverized and used largely in the manufacture of white lead where high purity is required.

Soft lead produced in the United States from domestic ores, 1929–35, in short tons

Year	Soft pig lead			Soft lead recovered in pigments	Total soft lead	Total domestic lead [1]	Soft lead percentage of domestic lead
	Undesilverized	Desilverized	Total				
1929	235,345	55,666	291,011	9,429	300,440	696,678	43
1930	201,361	45,578	246,939	6,686	253,625	588,042	43
1931	138,389	40,456	178,845	5,722	184,567	399,610	46
1932	63,130	35,524	98,654	4,932	103,586	263,846	39
1933	85,578	22,210	107,788	6,875	114,663	270,649	42
1934	102,024	22,744	124,768	7,538	132,306	313,280	42
1935	96,783	35,233	132,016	12,109	144,125	327,299	44

[1] Includes domestic refined lead, domestic lead in antimonial lead, and domestic lead in pigments. Domestic lead in antimonial lead computed on different basis beginning with 1931. (See following table.)

Antimonial lead.—Antimonial lead or hard lead is an important byproduct of the refining of base bullion, but the amount derived from this source is only a small part of the country's yearly production. The major part is derived 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 on Secondary Metals. 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, 1929–35

Year	Production (short tons)				Antimony content		Lead content by difference (short tons)			
	From domestic ore	From foreign ore	From scrap	Total	Short tons	Percentage	From domestic ore	From foreign ore	From scrap	Total
1929	17,062	8,607	17,575	43,244	4,935	11.4	(1)	(1)	(1)	38,309
1930	8,918	4,793	11,086	24,797	2,967	12.0	(1)	(1)	(1)	21,830
1931	(2)	(2)	(2)	21,842	2,438	11.2	3,628	1,603	14,173	19,404
1932	(2)	(2)	(2)	21,024	2,495	11.9	3,577	1,466	13,486	18,529
1933	(2)	(2)	(2)	17,805	1,720	9.7	4,158	791	11,136	16,085
1934	(2)	(2)	(2)	16,607	2,263	13.6	5,901	330	8,113	14,344
1935	(2)	(2)	(2)	16,384	1,729	10.6	4,685	491	9,479	14,655

[1] Not recorded.
[2] Segregation discontinued.

SECONDARY LEAD

Recovery of secondary lead increased 30 percent in 1935 and was the highest recorded since 1929. Since the output of domestic refined primary lead was only 4 percent higher, the ratio of secondary to primary lead production was the highest on record—87 percent. The increase in output of secondary lead may be ascribed in part to the large number of automobiles scrapped in 1935. Automobile storage batteries are one of the principal sources of scrap lead. Higher lead prices probably induced some liquidation of stocks of scrap accumulated during the depression.

Secondary lead recovered in the United States, 1929–35

[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)
1929	65,359	73,141	138,500	172,500	311,000	$39,186,000	46
1930	48,135	80,865	129,000	126,800	255,800	25,580,000	45
1931	43,774	85,026	128,800	105,900	234,700	17,367,800	60
1932	33,611	94,389	128,000	70,300	198,300	11,898,000	78
1933	41,632	90,168	131,800	92,700	224,500	16,613,000	86
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

LEAD PIGMENTS

Lead pigments manufactured in 1935 contained 197,404 tons of lead from the sources shown in the following table. Of this total about 185,151 tons were derived from refined pig lead, of which white lead accounted for 45 percent, litharge 40 percent, red lead 14 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] 1929–35, by sources, in short tons

Year	Lead in pigments from—				Year	Lead in pigments from—			
	Domestic ore [2]	Metal	Scrap	Total		Domestic ore [2]	Metal	Scrap	Total
1929	9,429	248,657	2,427	260,513	1933	6,875	143,027	56	149,958
1930	6,686	190,182	689	197,557	1934	7,538	157,294	379	165,211
1931	5,722	166,328	710	172,760	1935	12,109	185,151	144	197,404
1932	4,932	127,318	262	132,512					

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

MINE PRODUCTION

Mine production of recoverable lead in 1935 was nearly 332,000 tons, an increase of 15 percent over 1934; it was 50 percent below the average for 1925 to 1929. Production in the Western States increased 14 percent, in the Central States 16 percent, and in the Eastern States 37 percent.

Compared with the 5-year average for 1925–29, production in 1935 was as follows: Western States 52 percent, Central States 46 percent, and Eastern States about 122 percent. Missouri continued to rank first in production and increased 8 percent in output. Idaho ranked second and Utah third, with increases of 11 and 9 percent, respectively. These three States contributed 72 percent of the total output in 1935. All of the other important lead-producing States except New Mexico produced more lead in 1935 than in 1934. The southeastern Missouri district produced 96,941 tons of lead in 1935 and the tri-State district (Joplin), 36,100 tons.

Mine production of recoverable lead in the United States, 1925–35, in short tons

State	1925–29 average	1930	1931	1932	1933	1934	1935
Western States and Alaska:							
Alaska	982	1,365	1,661	1,261	1,157	840	[1] 726
Arizona	9,743	4,246	982	1,182	1,721	3,439	[1] 7,784
California	2,070	1,780	1,879	1,209	381	412	[1] 825
Colorado	30,112	22,130	6,884	2,150	2,402	4,218	5,673
Idaho	141,610	134,058	99,365	72,118	74,363	71,324	[1] 79,036
Montana	18,871	10,653	4,430	1,079	6,582	10,005	[1] 15,612
Nevada	9,807	11,529	7,930	440	2,303	10,991	[1] 12,652
New Mexico	6,730	10,378	11,269	10,114	11,043	9,365	7,289
Oregon	6	5	2	4	5	21	30
South Dakota	21	----------	----------	4	----------	----------	4
Texas	213	198	----------	17	3	360	522
Utah	149,509	115,495	79,212	62,776	58,688	58,077	[1] 63,507
Washington	1,323	576	1,386	921	840	291	[1] 103
Wyoming	----------	----------	----------	5	----------	1	3
	370,997	312,413	215,000	153,280	159,488	169,344	[1] 193,766
Central States:							
Arkansas	38	53	78	4	10	40	38
Illinois	552	248	205	31	240	40	436
Kansas	26,121	12,910	7,082	6,490	6,089	6,805	[1] 11,000
Kentucky	135	101	----------	----------	176	104	132
Missouri	202,240	199,632	160,121	117,159	84,980	90,493	[1] 97,580
Oklahoma	58,306	23,052	13,210	10,634	18,038	16,747	[1] 23,500
Wisconsin	1,745	1,537	952	910	540	234	286
	289,137	237,533	181,648	135,228	110,073	114,463	[1] 132,972
Eastern States:							
New York	----------						
Tennessee } Virginia }	4,096	8,367	7,974	4,460	3,116	3,625	4,982
	4,096	8,367	7,974	4,460	3,116	3,625	4,982
	664,230	558,313	404,622	292,968	272,677	287,432	[1] 331,720

[1] Subject to revision.

Mine production of recoverable lead in the principal lead-producing districts of the United States, 1929–35, in short tons

District	State	1929	1930	1931	1932	1933	1934	1935
Southeastern Missouri region	Missouri	197, 435	198, 622	158, 950	116, 152	83, 970	89, 580	[1] 96, 941
Coeur d'Alene region	Idaho	141, 558	129, 311	97, 771	71, 505	73, 926	70, 331	[1] 78, 314
Bingham	Utah	49, 447	42, 586	33, 597	32, 640	33, 030	32, 420	[1] 36, 293
Joplin region	Kansas, Missouri, Oklahoma.	74, 143	36, 972	21, 463	18, 131	25, 137	24, 465	[1] 36, 100
Park City region	Utah	42, 570	30, 875	17, 368	12, 653	11, 557	12, 360	[1] 13, 180
Tintic	do	44, 113	29, 474	18, 427	9, 842	6, 433	5, 715	[1] 5, 833
Willow Creek	New Mexico	5, 720	5, 431	7, 563	6, 449	7, 075	6, 143	5, 162
Rush Valley	Utah	11, 751	10, 157	8, 773	7, 222	6, 916	5, 594	(2)
Butte	Montana	8, 239	2, 540	-------	1	4, 185	5, 391	(2)
Pioche	Nevada	2, 986	4, 868	2, 892	(3)	(3)	4, 644	(2)
Central	New Mexico	3, 766	3, 936	3, 420	3, 521	3, 408	2, 846	(2)
Eagle	Montana	-------	1, 287	3, 489	771	1, 521	2, 560	(2)
San Juan Mountains	Colorado	17, 386	11, 722	908	792	906	1, 651	2, 428
Oro Blanco	Arizona	(3)	(3)	-------	-------	-------	1, 676	(2)
Ophir	Utah	25	18	(3)	2	87	1, 349	(2)
Leadville	Colorado	5, 172	6, 808	1, 470	76	505	524	1, 288
Pend d'Oreille	Idaho	863	956	1, 020	576	309	318	(2)
Upper Mississippi Valley	Iowa, northern Illinois, Wisconsin.	1, 536	1, 537	952	910	540	234	286
Inyo County	California	670	1, 711	1, 765	1, 102	301	277	(2)
Metaline	Washington	328	267	1, 257	682	722	237	(2)
Eagle County	Colorado	198	2, 821	3, 816	221	8	52	155
Banner	Arizona	2, 938	929	-------	-------	385	77	(2)
Bisbee (Warren)	do	1, 020	151	252	431	(3)	64	(2)
Warm Springs	Idaho	1, 507	1, 793	37	-------	21	8	(2)
Cedar Plains	Montana	1, 177	120	25	2	1	2	(2)
Barker	do	6, 137	4, 578	21	-------	28	-------	(2)
Dome	Idaho	1, 870	829	-------	1	-------	-------	(2)
Tybo	Nevada	1, 991	3, 622	4, 083	-------	(3)	(3)	(2)
San Francisco	Utah	691	1, 883	436	-------	-------	-------	(2)
Austinville [4]	Virginia	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Jack Rabbit [4]	Nevada	2, 430	1, 464	240	(3)	(3)	(3)	(3)
St. Lawrence County [4]	New York	-------	(3)	(3)	(3)	(3)	(3)	(3)

1 Subject to revision.
2 Data not yet available.
3 Bureau of Mines not at liberty to publish figures.
4 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 most of the refiners of secondary material that 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, 1929–35, in short tons

	1929	1930	1931	1932	1933	1934	1935
Refined pig lead	41, 726	95, 524	147, 466	164, 722	191, 624	223, 593	215, 595
Antimonial lead	9, 350	7, 723	4, 187	11, 435	11, 437	10, 437	6, 711
	51, 076	103, 247	151, 653	176, 157	203, 061	234, 030	222, 306
Lead in base bullion:							
At smelters and refineries	8, 313	8, 171	12, 952	13, 911	12, 786	6, 045	15, 072
In transit to refineries	7, 116	4, 261	2, 971	1, 302	2, 191	1, 528	1, 860
In process at refineries	16, 089	14, 368	10, 228	10, 720	10, 403	11, 567	16, 233
	31, 518	26, 800	26, 151	25, 933	25, 380	19, 140	33, 165
Lead in ore and matte and in process at smelters	28, 299	28, 697	40, 185	61, 206	67, 263	60, 699	58, 562
	110, 893	158, 744	217, 989	263, 296	295, 704	313, 869	314, 033

From 1929 to 1934 stocks of refined lead increased steadily, but in 1935 the trend was reversed; nevertheless, at the close of 1935 stocks were 5.2 times larger than at the close of 1929. Combined stocks of refined and antimonial lead on December 31, 1935, were equivalent to a 6-month supply at the average rate of consumption in 1935. Stocks of base bullion on hand and in process increased 14,000 tons during the year.

Available data on stocks of lead held outside of the United States at the close of 1935 vary considerably. The Consolidated Mining & Smelting Co. of Canada, Ltd., in its annual report for 1935, states that world stocks of lead declined from 525,000 short tons at the beginning of the year to 510,000 tons at the close. Since the United States stocks of refined and antimonial lead declined from 234,000 to 222,000 tons, stocks outside of the United States apparently declined only from 291,000 to 288,000 tons. A year ago the British Metal Corporation estimated stocks outside the United States at the beginning of 1935 to be 286,000 tons, but in its annual review for 1935 the company states that it is unable to give an estimate of foreign stocks at the close of 1935. However, this authority believes that there was considerable reduction during the year. This opinion is substantiated by the Metal Bulletin, which, in its October 4 issue, gives an unofficial estimate of 150,000 long tons (168,000 short tons) for stocks outside the United States at that time.

DOMESTIC CONSUMPTION

New supply.—The following table shows the refined primary lead available for consumption from 1929 to 1935. The computation does not take into account variations in producers' stocks, and as these have changed considerably during the past 7 years the quantitites shown do not indicate the true trend of the actual consumption of new lead. The supply available for consumption in 1935 was 4 percent greater than in 1934 but was equivalent to only 45 percent of that in 1929. Total consumption of lead advanced 11 percent in 1935, but much of the increased demand was supplied by secondary metal.

Refined primary pig lead available for consumption in the United States, 1929 and 1931–35, in short tons

	1929	1931	1932	1933	1934	1935
Supply:						
Stock in bonded warehouse Jan. 1	4,139	(1)	(1)	(1)	(1)	(1)
Imports of pigs, bars, and old	1,658	10	44	109	283	1,322
Production	774,633	442,764	288,361	273,579	311,236	324,560
	780,430	442,774	288,405	273,688	311,519	325,882
Withdrawn:						
Exports:						
Pig lead	73,251	21,665	23,516	22,831	5,906	6,976
In manufactures, with benefit of drawback	13,086	10,503	7,220	6,508	7,472	8,995
Stock in bonded warehouse Dec. 31	1,328	(1)	(1)	(1)	(1)	(1)
	87,665	32,168	30,736	29,339	13,378	15,971
Supply available for consumption	692,765	410,606	257,669	244,349	298,141	309,911

1 Stocks of pigs, bars, etc., in bonded warehouse included with base bullion. (See table on p. 149.)

Consumption by uses.—Owing to the large return of secondary lead from lead-consuming industries, the total consumption of pig lead greatly exceeds the supply of new lead avilable. The following table gives the American Bureau of Metal Statistics estimate of the total consumption of lead by industries during the past 7 years.

Lead consumed in the United States,[1] in 1929–35, in short tons

Purpose	1929	1930	1931	1932	1933	1934	1935
White lead	119,700	83,900	77,500	54,500	59,100	64,500	80,000
Red lead and litharge	30,000	32,000	18,000	32,000	38,000	42,000	47,500
Storage batteries	210,000	163,000	157,000	138,000	147,000	163,000	175,000
Cable covering	220,000	208,000	117,000	55,000	31,000	34,100	37,800
Building	96,000	67,000	40,000	22,000	26,000	30,000	32,000
Automobiles	18,000	11,000	6,000	3,500	5,000	7,300	10,000
Railway equipment	5,700	5,200	1,000	300	200	1,100	500
Shipbuilding	300	500	400	200	100	200	200
Ammunition	41,100	33,300	29,700	23,300	32,300	34,800	29,200
Terneplate	4,200	2,700	2,200	1,400	2,500	2,600	4,700
Foil	39,800	26,000	20,000	14,000	22,500	16,200	15,900
Bearing metal	33,000	20,000	12,000	10,000	15,000	16,500	17,400
Solder	37,000	27,000	20,500	14,000	16,000	16,000	20,000
Type metal	18,000	16,000	14,400	10,800	11,000	13,000	15,000
Calking	31,500	21,000	15,000	10,000	12,000	10,000	12,000
Castings	18,000	12,000	7,000	5,000	5,000	5,000	5,000
Other uses	50,000	40,000	30,000	22,200	30,000	35,000	41,000
	972,300	768,600	567,700	416,200	452,700	491,300	543,200

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

The total industrial use of lead increased 11 percent in 1935 but was still 44 percent below the 1929 record. Exceptionally good gains were made in lead consumed as white lead and the red oxides, but the use of lead in cable covering and for building continued to lag, while lead consumption in the manufacture of ammunition and foil declined sharply. The amount of lead used to manufacture cable covering was notably less than in any other major use of lead and was only 17 percent of the amount used in 1929. Improvement in this outlet for lead is contingent upon stabilization of the Government's policy with respect to public utilities. Only one-third as much lead was used for building in 1935 as in 1929. While construction increased in 1935, most of it was residential and affected chiefly white lead. A revival of factory construction would benefit this market greatly.

PRICES

The two major markets for lead in the United States are New York and St. Louis; a large part 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, normally 0.35 cent a pound.

The price of lead in 1935 was higher than in 1934. The average New York quotation was 4.06 cents per pound compared with 3.86 cents in 1934; it was 41 percent below the 1929 average of 6.83 cents. Early in 1935 the price was 3.70 cents. This quotation was maintained until the latter part of January, when a temporary decline in sales sent the price down to 3.50 cents early in February—the low for the year. Notwithstanding a dull market in March, which resulted in an increase in stocks, the price moved up to 3.65 cents by the end of the month. From then until the latter part of May it rose steadily to 4.35 cents, supported by brisk domestic demand and a rapidly rising London market. The uncertainty following the Supreme Court decision against N. R. A. on May 27 was reflected in a sharp drop in lead purchases which, in turn, caused pressure to be felt in selling. By June 6 the price had fallen to 4 cents. That condition was temporary, however, and during the last half of the year the demand for lead improved. The price rose steadily to a high for the year of 4.65 cents early in October and then settled to 4.50 cents, at which point it was maintained for the rest of the year.

The London quotation for 1935 (United States exchange basis) averaged 3.12 cents per pound—0.9 cent below the New York average compared with 1.4 cents in 1934. The agreement of foreign lead producers in July not to increase production without due notice to each other, the settlement of the dispute on British import duties in August, the threatened curtailment of supplies from Mexico owing to the shut-down of one of the large smelters on account of strikes, and the high rate of consumption in Europe all contributed to the relatively higher rise in prices abroad.

Average monthly and yearly quoted prices of lead at St. Louis, New York, and London, 1933–35, in cents per pound [1]

Month	1933			1934			1935		
	St. Louis	New York	London	St. Louis	New York	London	St. Louis	New York	London
January	2.87½	3.00	1.57	3.90	4.00	2.55	3.54	3.69	2.25
February	2.87½	3.00	1.59	3.90	4.00	2.61	3.38	3.53	2.22
March	3.03	3.15	1.63	3.90	4.00	2.63	3.43	3.58	2.35
April	3.13	3.27	1.74	4.05	4.18	2.65	3.54	3.69	2.64
May	3.52	3.65	2.12	3.99	4.14	2.52	3.81	3.96	3.02
June	4.02	4.17	2.45	3.82	3.98	2.49	3.87	4.02	3.03
July	4.30	4.45	2.78	3.63	3.77	2.43	3.97	4.12	3.20
August	4.35	4.50	2.45	3.60	3.75	2.45	4.10	4.25	3.50
September	4.35	4.50	2.49	3.54	3.69	2.32	4.26	4.41	3.58
October	4.18	4.32	2.46	3.51	3.66	2.28	4.36	4.51	3.99
November	4.14	4.29	2.65	3.42	3.57	2.32	4.35	4.50	3.94
December	4.04	4.14	2.61	3.45	3.60	2.28	4.35	4.50	3.70
Average	3.74	3.87	[2] 2.21	3.73	3.86	[2] 2.46	3.91	4.06	[2] 3.12

[1] St. Louis: Metal Statistics, 1936, p. 387. 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, 1936, p. 390. 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: 1933, £11.6708; 1934, £10.9333; 1935, £14.2375.

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 refined lead or in manufactured products. Since 1927, however, this trade has declined. In 1935 only 24,039 tons of lead in ore and base bullion (including a

[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.

small amount of refined and scrap lead) were imported compared with 161,389 tons in 1927; exports of refined lead decreased from 125,267 to 6,976 tons. During the same period lead exported in manufactures with benefit of draw-back declined from 12,004 to 8,995 tons.

Imports.—Total imports of lead in ore and matte, including imports for immediate consumption and entries for warehouse, increased 89 percent in 1935 due to increased shipments from Mexico and Newfoundland. Imports of base bullion increased 10 percent; imports of refined lead, which for several years amounted to only a few hundred tons, increased to 1,322 tons as a result of shipments from the new refinery at Peru. Total imports of lead increased 80 percent but were equivalent to less than 21 percent of the 1929 total.

Total lead imported into the United States, 1929–35, by classes, in short tons [1]

Year	Lead in ore and matte	Lead in base bullion	Pigs, bars, sheets, and old	Total lead content
1929	31,331	83,071	1,657	116,059
1930	39,377	38,630	209	78,216
1931	20,888	32,320	[2] 10	53,218
1932	21,001	13,462	44	34,507
1933	5,958	1,587	109	7,654
1934	10,611	2,450	283	13,344
1935	20,025	2,692	1,322	24,039

[1] Data for 1934 and 1935 include lead imported for immediate consumption plus material entering the country under bond.
[2] Reclaimed scrap, etc. No imports of pigs, bars, etc., were recorded for 1931.

Total lead imported into the United States, in ore, base bullion, and refined, 1929–35, by sources, in short tons [1]

Year	Canada	Mexico	Newfoundland	South America	Europe	Other countries	Total
1929	4,512	87,936		23,526	14	71	116,059
1930	17,268	36,721		22,472	113	1,642	78,216
1931	2,618	38,706	9,708	2,171		15	53,218
1932	2,459	13,545	10,598	2,811	5,053	41	34,507
1933	1,629	2,154		1,485	2,368	18	7,654
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

[1] Data for 1934 and 1935 include lead imported for immediate consumption plus material entering the country under bond.

Total lead imported into the United States, in ore and matte, 1929–35, by countries in short tons [1]

Country	1929	1930	1931	1932	1933	1934	1935
Canada	3,953	17,257	2,614	2,459	1,629	902	58
Chile	2,295	3,313	1,866	2,211	651	1,443	1,102
Mexico	23,415	16,341	6,495	195	862	1,283	7,986
Newfoundland and Labrador	(2)		9,708	10,598		3,357	6,818
Peru	1,601	831	194	477	522	3,545	3,716
Sweden				5,024	2,292		
Other countries	67	1,635	11	37	2	81	345
	31,331	39,377	20,888	21,001	5,958	10,611	20,025

[1] Data for 1934 and 1935 include lead in ore and matte imported for immediate consumption plus material entering the country under bond.
[2] Less than 1 ton.

Total lead imported into the United States, in base bullion, 1929–35, by countries, in short tons [1]

Country	1929	1930	1931	1932	1933	1934	1935
Mexico	63,458	20,350	32,210	13,340	1,281	1,987	1,746
Peru	19,605	18,280	110	121	306	463	784
Other countries	8			1			162
	83,071	38,630	32,320	13,462	1,587	2,450	2,692

[1] Data for 1934 and 1935 include lead in base bullion imported for immediate consumption plus material entering the country under bond.

Lead remaining in warehouses in the United States, Dec. 31, 1929–35, 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	Pigs, bars, sheets, and old	Year	Lead in ore and matte	Lead in base bullion	Pigs, bars, sheets, and old
1929	60,207	75,434	1,328	1933	21,540	[1] 1,058	(1)
1930	39,516	[1] 5,642	(1)	1934	15,709	[1] 606	(1)
1931	52,849	[1] 5,343	(1)	1935	22,598	[1] 2,173	(1)
1932	42,314	[1] 3,769	(1)				

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

Lead imported for consumption in the United States, 1929–35, by classes

Year	Lead in ore and matte [1]		Lead in base bullion		Pigs, bars, and old		Sheets, pipe, and shot		Not otherwise specified	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value		
1929	10,823	$1,160,533	6,198	$627,455	10,089	$1,052,087	450	$78,776	$126,966	$3,045,817
1930	15,458	1,461,350	10,423	1,127,920	571	60,493	454	78,737	87,612	2,816,112
1931	10,734	1,194,191	10,436	671,002	[2] 10	[2] 1,763	428	60,536	49,990	1,977,482
1932	9,647	863,135	2,574	131,579	44	2,031	543	53,510	14,848	1,065,103
1933	19,239	1,154,093	306	31,700	45	2,199	518	45,378	13,578	1,246,948
1934	10,760	558,558	2,220	117,729	285	10,678	286	35,130	12,940	735,035
1935	8,273	258,954	1,154	66,559	1,590	99,799	404	51,979	12,484	489,775

[1] Classification as follows: Jan. 1, 1929, to June 17, 1930, "Lead in ore and matte"; June 18, 1930, through 1935, "Lead in ores, flue dust, and mattes, n. s. p. f."
[2] Reclaimed scrap, etc. No imports of pigs, bars, etc., recorded for 1931.

Miscellaneous products containing lead imported for consumption in the United States, 1929–35

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
1929	1,505	663	$777,354	2,720	2,425	$180,679
1930	1,399	530	593,103	328	275	32,934
1931	906	310	436,574			
1932	498	191	143,662	6	5	479
1933	349	51	30,623	25	21	1,076
1934	709	102	71,505	112	94	6,784
1935	128	24	44,269	534	445	36,453

Exports.—Exports of refined lead increased 18 percent in 1935 but were equivalent to only 7 percent of the average from 1925 to 1929. The decline since 1929 has been due largely to the loss of markets in Japan and Europe, which have increased their purchases from Mexico, Canada, India, and Australia.

Foreign lead exported in manufactures with benefit of draw-back amounted to 8,995, an increase of 20 percent over 1934. About 33 percent of the 1935 total was contained in storage batteries exported. Other lead exports included litharge and red lead, 16 percent; white lead, 12 percent; sheets, pipes, solder, etc., 11 percent; and electrical apparatus, 9 percent.

Refined lead exported from the United States, 1929–35

Year	Pigs, bars, and old		Foreign lead exported in manufactures with benefit of drawback (short tons)	Year	Pigs, bars, and old		Foreign lead exported in manufactures with benefit of drawback (short tons)
	Short tons	Value			Short tons	Value	
1929	73,251	$7,178,337	13,086	1933	22,831	$832,984	6,508
1930	48,307	3,904,213	12,161	1934	5,906	304,581	7,472
1931	21,665	1,241,881	10,503	1935	6,976	471,542	8,995
1932	23,516	1,069,697	7,220				

Refined pig lead exported from the United States, 1929–35, by destinations, in short tons

Destination	1929	1930	1931	1932	1933	1934	1935
COUNTRY							
Argentina	599	934	226	------	113	(1)	------
Brazil	1,538	874	1,382	759	329	475	338
Canada	141	9	58	133	6	21	45
France	2,202	3,001	318	224	------	------	------
Germany	9,745	823	52	1,344	5	------	11
Japan	16,416	15,653	17,301	20,219	21,236	4,454	5,324
Mexico	83	40	171	13	5	21	38
Netherlands	1,522	22	13	112	------	4	188
Philippine Islands	111	543	400	475	360	169	217
Sweden	7,255	7,557	392	------	------	------	------
United Kingdom	23,732	9,157	3	------	------	36	8
Uruguay	448	364	145	84	140	------	112
Other	9,459	9,330	1,204	153	637	726	695
	73,251	48,307	21,665	23,516	22,831	5,906	6,976
CONTINENT							
North America	693	318	435	160	41	107	156
South America	3,852	2,442	1,903	863	732	1,076	663
Europe	50,649	27,899	795	1,793	5	40	212
Asia	18,055	17,289	18,524	20,700	21,693	4,512	5,945
Africa and Oceania	2	359	8	------	360	171	(1)
	73,251	48,307	21,665	23,516	22,831	5,906	6,976

[1] Less than 1 ton.

WORLD ASPECTS OF LEAD INDUSTRY

International cooperation.—During 1928 an association of foreign lead producers was formed in an attempt to stabilize the foreign lead market. At first activities were confined to mere exchange of statistical data, but later sales agreements and production-control measures were adopted. However, with the imposition of the British tariff on lead in March 1932, stabilization measures were abandoned, and during the latter part of 1934 the compilation of statistics also was discontinued. In July 1935, foreign lead producers met in London to consider reformation of a cartel. According to press reports, no formal organization was formed, but apparently some of the producers agreed informally not to increase production without due notice to each other.

World production.—World smelter production of lead increased 6 percent in 1935 and was equivalent to 78 percent of the record output in 1929. Production increased 5 percent over 1934 in the United States and 7 percent elsewhere. The domestic output amounted to only 46 percent of the 1929 total, whereas that of the rest of the world was 96 percent. The United States continued as the leading producer and contributed 21 percent of the 1935 total. The 10 other leading producing countries and the percentage of the world total each contributed in 1935 were as follows: Australia, 15.6; Mexico, 13.2; Canada, 10.6; Germany, 8.7; Belgium, probably between 5 and 6; India, 5.2; Spain, 4.5; U. S. S. R. (Russia), 3.2; Italy, 2.8; and Tunisia, 1.8. Of these, Australia, Mexico, Canada and Germany recorded moderate increases in 1935; India a small increase; and U. S. S. R. (Russia) an increase of two-thirds, whereas the production of Spain, Italy, and Tunisia declined substantially. Among the less-important producers, outstanding gains were made in Poland, the United Kingdom, and Peru. France's lead production amounted to only one-third of the 1934 output. Production in the British Empire was about 462,000 metric tons in 1935, an increase of 9 percent over 1934. The Empire's share of world output was 33 percent in 1935 compared with 22 percent from 1925 to 1929.

World production of lead, 1930–35, in metric tons [1]

[Compiled by R. B. Miller]

Country [2]	1930	1931	1932	1933	1934	1935
Argentina	8,882	7,609	3,481	2,799	5,000	(3)
Australia	171,248	152,850	189,347	208,558	199,151	218,089
Austria	6,935	6,117	1,986	4,626	5,629	(3)
Belgium	85,370	70,850	64,160	69,390	74,750	(3)
Canada	138,105	126,301	114,820	115,469	142,635	148,558
Chosen	130	97	453	784	1,806	(3)
Czechoslovakia	4,225	3,569	4,124	3,811	4,066	(3)
France	20,170	19,100	19,600	20,400	17,867	[4] 6,000
Germany [5]	110,800	101,300	95,216	116,600	119,980	122,328
Greece	7,329	6,707	6,482	8,205	8,899	(3)
Hungary	70	52	----	11	42	(3)
India (Burma)	81,010	75,985	72,345	73,201	72,968	73,218
Indochina	11	6	16	18	15	(3)
Italy	24,340	24,882	31,471	24,756	47,843	39,650
Japan	3,581	4,070	6,415	6,825	7,039	(3)
Mexico	242,537	210,427	137,099	118,460	165,416	184,193
Northern Rhodesia	----	----	----	75	187	185
Norway	[4] 300	347	435	365	333	(3)
Peru	14,979	252	327	497	1,998	7,660
Poland	40,900	31,380	11,902	12,065	10,350	18,819
Portugal	89	108	109	70	54	----
Rumania	984	1,314	1,938	4,082	4,382	4,800
South-West Africa [6]	3,661	2,641	1,044	408	----	----
Spain	123,263	109,630	105,370	88,354	72,151	62,742
Tunisia	19,400	19,112	14,082	14,873	27,311	24,835
Turkey	4,664	2,767	----	----	----	(3)
U. S. S. R. (Russia)	10,750	16,140	18,800	13,700	27,000	45,000
United Kingdom	10,383	10,723	7,100	5,600	9,100	22,100
United States (refined) [7]	551,645	374,224	251,365	242,483	281,300	294,075
Yugoslavia	10,049	7,929	8,321	6,336	9,803	(3)
	1,696,000	1,386,000	1,168,000	1,163,000	1,317,000	1,400,000

[1] By countries where smelted but not necessarily refined.
[2] In addition to the countries listed, China smelts lead, but no reliable data of output are available.
[3] Data not available.
[4] Approximate production.
[5] Exclusive of secondary material (Metallgesellschaft, Frankfurt).
[6] Year ended Mar. 31 of year following that stated.
[7] Figures cover domestic refined and lead refined from foreign ore; refined lead produced from foreign base bullion not included.

World consumption.—World consumption of lead in 1935 was estimated at 1,426,700 metric tons, an increase of 6 percent over 1934. The increase in the United States, after allowance for changes in stocks and including secondary and antimonial lead produced at primary refineries, was 17 percent compared with 3 percent elsewhere. Compared with predepression levels, however, foreign consumption was relatively much higher, as it actually exceeded the 1929 total by 4 percent, whereas the United States used 47 percent less. In Europe there was a marked decline in the use of lead in Belgium and France, while Germany, Italy, and the U. S. S. R. (Russia) recorded large increases. Consumption in the United Kingdom declined only slightly from the record of 1934. Japan also took less lead in 1935 than in 1934. The United States used 25 percent of the total amount consumed in 1935 and again ranked first in lead consumption after having yielded its premier position to the United Kingdom in 1934. The leading consumers, besides the United States, and the percentage of the total each absorbed in 1935 were as follows: United Kingdom 23, Germany 12, Japan 7, France 6, U. S. S. R. (Russia) 5, Italy 4, and Belgium 3.

REVIEW BY COUNTRIES

Australia.—A large increase in the production of lead at Port Pirie was offset partly by a substantial decline in production at Mount Isa. The former smelter treats concentrates from the Broken Hill district in New South Wales, and the latter handles the product of the Mount Isa mine in Queensland.

At Broken Hill 1,304,000 long tons of ore were raised, an increase of about 50,000 tons over 1934. Production of lead concentrates increased from 241,500 tons to 243,800 tons. All four principal producers operated in 1935. The large increase in production at Port Pirie indicates liquidation of stocks of ore accumulated in previous years.

Curtailment of lead bullion output at Mount Isa from 42,600 tons to 33,100 tons was due to changes in operation. Formerly, production had been maintained largely on lead-silver carbonate ore, but in 1935 the plant was modified to operate entirely on lead-zinc-silver sulphide ores. Production of zinc concentrates commenced in the latter part of the year.

Exports of pig lead from Australia increased from 182,000 tons to 189,000 tons, and shipments of ore and concentrates declined from 28,000 tons to 18,000 tons. Both metal and ore are sold chiefly in in the European market.

Belgium.—Refined-lead production in Belgium is derived from foreign ores and base bullion. In 1935, 85,000 metric tons of lead ores and nearly 23,000 tons of pig lead were imported. Yugoslavia, Sweden, Canada, South America, Newfoundland, and Australia were the principal sources of ore, and Mexico supplied most of the pig lead. Imports of ore were 12 percent less than in 1934 and imports of metal 11 percent more. About 45,000 tons of pig lead and 9,000 tons of lead in sheets, pipe, etc., were exported in 1935.

Canada.—Mine production of lead in Canada in 1935 was 169,500 short tons, a decrease of 2 percent from 1934. British Columbia supplied over 99 percent of the total. Quebec contributed about 1,000 tons. The principal source of lead in British Columbia is the

Sullivan mine of the Consolidated Mining & Smelting Co., Ltd. A total of 1,861,000 tons of ore was mined, an increase of 7 percent over 1934. Nearly 227,000 tons of lead concentrates were produced compared with 222,000 tons in the previous year. The ore treated in 1935 was lower grade than in 1934, but recoveries were well-maintained. Net costs were again reduced in 1935 but only on account of the greater revenue from silver; operating costs were higher. The company smelter at Trail is the only active lead smelter in Canada. The Base Metals Mining Corporation, Ltd., shipped less than 4,000 tons of lead concentrates in 1935 compared with nearly 12,000 tons in 1934. The property ceased producing during the latter part of the year owing to depletion of ore reserves. Higher lead prices resulted in the reopening of the Tetreault mine in Quebec and the Stirling mine in Nova Scotia.

One hundred and forty-one thousand five hundred tons of refined pig lead were exported, approximately the same as in 1934; the United Kingdom took 94,000 tons and Japan 35,000 tons. Shipments to the United Kingdom were 16 percent higher and to Japan 24 percent lower than in 1934. Exports of lead in the form of ore declined from 11,800 tons in 1934 to 5,700 tons in 1935, most of the latter going to Belgium.

France.—France ranks fifth in lead consumption and depends largely on foreign lead for its supply. In 1935 consumption was 87,000 metric tons, a decline of 25 percent from 1934. The domestic smelter output was only 6,000 tons compared with 18,000 tons in 1934. Imports of pig lead declined from 99,000 tons in 1934 to 82,000 tons in 1935. The principal sources in 1935 were Tunisia, 31 percent; Belgium and Mexico, 24 percent each; and Spain, 14 percent. Only 7,000 tons of lead ore were imported in 1935 compared with 26,000 tons in 1934; over 8,000 tons of ore were exported in 1935. Other lead exports were relatively unimportant.

The unsatisfactory condition of lead production in France and in the French colonies in recent years has provoked agitation for Government aid. From time to time various measures have been proposed and some tariffs established, but all proved inadequate. In May 1935, a law was passed establishing surtaxes on and requiring licenses for importation of nonargentiferous lead. In July the Government provided for the payment of a bounty to French producers. For the last quarter of 1935 the bounty was fixed at about 217 francs per ton of 70-percent lead concentrates. This measure stimulated production at some French mines during the latter part of the year. In November it was reported that the Coueron smelter, which had suspended operations early in the year, had reopened. Pennarroya has a smelter under construction at Noyelles-Godault.

Germany.—The apparent consumption of lead in Germany in 1935 was 172,000 metric tons compared with 160,000 tons in 1934. As the smelter output increased only slightly, net imports increased about 10,000 tons. Total imports of pig lead were 54,000 tons, of which Mexico supplied 30,000; 4,000 tons were exported. Imports of lead ore were slightly higher in 1935, amounting to 84,000 tons. Yugoslavia, Newfoundland, South America, and the United Kingdom were the principal sources. Nearly 9,000 tons of ore were exported to Poland. Foreign trade in lead and lead ores is subject to strict regulation, and the domestic industry is heavily subsidized by the

Government. A new concentrating plant under construction at Oker is expected to increase the mine output of lead by 37,000 tons annually.

India.—The Burma Corporation, Ltd., produced approximately 106,000 long tons of lead concentrates containing about 65 percent lead and 43 ounces of silver per ton compared with 97,600 tons in 1934. The output of refined lead was 70,560 tons, the same as in 1934; 1,500 tons of antimonial lead were produced in 1935 as well. Exports of refined and antimonial lead totaled 66,000 tons, of which United Kingdom took 41,000 and Japan 21,000 tons.

Italy.—Since 1921 Italy has endeavored to make itself independent of foreign sources of lead by imposing heavy import duties on metallic lead. Under this program the smelting industry has grown, so that in 1934 it supplied nearly 90 percent of domestic requirements. However, this required importation of large quantities of foreign lead ores, as the local mines were unable to meet the demands of the smelters. To stimulate domestic mining, a duty was placed on foreign ore in October 1934. Further protection was accorded early in 1935 by the prohibition of all imports of metallic lead and scrap except by special permit. That these measures were not entirely effective is indicated by the increase in imports of the metal from 2,800 tons for the first 9 months of 1934 to 19,800 tons for the same period in 1935. Imports of lead ore for the same periods were 28,900 tons and 17,700 tons, respectively. The decline in metal output in 1935 was due to the closing down of the La Spezia smelter following the imposition of the duty on imports of lead ore.

Japan.—Japan relies on imports for over 90 percent of its lead requirements. In 1935 imports amounted to 90,200 metric tons, a decrease of 5 percent from 1934. Of the 1935 total, Canada was credited with 31,500 tons, British India 20,400 tons, Australia 1,900 tons, and other countries 13,000 tons. Shipments from the United States were reported at 23,400 tons, but probably this was largely Mexican lead, as the United States reported exports to Japan of less than 5,000 tons. A new smelter at Anshan began production the latter part of the year. The ore supply will be obtained from a deposit in the Province of Jehol, China, said to contain 3,000,000 tons of 20-percent ore.

Mexico.—Production of lead again increased in 1935. The smelter output rose from 165,000 metric tons in 1934 to 184,000 tons in 1935, the latter being 24 percent below the record output of 1930. Formerly large quantities of Mexican lead bullion were shipped to the United States for refining, but recently this trade has declined to very small proportions due to extension of refining capacity in Mexico. In 1928 nearly 109,000 tons of Mexican bullion were imported by the United States, but in 1935 only 1,000 tons were brought in. Mexico now ships refined lead to Europe and Japan, the latter having taken large tonnages in 1934 and 1935. Some lead ore is exported, the United States having taken about 7,000 tons in 1935. During the year production was interrupted by frequent labor disputes. A strike closed the Chihuahua smelter of the American Smelting & Refining Co. from August to October, and many of the principal lead mines had similar experiences during the year.

Newfoundland.—Production of lead concentrates in 1935 was 48,100 short tons containing 30,800 tons of lead and 552,000 ounces of silver compared with 46,500 tons of concentrates containing 29,300 tons of lead and 536,000 ounces of silver in 1934. In addition, 146,000 tons of zinc concentrates containing 8,200 tons of lead were produced in 1935. During the fiscal year, ended June 30, 1935, 48,000 tons of lead concentrates were exported, of which Belgium took 40,000, Germany 3,000, and the United States 5,000 tons.

Peru.—Cerro de Pasco Copper Corporation completed a 30-ton-per-day pilot plant for the electrolytic refining of an impure lead bullion obtained from treating flue dusts recovered at its copper smelter. The plant uses a modified Betts process.

Spain.—Lead production declined again in 1935. Depletion of deposits and inability to compete in the world market with newer low-cost producers have caused serious declines in Spanish lead mining. The peak production of 232,000 metric tons was reached in 1912; since then the output has declined persistently. By 1928 production had fallen to 131,000 tons; there was a temporary rise in 1929, but during the depression the trend has been steadily downward. In 1935 only 68,000 tons were produced. Exports of pig lead declined from 57,000 tons in 1934 to 43,000 in 1935. Exports of lead concentrates, which in 1933 amounted to 11,000 tons, virtually have ceased.

The lead industry of Spain functions under a consortium, which is subject to strict Government regulations. For some time the activities of the consortium have been criticized severely on the grounds that the high prices maintained in the domestic market were affecting consumption adversely and that profitable producers were being taxed to maintain unprofitable ones. Early in 1935 it was reported that the Cortes would be asked to make drastic changes in the consortium, but apparently nothing was done. Later in the year a Government decree established heavy penalties for sales of lead in Spain other than through the consortium. It stated that clandestine sales had increased to such a degree that the earnings of the consortium were threatened.

Tunisia.—Most of the lead smelted in 1935 was derived from ores imported from Yugoslavia, Turkey, and Italy.

U. S. S. R. (Russia).—Notwithstanding the large increase in smelter output in 1935, Russian imports of lead increased from 19,000 to 31,000 tons, indicating an increase in consumption of from 46,000 tons in 1934 to 76,000 tons in 1935. Lead smelters are located at Tetiukhe, Alagir, Ridder, and Chimkent. At the latter a new electrolytic refinery began operations in December 1935.

United Kingdom.—Apparent consumption of pig lead was only slightly below the record level of 1934 and amounted to 327,000 long tons. Owing to the substantial increase in smelter output, net imports of pig lead declined from 304,000 tons to 290,000 tons, the latter figure resulting from imports of 317,000 tons and exports of 27,000 tons. Australia supplied 57 percent of the 1935 imports, Canada 27 percent, and India 13 percent. The domestic smelter output supplied about 7 percent of domestic needs. The British Metal Corporation, Ltd., estimates that 65 percent of the lead consumed in the United Kingdom is used in sheet, pipe, white lead, and oxide, 18 percent in cable, 7 percent in storage batteries, and 10 percent in miscellaneous products.

The increase in smelter output in 1935 was due to the first year's operation of the Mill Close smelter, which was completed late in 1934. This plant treats ores produced in the United Kingdom and formerly smelted on the continent. Production of 80-percent concentrates amounted to 53,000 tons, compared with 68,000 tons in 1934.

Effective August 27, 1935, the British import duty on non-British unwrought lead was revised from a flat 10-percent ad valorem to 7.5 shillings per long ton or 10 percent ad valorem, whichever is less.

Yugoslavia.—By far the largest producer of lead in Yugoslavia is Trepca Mines, Ltd., which in 1935 treated 593,000 tons of ore, from which were obtained 64,000 tons of 79-percent lead concentrates and 92,000 tons of 50-percent zinc concentrates. Further increase in Yugoslavia's output is expected, as Kopaonik Mines, which adjoins Trepca, is to be brought into production. Trepca is adding a fourth section to its mill to handle the ore. Early in 1935 a new smelter was completed at Kralyevo, Serbia, which has a daily capacity of 25 tons of lead. Most of the lead concentrates produced in Yugoslavia are exported chiefly to Belgium. During the last 2 years Tunisia has taken substantial tonnages, also. Early in 1936 it was reported that an American company was to begin working the Kucajna mine in the near future.

ZINC[1]

By Elmer W. Pehrson

SUMMARY OUTLINE

The domestic zinc industry in 1935 experienced the best year since 1930. The quantity of primary and secondary metal used was 28 percent more than in 1934 and equaled nearly three-fourths of the peak year 1929. This increase in demand reflected general improvement in industrial activity, particularly in automobiles and construction, and better conditions in the farm areas that contributed to larger sales of galvanized products. Smelter production of new and old zinc, although 21 percent higher, was restrained sufficiently to permit a substantial reduction in stocks from over 127,000 tons at the beginning of the year to less than 92,000 tons at the end of the year. The latter was only 2,200 tons more than the quantity on hand at the end of 1929. This marked improvement in the statistical position greatly strengthened the weak market prevailing at the beginning of the year. Following the precipitous decline during the latter part of 1934, the St. Louis quotation for prime western zinc rose from 3.72½ cents per pound on January 2, 1935, to 4.85 cents on December 31. The average for the year was 4.33 cents compared with 4.16 cents in 1934 and 6.49 cents in 1929. The London quotation also increased in 1935 but failed to keep pace with domestic trends, so that the differential between New York and London widened. In December it actually exceeded the domestic tariff on zinc. Imports of zinc for consumption in the United States were considerably higher in 1935, the larger part having been brought in during the latter half of the year.

All major out lets for zinc made substantial gains in 1935. Galvanizing and brassmaking took the largest tonnages since 1930, and rolled zinc production was the highest since 1929. The use of zinc in

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

die castings exceeded all records, due largely to wider adoption in automobile manufacture. Although the automobile industry at present is the principal consumer of zinc die castings, the number of novelties, household wares, and mechanical devices being made from this material is increasing rapidly, not only providing expanding markets for zinc die castings in the near future but also tending to cushion

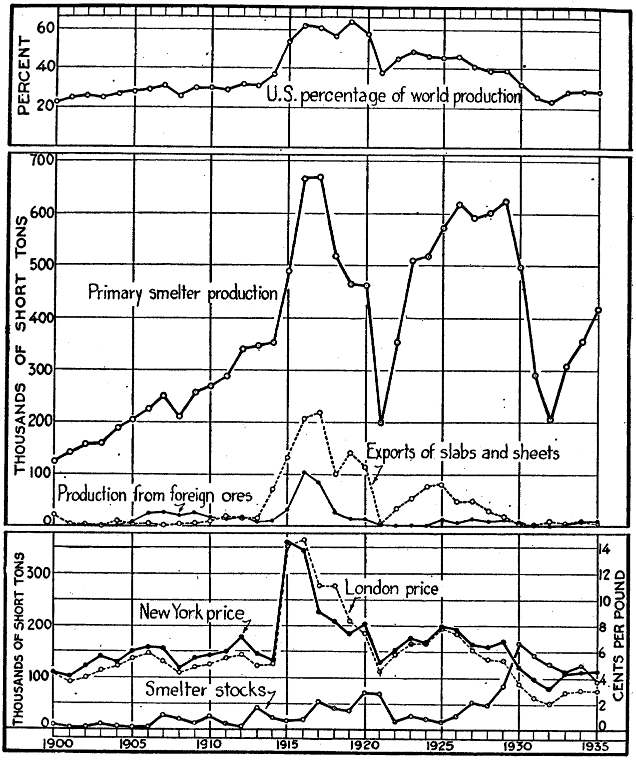

FIGURE 60.—Trends in the zinc industry in the United States, 1900–1935. Imports of slab and sheet zinc are not shown, as they seldom exceed 500 tons annually. In the last few years, however, there has been an increase, and in 1935 they amounted to about 4,500 tons.

the effects of style changes in automobile manufacture, which may cause such parts as the present popular radiator grilles to become obsolete.

In the foreign market the statistical position of the metal made progress, although not so pronounced as in the United States. Production of primary zinc increased only 10 percent abroad compared with 16 percent at home; consumption increased 11 percent elsewhere compared with 32 percent in the United States. Foreign stocks again declined in 1935. There was a substantial rise in the London quotation during the first 10 months of the year, but a sharp recession in the last 2 months was due to selling pressure on the London Metal Exchange by foreign producers. The import duty on zinc in the United Kingdom was decreased from over 30s. per long ton (10 percent ad valorem) to 12½s. on August 27, 1935. At the close of the year British smelting interests were asking for either an increase in the duty or for an agreement with foreign producers guaranteeing British producers a market in the United Kingdom for their output. Efforts to revive the European Cartel were unsuccessful.

Salient statistics of the zinc industry in the United States, 1925–35

	1925–29 average	1930	1931	1932	1933	1934	1935
Production of primary slab zinc:							
From domestic ores........short tons..	589,648	489,361	291,996	207,148	306,010	355,366	412,184
From foreign ores.................do....	12,734	8,684	....	....	1,172	8,224	8,450
	602,382	498,045	291,996	207,148	307,182	363,590	420,634
Electrolytic..............percent of total..	21	26	28	11	29	21	28
Distilled..............................do....	79	74	72	89	71	79	72
Production of secondary slab zinc..short tons..	65,380	49,300	34,800	20,000	48,100	29,300	55,400
Stocks on hand at primary smelters Dec. 31 short tons..	45,575	167,293	143,592	128,192	110,487	124,783	90,539
Primary zinc available for consumption..do....	544,016	408,469	312,592	213,280	321,789	340,529	450,794
Price—prime western at St. Louis:							
Average for year........cents per pound..	6.76	4.56	3.64	2.88	4.03	4.16	4.33
Highest quotation..................do....	8.90	5.45	4.12½	3.50	5.00	4.40	4.95
Lowest quotation..................do....	5.40	3.95	3.12½	2.30	2.55	3.67½	3.70
Price—yearly average at London........do....	6.46	3.60	2.52	2.12	2.96	3.07	3.08
Mine production of recoverable zinc short tons..	724,720	595,425	410,318	285,231	384,280	438,726	[1] 518,373
Tri-State district (Joplin) percent of total..	49	36	29	34	36	35	37
Western States.....................do....	30	33	30	25	29	29	31
Other..................................do....	21	31	41	41	35	36	32
World smelter production of zinc..short tons..	1,435,000	1,537,000	1,099,000	862,000	1,089,000	1,294,000	1,445,000

[1] Subject to revision.

N. R. A.—A Code of Fair Competition for the Zinc Industry was approved on March 26, 1935. The enabling act was invalidated by the Supreme Court on May 27. The uncertainty following the Supreme Court's decision caused a temporary recession in the demand for zinc, which resulted in a rise in stocks and a fall in prices, but by the latter part of August all of the loss had been regained.

Zinc reserves and capacity for production.—Kenneth Leith and Donald M. Liddell, in a report entitled "Mineral Reserves of the United States and Its Capacity for Production," prepared for the Planning Committee for Mineral Policy, state that the measured and estimated reserves of zinc in the important mines total over 12,000,000 short tons of metal, equivalent to about a 20-year supply with consumption at normal rates. This reserve is available at prices ranging from 4 to 6 cents. Smelting capacity is estimated at 940,000 tons of metal per annum, which is said to exceed the country's needs for some time to come.

Reciprocal trade agreements.—The United States import duty on lithopone containing less than 30 percent zinc sulphide was reduced from 1¾ to 1½ cents per pound, effective February 1, 1936. This was the only change in tariffs on zinc products contained in trade agreements concluded by the end of 1935.

DOMESTIC PRODUCTION

Production of primary and secondary slab zinc.—Production of primary slab zinc from domestic and foreign ores in 1935 was 16 percent higher than in 1934 and was equivalent to 70 percent of the average output for the 5-year period 1925–29. It exceeded the depression low established in 1932 by 103 percent. Of the total output in 1935, 98 percent was derived from domestic ore and 2 percent from foreign ore. Production of secondary slab zinc increased 89 percent from 1934 and was equivalent to 85 percent of the predepression 5-year average.

The following table shows the production of primary and secondary slab zinc during the past 10 years.

Primary and secondary slab zinc produced in the United States, 1926–35

Year	Primary (short tons)			Secondary (short tons)			Total
	Domestic	Foreign [1]	Total	Redistilled	Remelted	Total	Short tons
1926	611,991	6,431	618,422	40,799	23,771	64,570	682,992
1927	576,960	15,556	592,516	42,784	22,016	64,800	657,316
1928	591,525	11,056	602,581	48,666	22,034	70,700	673,281
1929	612,136	13,311	625,447	47,348	18,052	65,400	690,847
1930	489,361	8,684	498,045	[2] 34,849	14,451	49,300	547,345
1931	291,996	----------	291,996	[2] 21,625	13,175	34,800	326,796
1932	207,148	----------	207,148	14,718	5,282	20,000	227,148
1933	306,010	1,172	307,182	30,087	18,013	48,100	355,282
1934	355,366	8,224	363,590	19,691	9,609	29,300	392,890
1935	412,184	8,450	420,634	28,650	26,750	55,400	476,034

[1] Since 1926 all foreign zinc smelted in the United States has been derived from Mexican ores.
[2] Includes 22 tons of secondary electrolytic zinc in 1930 and 312 tons in 1931.

The term "primary zinc," as used herein, refers only to zinc produced from ores or from the immediate byproducts of primary reduction operations. Some of this zinc soon returns to the smelter in the form of galvanizers' drosses, ashes, and scrap metal to be reworked into slab zinc. There is, therefore, duplication in the table of production shown above, inasmuch as the same metal may be counted as production two or more times in a single year. Although much secondary zinc enters the market indistinguishable from ordinary primary zinc and becomes part of the supply of zinc available to consumers, nevertheless it is deemed advisable to maintain a segregation of primary and secondary zinc; otherwise the long-time record of production might include metal that is constantly reworked.

Distilled and electrolytic zinc.—Of the total output of primary zinc in 1935, 72 percent was distilled and 28 percent electrolytic. Production of distilled zinc increased 5 percent in 1935, while that of electrolytic zinc increased 55 percent. The relatively larger percentage increase in electrolytic zinc production was due to the abnormally low rate of production in 1934. The Great Falls (Mont.) plant, which was shut down during part of 1934 as a result of labor troubles, operated continuously in 1935. Production of redistilled secondary zinc increased 45 percent, most of the increase being in the output at primary smelters.

The production of primary and secondary electrolytic and distilled zinc, apportioned by method of reduction and by grades, is given in the following table.

Distilled and electrolytic zinc, primary and secondary, produced in the United States, 1929–35, in short tons

APPORTIONED ACCORDING TO METHOD OF REDUCTION

Year	Electrolytic primary	Distilled primary	Redistilled secondary [1]		Total
			At primary smelters	At secondary smelters	
1929	156,235	469,212	11,425	35,923	672,795
1930	131,166	366,879	[2] 8,500	26,349	532,894
1931	81,898	210,098	[3] 5,343	16,282	313,621
1932	23,208	183,940	1,596	13,122	221,866
1933	88,315	218,867	14,230	15,857	337,269
1934	76,657	286,933	4,962	14,729	383,281
1935	118,476	302,158	13,439	15,211	449,284

APPORTIONED ACCORDING TO GRADE

Year	Grade A (high-grade)	Grade B (intermediate)	Grade C (brass special)	Grade D (selected)	Grade E (prime western)	Total
1929	207,321	27,430	96,163		341,881	672,795
1930	156,494	26,079	93,270		257,051	532,894
1931	83,445	23,924	73,274		132,978	313,621
1932	44,195	13,295	66,844		97,532	221,866
1933	104,842	27,101	57,318		148,008	337,269
1934	116,720	32,621	43,657		190,283	383,281
1935	155,516	49,118	49,909		194,741	449,284

[1] For total production of secondary zinc see below.
[2] Includes 22 tons of secondary electrolytic zinc.
[3] Includes 312 tons of secondary electrolytic zinc.

Production of primary slab zinc by States.—Pennsylvania, with an increase of 19 percent over 1934, continued to rank first in production in 1935, Montana ranked second with an increase of 59 percent, Illinois ranked third, and Oklahoma fourth. All of the production of Montana and Idaho is electrolytic zinc, whereas all the other States shown produce distilled zinc. The output of all zinc-smelting States of the Mississippi Valley region except Illinois decreased in 1935.

Primary slab zinc produced in the United States, by States, 1929–35, in short tons

Year	Arkansas	Idaho	Illinois	Kansas	Montana	Oklahoma	Pennsylvania	Other States	Total	Total value
1929	17,923	16,582	112,425	37,795	138,019	111,683	108,167	82,853	625,447	$82,559,000
1930	13,917	9,509	103,331	13,682	112,908	79,742	101,916	63,040	498,045	47,812,000
1931	3,362	8,466	76,290	4,660	63,090	26,924	65,445	43,759	291,996	22,192,000
1932	639	5,955	67,610	--------	17,250	27,226	55,536	32,932	207,148	12,429,000
1933	9,129	7,686	60,140	--------	80,629	52,000	62,583	35,015	307,182	25,803,000
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

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.

Byproduct sulphuric acid.—An important byproduct of zinc smelting is sulphuric acid made from the sulphur dioxide gases evolved from the roasting of zinc blende. Some of these plants also use large quantities of sulphur in addition to blende to utilize a larger proportion of their acid-producing capacity. The following table shows the production of sulphuric acid at zinc-blende roasting plants from 1929 to 1934. Data for 1935 were not available at the time this chapter was prepared.

Production and value [1] of sulphuric acid (60° B. basis) made at zinc-blende roasting plants in the United States, 1929–34

Year	Made from zinc blende		Made from sulphur		Total		
	Short tons	Value	Short tons	Value	Short tons	Value	Value per ton
1929	627,018	$6,038,183	646,980	$6,230,417	1,273,998	$12,268,600	$9.63
1930	536,614	5,167,593	474,092	4,565,506	1,010,706	9,733,099	9.63
1931	426,618	3,745,706	[2] 381,216	3,347,077	807,834	7,092,783	8.78
1932	341,340	2,594,184	244,644	1,859,294	585,984	4,453,478	7.60
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

[1] At average of sales of 60° acid.
[2] Includes acid made from small quantity of pyrites.
[3] Includes acid from small quantity of foreign blende.

Rolled zinc.—Production of rolled zinc in 1935 increased 38 percent over that in 1934 and was the highest recorded since 1929. Some producers fabricate their rolled zinc into forms other than those shown in the accompanying table. In 1935, 13,551 tons of scrap resulting from these operations were remelted and rerolled. Zinc lost in waste products, such as skimmings and drosses and pot losses, totaled 1,571 tons in 1935—equivalent to about 3 percent of the net production of rolled zinc. Of the zinc purchased for rolling in 1935, 45 percent was brass special, 18 percent prime western, 16 percent high-grade, 16 percent selected, and 5 percent electrolytic and intermediate grade. Stocks of slab zinc on hand at zinc-rolling mills were about 6,100 tons at the beginning and about 9,000 tons at the end of the year.

Production of rolled zinc and quantity available for consumption in the United States, 1934–35

	1934			1935		
	Short tons	Value		Short tons	Value	
		Total	Average per pound		Total	Average per pound
Sheet zinc not over 0.1-inch thick	13,082	$2,338,000	$0.089	16,061	$2,908,000	$0.091
Boiler plate and sheets over 0.1-inch thick	817	118,000	.072	1,011	160,000	.079
Strip and ribbon zinc [1]	27,017	3,745,000	.069	39,469	5,706,000	.072
Total zinc rolled [1]	40,916	6,201,000	.076	56,541	8,774,000	.078
Imports	55	7,000		112	9,000	
Exports	3,462	569,000	.082	4,813	755,000	.078
Available for consumption	37,509			51,840		
Slab zinc (all grades)			.043			.044
Value added by rolling			.033			.034

[1] Figures represent net production. In addition, 9,333 tons of strip and ribbon zinc in 1934 and 13,551 tons of strip and ribbon zinc in 1935 were rerolled from scrap originating in fabricating plants operated in connection with zinc-rolling mills.

Zinc dust.—Commercial production of zinc dust in the United States was begun in 1910, and from 1922 to 1927 the annual production averaged about 8,000 tons. In 1935, 12,453 tons were produced, an increase of 15 percent over 1934 and the largest output ever recorded.

The zinc content of zinc dust produced in 1935 averaged 97 percent. Since 1931 virtually all zinc dust has been produced by redistillation of zinc drosses and slab zinc. The production of atomized zinc dust for market is relatively small.

Zinc dust [1] sold by producers in the United States, 1929–35

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average per pound			Total	Average per pound
1929	11,050	$1,864,672	$0.084	1933	11,157	$1,308,594	$0.059
1930	9,237	1,205,740	.065	1934	10,856	1,342,133	.062
1931	10,611	1,148,152	.054	1935	12,453	1,574,259	.063
1932	9,440	900,796	.048				

[1] The zinc dust produced is principally "distilled." Some "atomized" dust was produced in each of the years shown except 1934 and 1935, but the Bureau of Mines is not at liberty to publish the figures separately.

Zinc pigments and salts.—Zinc oxide, leaded zinc oxide, and lithopone are the principal pigments of zinc and the chloride and sulphate 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.—The following table shows the mine production of recoverable zinc in the United States, by States, from 1925 to 1935.

Mine production of recoverable zinc in the United States, 1925–35, in short tons

State	1925–29 average	1930	1931	1932	1933	1934	1935
Western States:							
Arizona	2,628	815	------	------	6	905	[1] 3,316
California	3,999	------	80	------	145	361	[1] 132
Colorado	32,868	36,259	16,187	109	1,285	772	1,202
Idaho	29,128	37,649	19,569	10,252	20,968	24,799	[1] 31,098
Montana	72,519	26,421	6,747	2,197	20,724	30,721	[1] 54,772
Nevada	5,570	14,584	10,431	127	6,387	13,940	[1] 15,661
New Mexico	23,351	32,765	27,866	25,593	30,924	26,522	22,126
Oregon	------	6	------	6	6	37	------
Utah	44,385	44,495	37,291	29,666	29,745	28,198	[1] 31,102
Washington	575	352	4,974	2,245	3,369	1,926	[1] 1
	215,023	193,346	123,145	70,195	113,559	128,181	[1] 159,410
Central States:							
Arkansas	71	------	------	------	11	68	153
Illinois	1,174	9	------	------	------	------	------
Kansas	114,323	74,304	39,051	26,277	40,947	38,261	[1] 50,000
Kentucky	644	------	------	46	228	125	127
Missouri	16,708	10,811	3,205	986	5,042	7,059	[1] 7,500
Oklahoma	226,969	136,153	78,132	63,437	91,065	107,772	[1] 134,000
Wisconsin	23,055	12,558	10,088	7,522	7,800	9,807	8,923
	382,944	233,835	130,476	98,268	145,093	163,092	[1] 200,703
Eastern States:							
New Jersey	93,839	97,626	94,285	81,460	75,125	76,553	85,708
New York	7,091	22,471	24,100	16,794	17,733	23,188	23,720
Tennessee and Virginia [2]	25,823	48,147	38,312	18,514	32,770	47,712	48,832
	126,753	168,244	156,697	116,768	125,628	147,453	158,260
	724,720	595,425	410,318	285,231	384,280	438,726	[1] 518,373

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

Mine production of zinc increased 18 percent in 1935 but was still 28 percent below the yearly average from 1925 to 1929. All sections of the country shared in the 1935 advance, production having increased 24 percent in the Western States, 23 percent in the Central States, and 7 percent in the Eastern States. Compared with predepression levels, however, the output of the Eastern States in 1935 was 25 percent greater, whereas that of the Central and Western States was 48 and 26 percent less, respectively.

Montana made the largest tonnage increase in the Western States. Production was largely from the mines at Butte and the slag dump at the East Helena lead smelter. Output at all of the important producing States in the West except New Mexico was higher in 1935 than in 1934. The decline in New Mexico reflected lower output at the Pecos mine. In the Central States the tri-State district (Joplin) increased its production 25 percent and accounted for 95 percent of the total output of the area and 37 percent of the country's total. The Eastern States contributed 31 percent of the 1935 total compared with 17 percent from 1925 to 1929. This increase in relative importance in recent years has been due to development of deposits in northern New York and southwestern Virginia.

The table that follows shows the output of the principal zinc-producing districts of the United States during the past 7 years. Further details of operations in these districts are given in the State reports included in this volume.

Mine production of recoverable zinc in the principal zinc-producing districts of the United States, 1929–35, in short tons

District	State	1929	1930	1931	1932	1933	1934	1935
Joplin region	Kansas, Missouri, Oklahoma.	309,436	216,961	119,168	90,660	137,054	153,092	[1] 191,500
New Jersey	New Jersey	103,740	97,626	94,285	81,460	75,125	76,553	85,708
Eastern Tennessee Austinville	Tennessee Virginia	40,558	48,147	38,312	18,514	32,770	47,712	48,832
Coeur d'Alene region	Idaho	43,046	33,145	18,934	10,251	20,958	24,799	31,054
St. Lawrence County	New York	10,250	22,471	24,100	16,794	17,733	23,188	23,720
Summit Valley (Butte).	Montana	50,550	13,984	--------	--------	15,481	21,165	(2)
Bingham	Utah	21,794	22,362	26,608	21,746	20,648	16,611	[1] 17,996
Willow Creek	New Mexico	22,865	16,638	20,817	20,356	18,665	16,847	13,372
Pioche	Nevada	6,498	11,086	6,708	(3)	(3)	11,196	(2)
Park City region	Utah	27,965	19,543	9,436	7,863	8,296	9,693	[1] 9,659
Central	New Mexico	11,224	15,319	7,050	5,121	11,220	9,109	(2)
Upper Mississippi Valley.	Iowa, northern Illinois, Wisconsin.	17,017	12,567	10,088	7,522	7,800	9,807	8,923
Metaline Falls	Washington	1,031	352	4,974	2,245	3,369	1,926	(2)
Leadville	Colorado	13,414	11,519	2,887	63	1,246	515	924
San Juan Mountains	do	14,403	10,434	41	4	9	125	153
Battle Mountain	do	420	14,272	13,259	--------	--------	--------	(2)
Southeastern Missouri region.	Missouri	3,473	4,307	1,220	40	--------	--------	--------

[1] Subject to revision.
[2] Data not yet available.
[3] Bureau of Mines not at liberty to publish figures.

Zinc deposits of southwestern Virginia.—The following description of the zinc deposits of southwestern Virginia, by L. W. Currier of the United States Geological Survey, is published by permission of the Director of that Bureau.

Zinc deposits have been found at many places in the Valley of Virginia between Roanoke and Bristol, but only in the general vicinity of Austinville have they been found in sufficient concentration to permit exploitation. At Austinville, on New River, about 60 miles southwest of Roanoke and 10 miles southeast of

Wytheville, the Bertha Mineral Co. (subsidiary of New Jersey Zinc Co.) operates a large mine to a depth of 700 feet. At Ivanhoe, 2½ miles west of Austinville, the Ivanhoe Mining & Smelting Co. has produced a small amount of ore from time to time, partly from shallow shaft mines, and partly from open-cuts. At Bertha, about 7 miles northeast of Austinville, the first systematic zinc mining in Virginia is reported to have been done, and at this locality oxidized zinc ores of high quality were obtained from open-cuts. The Bertha district has long since ceased to be productive. At Cedar Springs, 20 miles west of Austinville, zinc ores were mined for a short time, and at Sugar Grove (Rye Valley) 8 miles west by south of Cedar Springs, several shafts were sunk on a lead ore vein from which it is reported that 30 carloads of ore were shipped. Many prospects and outcrops of zinc-bearing rock are scattered along the valley between the points mentioned. The United States Geological Survey and Virginia Geological Survey acting cooperatively have recently completed a detailed geologic study of a 60-mile stretch of the valley including these localities, and the results of the study, including a geologic map covering about 360 square miles, is now in press.

The formations exposed in the zinc belt of southwestern Virginia are of Lower Cambrian age, and make up the following sequence, from lower to upper: Quartzites, 2,000 to 2,500 feet; Shady dolomite (much limestone at base, and locally at top) 1,700 to 2,500 feet; Rome formation (preponderantly shale at base) 2,000± feet; Elbrook dolomite, at top, thickness undetermined. The known zinc deposits are all within the Shady dolomite beds, which are overlain by a thick shale formation and underlain by massive quartzite. This lithologic sequence is regarded as significant in limiting the zinc ores to the Shady dolomite.

The ores are furthermore consistently limited to breccias in the dolomite beds; limestone beds in the formation are not mineralized. The textural characteristics of the breccia and their association with faulted and folded beds indicate their tectonic origin. The explanation of this condition probably lies in the fact that the dolomite beds were more brittle than the limestone beds, and were deformed by intense fracturing during the folding and faulting to which they were subjected previous to mineralization, while the limestone beds were relatively plastic.

Coarsely crystalline white vein or "gangue" dolomite is the common cementing material of the breccias and together with rock fragments has been partly replaced by the sulphide minerals.

The mineralogy of the ores is simple. At Austinville sphalerite, pyrite, and galena comprise the sulphide minerals; associated minerals are dolomite, cherty silica, fluorite, and barite. At the mine of Rye Valley Mining Co., Sugar Grove, galena was the chief sulphide. In general, sphalerite and pyrite are widely distributed, whereas galena and fluorite appear at a very few points. Throughout the district, oxidized ores, obtained from pits in the heavy residual clay and partly decomposed dolomite "pinnacles," consist of calamine and smithsonite, and very subordinately (at Austinville) of cerussite.

The mineralized breccias appear to have a definite relation to major and minor geologic structural features. Thus the brecciation was brought about by folding and overthrusting and was particularly favored by local cross-fracturing (faulting and sheet jointing), minor warping, and deflection of fold axes. The paths of access for the mineralizing solutions were either the deeply extending thrust zones, or later-formed cross-faults. The latter are found at several points, particularly at Austinville and Ivanhoe. The directness and continuity of cross fissures would theoretically seem to favor them as feeding channels. Solutions ascending along such fissures would, upon reaching zones of thrust breccias, spread laterally through such zones and permit precipitation and concentration of the ore minerals in such places, particularly near the feeding channels, but extending to some distance on either side. It is believed that the characteristic thick tabular ore bodies originated in this manner. It is clear, therefore, that local structural features such as sharp folding, thrust faulting, and cross faulting or other fissuring, which favored ore localization, should be sought in exploration. Geologic mapping of the district was carried on from this viewpoint.

STOCKS

Stocks of zinc at primary reduction plants decreased 27 percent in 1935 and at the close of the year were only 4,600 tons greater than at the end of 1929. Stocks at secondary distilling plants also decreased. An analysis of the decrease in 1935 shows that stocks of the higher grades of zinc (A and B) decreased 24 percent, while those of the lower grades (C, D, and E) decreased 29 percent. At the beginning of 1935 there were on hand 17,796 tons of grades A and B and 109,672 tons of grades C, D, and E. At the close of the year the tonnages were 13,546 and 78,144, respectively.

Stocks of zinc on hand at zinc-reduction plants in the United States at end of year, 1929–35, in short tons

	1929	1930	1931	1932	1933	1934	1935
At primary reduction plants	85,904	167,293	143,592	128,192	110,487	124,783	90,539
At secondary distilling plants	3,549	1,909	2,497	3,370	2,479	2,685	1,151
	89,453	169,202	146,089	131,562	112,966	127,468	91,690

Stocks of zinc ore in the Joplin district increased slightly during 1935. At the beginning of the year about 15,000 tons of concentrates were on hand, with an estimated recoverable zinc content of 8,000 tons, whereas at the end of the year stocks amounted to 17,000 tons of ore, representing about 9,000 tons of metal.

Stocks of slab zinc outside of the United States were reported as 122,000 tons at the beginning of the year by the International Zinc Cartel. Since the cartel was not functioning during 1935, however, statistical data on stocks at the end of 1935 are not available. The British Metal Corporation, Ltd., in its review of nonferrous metals for 1935 ,states that stocks of zinc outside of the United States probably were less than 110,000 tons at the close of the year. World stocks of slab zinc may therefore be estimated at 249,000 tons on January 1 and approximately 200,000 tons on December 31, 1935, a decrease of 20 percent. World stocks at the close of 1935 were equivalent to less than 2 months' supply at the average rate of consumption in 1935.

DOMESTIC CONSUMPTION

New supply.—The supply of new zinc available for consumption in 1935 increased 32 percent over 1934 but still was 22 percent below the record year 1928. Withdrawals of new copper on domestic account increased 37 percent from 1934, and the supply of new lead available for consumption increased about 4 percent. Shipments of pig iron increased about 30 percent in 1935. Consumption of new zinc in 1935 was 83 percent of the predepression 5-year average, while that of lead and copper was 46 and 57 percent, respectively. The better showing of primary zinc may be ascribed to the fact that a smaller proportion of zinc than of copper and lead is consumed in the manufacture of capital goods, production of which has lagged behind consumers' goods. A very large proportion of zinc is used in galvanized wares, paint pigments, radio and flashlight batteries, fruit-jar covers, and other items that pass on to the consuming public rapidly. Moreover, the uses to which zinc is put are such that there is much less return of scrap than for lead and copper.

The following table gives the quantity of new zinc available for consumption in the United States during the past 7 years.

Primary slab zinc available for consumption in the United States, 1929–35, in short tons

	1929	1930	1931	1932	1933	1934	1935
Supply:							
Stock Jan. 1:							
At smelters	[1]48,432	85,904	167,293	143,592	128,192	110,487	124,783
Production	625,447	498,045	291,996	207,148	307,182	363,590	420,634
Imports, foreign [2]	226	346	294	349	1,936	1,780	4,556
Imports, domestic, returned	--------	--------	3	--------	--------	--------	--------
Total available	674,105	584,295	459,586	351,089	437,310	475,857	549,973
Withdrawn:							
Exports, foreign, from warehouse	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Exports, foreign, under drawback	--------	32	--------	136	700	1,978	2,210
Exports, domestic	[3] 19,676	[3] 8,501	[3] 3,402	[3] 9,481	[3] 4,334	[3] 8,567	[3] 6,430
Stock Dec. 31:							
At smelters	85,904	167,293	143,592	128,192	110,487	124,783	90,539
Total withdrawn	105,580	175,826	146,994	137,809	115,521	135,328	99,179
Available for consumption	568,525	408,469	312,592	213,280	321,789	340,529	450,794

[1] Includes stocks at secondary distilling plants.
[2] Includes sheets.
[3] Foreign exports included under domestic exports. Figures include plates and sheets.

The foregoing table attempts to include only primary slab zinc or zinc produced from ores. Each year primary smelters produce a substantial tonnage of redistilled secondary zinc, most of which is inseparable from primary metal; therefore, smelter stocks at the end of the year and exports of domestic zinc probably contain some secondary metal, although the amount is relatively small. More precise segregation of figures for primary and secondary metal is virtually impossible. As the table does not consider the fluctuation in consumers' stocks, only the general trend of consumption of primary zinc is indicated.

Industrial use of slab zinc.—In addition to the new supply noted above, 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 7 years as follows:

Estimated industrial use of zinc in the United States, 1929–35, in short tons [1]

Purpose	1929	1930	1931	1932	1933	1934	1935
Galvanizing:							
Sheets	142,800	103,900	77,100	52,500	74,400	83,300	110,000
Tubes	52,200	38,800	28,300	16,000	22,600	22,000	25,000
Wire	39,000	25,100	21,600	12,100	21,700	20,000	25,000
Wire cloth	10,800	9,400	6,900	4,400	4,800	4,000	5,000
Shapes [2]	45,200	39,800	34,100	24,000	24,500	22,700	30,000
	290,000	217,000	168,000	109,000	148,000	152,000	195,000
Brass and castings [3]	185,000	120,000	98,000	66,000	94,000	98,000	112,000
Rolled zinc	[4] 68,300	[4] 51,400	49,300	40,000	41,300	40,900	56,500
Die castings	36,000	21,500	20,000	17,000	26,000	32,000	55,500
Other purposes [5]	55,000	41,000	34,700	27,000	41,000	37,000	42,000
	634,300	450,900	370,000	259,000	350,300	359,900	461,000

[1] Year Book, American Bureau of Metal Statistics, 1935.
[2] Includes pole-line hardware, hollow ware, chains, and all articles not elsewhere mentioned. The estimates for the use of slab zinc under this head, and also for wire cloth, are probably incomplete.
[3] Includes all casting other than die casting, slush casting, and battery zinc.
[4] Includes some duplication of tonnage.
[5] Includes slab zinc used for manufacture of French oxide, lithopone, atomized zinc dust, and wire, and zinc for wet batteries, slush castings, and desilverization of lead.

The industrial use of zinc in 1935 increased 28 percent and was the largest recorded since 1929; it was equivalent to 73 percent of the quantity used in that year. The largest tonnage increase was in galvanizing, which took 28 percent more zinc in 1935 than in 1934, principally in the manufacture of sheets which account for nearly 60 percent of the total consumption in this industry. Zinc used in electrogalvanized products increased from 1,900 tons in 1934 to 3,100 in 1935, and further increase in expected in 1936 as a result of the recent completion of a new electrogalvanizing plant at Johnstown, Pa. This process is used chiefly in the manufacture of zinc-coated wire. The largest percentage increase in zinc consumption in 1935 was in die castings, which used 73 percent more zinc than in 1934. This marked change reflected the increase in automobile manufacture, where zinc die castings are used in a variety of parts, including hardware, structural parts, carburetors, fuel pumps, and radiator grilles. Some of the 1936 models contained as much as 80 pounds of zinc die castings. In 1935, 62 percent of the die-cast zinc was used in motor vehicles as against 57 percent in 1934. The 14-percent increase in the use of zinc in brass manufacture likewise reflected the improvement in automobile production, but an appreciable advance in building activity was a factor here also. Rolled-zinc production increased 38 percent; of the 1935 total, 18,000 tons were used for glass-jar tops, 15,300 tons for battery cans, 1,000 tons for boiler plate, 4,800 tons for exports, and the balance for various purposes. One of the principal uses included in the table under "other purposes" is French-process zinc oxide, in the manufacture of which nearly 27,000 tons of slab zinc were used in 1935 compared with 25,000 tons in 1934. Other miscellaneous uses include slush castings, cast zinc for wet batteries (2,600 tons in 1935), lead desilverization, and zinc dust.

PRICES

The trend in the price of zinc in 1935 was decidedly upward and reflected the sharp increase in consumption resulting from rising industrial activity. The average St. Louis quotation for prime western zinc increased from 3.72½ cents per pound at the beginning of the year to 4.85 cents at the close of the year. The increase was maintained steadily throughout the year, although in June and July the rate of increase was relatively less, owing to a temporary decline in demand that caused accumulation of stocks. The low for the year—3.70 cents—was reached in the latter part of January and early in February. The high of 4.95 cents occurred early in November, but during the latter part of that month and during December the price was steady at 4.85 cents. The average for 1935 was 4.33 cents compared with 4.16 cents in 1934. In 1929 the average was 6.49 cents.

The following table presents a 7-year summary of zinc price data. It will be noted that in 1935 quotations averaged 4.70 cents in New York and 3.08 cents (United States exchange basis) in London, making a differential of 1.62 cents in favor of New York compared with 1.44 cents in 1934 and 1.13 cents in 1932. The relatively high differential in favor of New York, which in December actually exceeded the domestic tariff on slab zinc, probably was a factor in the increase in zinc imported for consumption in 1935.

Prices of zinc and zinc concentrates, 1929–35

	1929	1930	1931	1932	1933	1934	1935
Average price of common zinc at—							
St. Louis (spot)....cents per pound..	6.49	4.56	3.64	2.88	4.03	4.16	4.33
New York....do....	6.84	4.91	3.99	3.25	4.40	4.51	4.70
London....do....	5.40	3.60	2.52	2.12	2.96	3.07	3.08
Excess New York over London....do....	1.44	1.31	1.47	1.13	1.44	1.44	1.62
Joplin 60-percent zinc concentrates:							
Price per short ton....dollars...	42.39	31.97	22.69	17.83	26.88	27.14	28.81
Price of zinc content....cents per pound..	3.53	2.66	1.89	1.49	2.24	2.26	2.40
Smelter's margin....do....	2.96	1.90	1.75	1.39	1.79	1.90	1.93
Price indexes (1925–29 average=100):							
Zinc (New York)....	96	69	56	46	62	63	66
Lead (New York)....	91	74	57	43	52	52	54
Copper (New York)....	123	89	56	38	48	58	59
Nonferrous metals [1]....	107	83	63	50	60	68	69
All commodities [1]....	97	88	74	66	67	76	81

[1] Based on price indexes of the U. S. Department of Labor.

In terms of price, zinc has staged a greater recovery than lead or copper. The New York average price for zinc in 1935 was 66 percent of the predepression average, whereas prices of lead and copper were only 54 and 59 percent, respectively. These three metals, however, have not fared as well as the nonferrous metal group as a whole and are considerably below the average price level of all commodities.

The price of 60-percent zinc concentrates at Joplin averaged $28.81 per ton in 1935, an increase of 6 percent over 1934; it was still 32 percent below the 1929 average. The 1935 average was equivalent to 2.40 cents per pound of contained zinc. Since the St. Louis price of zinc averaged 4.33 cents, the difference of 1.93 cents per pound covers metallurgical losses, the cost of smelting and marketing, and such smelting profits as are realized. This was an increase of 2 percent over the smelter's margin in 1934 but was only 65 percent of the margin in 1929.

Average monthly quoted prices of common zinc (prompt delivery or spot) at St. Louis and London, and of 60-percent zinc concentrates at Joplin, 1934–35 [1]

Month	1934			1935		
	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....	25.65	4.27	3.31	26.00	3.73	2.62
February....	28.65	4.39	3.33	26.00	3.72	2.57
March....	30.00	4.37	3.35	26.00	3.90	2.58
April....	29.30	4.37	3.43	25.72	4.03	2.78
May....	29.46	4.35	3.36	26.00	4.22	3.17
June....	26.70	4.24	3.21	27.93	4.30	3.03
July....	28.00	4.32	3.03	28.00	4.33	3.11
August....	28.00	4.28	3.09	29.50	4.54	3.26
September....	25.25	4.06	2.82	30.00	4.67	3.39
October....	25.00	3.84	2.69	31.55	4.83	3.60
November....	25.10	3.73	2.67	32.00	4.86	3.56
December....	25.56	3.71	2.59	32.00	4.85	3.32
Average for year....	27.14	4.16	3.07	28.81	4.33	3.08

[1] All quotations from Metal Statistics, 1936. Conversion of English quotations into American money based on average rates of exchange recorded by the Federal Reserve Board of the Treasury.

The preceding table shows the monthly fluctuations in quotations of common zinc at St. Louis and London and of 60-percent zinc concentrates at Joplin during 1934 and 1935. The New York quotation for slab zinc exceeds that at St. Louis by the freight differential, which normally is 0.35 cent per pound. From January 4, 1932, to September 30, 1933, the differential was increased to 0.37 cent per pound, due to a temporary increase in the freight rate. On April 18, 1935, another increase in rates became effective that increased the freight differential to 0.375 cent.

The following table shows the actual prices received by producers for various grades of zinc during the past 7 years. It will be noted that all producers do not realize the premiums usually quoted in the trade journals for the higher grades of zinc.

Average price of zinc received by producers, 1929–35, by grades, in cents per pound

	1929	1930	1931	1932	1933	1934	1935
Grade A (high grade) [1]	6.80	4.92	4.00	3.25	4.35	4.50	4.55
Grade B (intermediate)							
Grades C and D (select and brass special)[1]	6.44	4.71	3.63	2.95	3.98	4.10	4.31
Grade E (prime western)	6.42	4.69	3.73	2.85	4.07	4.15	4.32
All grades	6.6	4.8	3.8	3.0	4.2	4.3	4.4
Prime western; average spot quotation at St. Louis	6.5	4.6	3.6	2.9	4.0	4.2	4.3

[1] American Metal Market quotes average prices of high grade and brass special as follows: High grade (f. o. b. New York), 1929, 7.88 cents; 1930, 5.58 cents; 1931, 4.63 cents; 1932, 3.99 cents; 1933, 5.25 cents; 1934, 5.24 cents; 1935, 5.33 cents. Brass special (f. o. b. East St. Louis), 1929, 6.60 cents; 1930, 4.64 cents; 1931, 3.73 cents; 1932, 2.96 cents; 1933, 4.08 cents; 1934, 4.23 cents; 1935, 4.41 cents.

ZINC-REDUCTION PLANTS

Zinc smelters.—At the close of 1935 there were 20 retort-zinc smelters in the United States; 6 were idle throughout the year. The number of horizontal retorts at the 20 plants totaled 103,252, but at the close of the year only 35,707 were in use. There was a total of 40 vertical-type continuous retorts at three of the plants, but data on the number in operation are not available. The smelter at Kusa, Okla., with 3,760 retorts, was being dismantled at the end of 1935, and early in 1936 it was reported that the smelting activities of the Illinois Zinc Co., which had been maintained for 66 years at Peru, Ill., would be transferred to the Texas Panhandle to take advantage of the low-cost natural gas available there. A list of these plants is given on page 113 of Minerals Yearbook, 1935.

In addition to the 20 primary smelters mentioned the Federated Metals Corporation has a smelter at Beckemeyer, Ill., which contains 1,032 regular horizontal retorts. This plant formerly treated ores but in recent years has been operated on secondary materials exclusively. The Sandoval Zinc Co. has a plant at Sandoval, Ill., containing 896 regular horizontal retorts; it has been operated only on secondary materials for several years. Both plants were operated at part capacity in 1935. Other secondary smelters that produced zinc in large graphite retorts in 1935 were the General Smelting Co., Philadelphia, Pa.; Nassau Smelting & Refining Co., Tottenville, N. Y.; Superior Zinc Corporation, Bristol, Pa.; Trenton Smelting &

Refining Branch of Federated Metals Corporation, Trenton, N. J.; and Wheeling Steel Corporation, Wheeling, W. Va. The secondary smelter of the Birmingham Smelting & Refining Co. was idle throughout the year.

Electrolytic plants.—The Evans-Wallower Zinc Co. plant at East St. Louis and the Anaconda plant of the Anaconda Copper Mining Co. were idle throughout 1935. At the close of the year the Kellogg plant of the Sullivan Mining Co. and the Great Falls plant of the Anaconda Copper Mining Co. were operating at full capacity.

FOREIGN TRADE [2]

Foreign trade of the United States in zinc normally consists largely of imports of zinc ore smelted in bond and exports of slab zinc derived from the foreign ore. Considerable domestic ore was exported before the war and from 1925 to 1927. There is a fairly steady export trade in rolled zinc, zinc dust, and zinc dross and some flow of zinc pigments into and out of the country. By 1932 foreign trade had declined to small proportions as a result of the depression, but during the past 2 years has increased considerably.

Imports.—The following tables give zinc imports into the United States from 1929–35 and a record of bonded-warehouse inventories.

Total imports of zinc ore into the United States, 1929–35,[1] zinc content in short tons

Year	Canada	Mexico	Other countries	Total
1929	848	13,563	--------	14,411
1930	13	25,644	182	25,839
1931	(2)	778	2	780
1932	--------	1,904	--------	1,904
1933	44	2,089	(2)	2,133
1934	(2)	14,277	(2)	14,277
1935	--------	10,520	--------	10,520

[1] Data for 1934 and 1935 include ore imported for immediate consumption plus material entering the country under bond and are comparable to "general imports" given in the table for 1929–33.
[2] Less than 1 ton.

Zinc remaining in warehouse in the United States, Dec. 31, 1929–35

Year	Ore		Blocks, pigs, and old		Zinc sheets	
	Zinc content (pounds)	Value	Pounds	Value	Pounds	Value
1929	3,758,809	$113,479	--------	--------	--------	--------
1930	27,185,311	784,670	--------	--------	43,334	$2,081
1931	22,377,439	269,019	22,909	$160	71,089	2,896
1932	10,211,618	240,338	--------	--------	43,339	2,071
1933	7,985,703	178,291	101,523	7,622	--------	--------
1934	[1] 14,354,435	(2)	(1)	(1)	(2)	(2)
1935	[1] 13,840,586	(2)	(1)	(1)	(2)	(2)

[1] "Blocks, pigs, and old" included with "ore"; not separately recorded.
[2] Data not available.

[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.

Zinc imported for consumption in the United States, 1929–35

Year	Blocks or pigs		Sheets		Old		Zinc dust		Value of manufactures	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value		
1929	226	$21,502	(1)	$52	(1)	$20	159	$19,543	$128,395	$169,512
1930	281	25,389	65	6,420	[2] 35	[2] 1,968	76	7,086	76,062	116,925
1931	274	14,793	20	2,283	(1)	35	1	97	13,591	30,799
1932	310	20,132	39	4,636	--------	--------	11	966	9,318	35,052
1933	1,890	127,416	46	6,703	--------	--------	31	2,244	7,400	143,763
1934	1,725	112,923	55	6,978	--------	--------	18	1,395	8,523	129,819
1935	4,444	270,350	112	9,423	[3] 29	[3] 979	40	2,486	1,149	284,387

[1] Less than 1 ton.
[2] Includes 33 tons of dross and skimmings, valued at $1,829, imported June 18 to Dec. 31; not separately recorded prior to change in tariff.
[3] Includes 29 tons of dross and skimmings valued at $974.

The chief zinc import of the United States normally is zinc ore, largely imported under bond so that it can be smelted and the metallic zinc therefrom reexported without import duties. In 1935, 10,520 tons of zinc in ore were imported, a decrease of 26 percent from 1934. All of this ore came from Mexico. Zinc derived from foreign ores and exported with benefit of draw-back totaled 5,086 tons in 1935. Most of it left the country in rolled-zinc products. Imports of slab zinc since 1933 have been considerably higher than in previous years and in 1935 amounted to 4,444 tons, of which Mexico supplied 2,932 tons, Poland 1,113 tons, and Canada 399 tons. Much of this metal is used in manufactures and exported with benefit of drawback. In 1933, 700 tons were so exported; in 1934, 1,978 tons; and in 1935, 2,210 tons.

Exports.—The total value of the 1935 exports of zinc ore and domestic and foreign manufactures of zinc (not including galvanized products, alloys, and pigments) was approximately $1,088,000, a decrease of 12 percent from 1934 and 94 percent below the recent high in 1925.

The following table shows the principal zinc exports of the United States during the past 7 years.

Domestic zinc ore and domestic manufactures of zinc exported from the United States, 1929–35

Year	Zinc ore and concentrates		Pigs or slabs [1]		Plates and sheets		Zinc dross		Zinc dust	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1929	71	$2,434	14,411	$1,879,039	5,265	$1,075,000	3,490	$217,019	1,256	$250,447
1930	--------	----------	4,633	450,417	3,868	761,007	1,162	57,288	1,177	194,252
1931	13	373	643	51,010	2,759	461,130	382	19,218	1,400	204,277
1932	--------	----------	6,471	277,612	3,010	432,849	178	8,357	1,378	189,236
1933	[2] 809	[2] 43,650	1,145	79,274	3,189	467,742	(2)	(2)	1,569	234,125
1934	[2] 3,621	[2] 157,419	5,105	284,023	3,462	569,208	(2)	(2)	1,489	223,868
1935	[2] 461	[2] 10,818	1,617	83,925	4,813	755,033	(2)	(2)	1,613	238,158

[1] Includes slab zinc made from foreign ore. Not separately recorded.
[2] Zinc dross included with ore and concentrates; not separately recorded.

Exports tabulated in the column headed "Zinc ore and concentrates" consist mostly of zinc dross. Shipments of this commodity, which increased sharply in 1934, declined to relatively small proportions in

1935, owing to lower shipments to Germany and Japan. The sharp decline in exports of slab zinc was due largely to loss of markets in Europe, British India, and Japan. Exports of plates and sheets increased 39 percent in 1935. The following table shows the exports of slab and sheet zinc by destinations during the past 4 years.

Slab and sheet zinc exported from the United States, 1932–35, by destinations, in short tons

Destination	Slabs, blocks, or pigs				Sheets, strips, etc.			
	1932	1933	1934	1935	1932	1933	1934	1935
Countries:								
Canada	15	(1)	5	5	1,497	1,417	1,442	2,159
Chile	4	14	3	7	2	3	2	2
France	--------	--------	--------	--------	19	25	18	12
Germany	35	11	--------	72	--------	2	6	8
India (British)	1,457	--------	1,849	1,121	--------	(1)	2	2
Japan	3,371	758	471	--------	197	220	159	191
United Kingdom	1,428	--------	2,562	1	1,029	991	1,161	1,367
Others	161	362	215	411	266	531	672	1,072
Total	6,471	1,145	5,105	1,617	3,010	3,189	3,462	4,813
Continents:								
North America	16	4	38	43	1,587	1,562	1,617	2,379
South America	5	43	31	21	89	254	271	285
Europe	1,611	335	2,708	425	1,066	1,087	1,296	1,587
Asia	4,839	763	2,320	1,128	261	272	223	382
Africa	--------	--------	--------	--------	6	11	13	15
Oceania	--------	--------	8	(1)	1	3	42	165

[1] Less than 1 ton.

Considerable zinc is exported each year in the form of brass and in galvanized iron and steel. The American Bureau of Metal Statistics estimates that 12,800 tons of zinc were exported in galvanized products in 1935, compared with 13,000 tons in 1934. Export data on zinc pigments and chemicals are given in the chapter on lead and zinc pigments and zinc salts.

WORLD ASPECTS OF THE ZINC INDUSTRY

International (European) Zinc Cartel.—During the early part of 1935 efforts were made to revive the cartel which had collapsed in December 1934,[3] but soon it became evident that no progress could be made until the impending changes in the British import duty on zinc were completed. Although this occurred in the latter part of August and although the formation of a new cartel was urged vigorously, particularly by the Belgian producers, nothing definite was accomplished by the end of the year. It was reported that British producers, being assured of the British market by the tariff, were not anxious to participate in the cartel except under much more favorable terms than they had been given in the old cartel. German producers, likewise, were not interested, as all of their output was being absorbed by the domestic market and capacity was being increased to make the nation independent of imports. French producers were also reported to be indifferent following the adoption of measures to encourage the domestic industry. Thus, Belgium and Poland re-

[3] A chronological record of the cartel's activities and events leading to its demise is given in previous issues of Minerals Yearbook.

mained the only continental producers vitally interested in reformation of the cartel.

During the latter part of March 1936 it was reported that a meeting of zinc producers was held at Brussels to discuss the situation. No official statement as to the results of the meeting was given out, but it was rumored that some progress was made and that further discussion would take place in May.

World production.—World production of zinc (smelter basis) increased 12 percent in 1935 and was only 10 percent below the record output of 1929. Production increased 16 percent in the United States and 10 percent elsewhere. The United States continued to rank first in production, contributing 29 percent of the world total compared with 28 percent in 1934 and 39 percent in 1929. Production of zinc in the United States in 1935 was 33 percent below 1929, whereas production outside of the United States was 5 percent above the 1929 level. Belgium contributed 13 percent of the 1935 total, but its output decreased 2 percent. Canada ranked third in production with 10 percent of the total, followed by Germany with 9 percent, Poland with 6 percent, Australia and the United Kingdom with 5 percent each, and France, U. S. S. R. (Russia), and Norway with about 4 percent each. Of the forementioned countries, U. S. S. R. made the largest percentage increase in output—75 percent. United Kingdom increased its output 18 percent, Australia 17 percent, and Canada 11 percent, but Poland decreased its output 9 percent. Of the more important minor producers, Japan showed the largest increase—18 percent. The production of the Netherlands and Mexico decreased 31 and 25 percent, respectively. There were no new producing countries in 1935.

World smelter production of zinc, 1930–35, in metric tons, by countries where smelted

[Compiled by R. B. Miller]

Country	1930	1931	1932	1933	1934	1935
Australia	55,782	54,696	54,054	54,822	55,506	[1] 65,000
Belgium	176,230	134,720	96,330	137,300	174,900	[1] 172,000
Canada	110,219	107,612	78,146	83,412	122,394	135,645
Czechoslovakia	13,472	7,947	6,031	6,605	7,634	[1] 8,000
France	86,928	57,113	45,700	51,900	51,203	52,087
Germany [2]	97,300	45,300	41,979	50,867	72,888	124,216
Indochina	3,857	2,900	2,280	3,250	4,960	3,936
Italy	19,264	16,913	17,984	23,283	24,864	[1] 26,300
Japan	24,669	25,407	27,043	30,658	29,637	[1] 35,000
Mexico	29,431	35,619	30,349	26,799	29,148	22,000
Netherlands	23,255	19,323	15,624	18,478	19,911	13,747
Northern Rhodesia	18,194	7,038		18,839	19,854	21,012
Norway	34,611	39,472	39,373	44,948	45,027	[1] 45,000
Poland	174,362	130,756	84,953	82,866	92,921	84,606
Spain	10,697	10,094	9,505	8,548	8,184	[1] 6,600
Sweden	4,126					
U. S. S. R. (Russia)	[3] 4,650	11,400	14,800	16,900	26,300	[1] 46,000
United Kingdom [4]	49,378	21,582	27,300	46,000	55,000	[1] 65,000
United States	451,816	264,893	187,921	278,669	329,842	381,591
Yugoslavia	5,514	4,504	2,157	3,461	3,534	[1] 3,500
Total	1,394,000	997,000	782,000	988,000	1,174,000	1,311,000

[1] Approximate production.
[2] Exclusive of secondary material (Metallgesellschaft). The figures published by the Stat. Reichsamt, which include secondary material, are as follows: 1930, 101,385 tons; 1931, 48,621 tons; 1932, 45,035 tons. Figures for 1933 and 1934 not yet available.
[3] Year ended Sept. 30.
[4] Some secondary material included.

World consumption.—Data on production, imports, and exports of the principal zinc-consuming countries indicate that world consumption of slab zinc (including primary and some secondary) in 1935 totaled about 1,351,100 metric tons, an increase of 17 percent over 1934 and 2 percent over the 5-year average for 1925–29. This estimate does not consider the change in stocks outside of the United States and Great Britain, and since these stocks appear to have declined the figure given probably understates actual consumption.

The increase in consumption in the United States was more pronounced than in the rest of the world. Domestic deliveries of primary zinc increased 32 percent in 1935, whereas consumption elsewhere increased 11 percent. Compared with predepression averages, however, the United States lags behind all other nations. The quantity of zinc consumed in 1935 outside the United States was 14 percent above the predepression 5-year average, but in the United States it was 18 percent below.

The United States again ranked first in zinc consumption, having taken about 31 percent of the total. Next in order of percentage consumed were Great Britain 15 percent, Germany 15 percent, Belgium 7 percent, France 6 percent, Japan 5 percent, and Russia 4 percent. France and Belgium used 5 and 10 percent less zinc in 1935, respectively, and were the only important consumers with decreased consumption. Other nations increased consumption as follows: Great Britain 16 percent, Germany 17 percent, Russia 51 percent, Japan 13 percent, and Italy 28 percent.

REVIEW BY COUNTRIES

Australia.—Production of zinc at the electrolytic plant at Risdon, Tasmania, which has been maintained at approximately full capacity throughout the depression, was substantially increased during 1935, following the completion of a new unit of the plant in March.

At Broken Hill 1,304,000 long tons of ore were raised, an increase of about 50,000 tons over 1934. All four principal producers operated in 1935. Early in the year Broken Hill South, Ltd., put into operation a new flotation plant designed to treat 8,000 tons of ore per week. Zinc concentrates from the district are shipped to the plant at Risdon and exported to Europe.

Early in 1936 the Electrolytic Zinc Co. of Australasia, Ltd., began milling at its mines at Rosebery, Tasmania. Reserves have been reported at 1,400,000 tons averaging 27 percent zinc, 7.5 percent lead, and 9.5 ounces of silver and 0.125 ounce of gold per ton. The mine was equipped to produce 3,000 tons of ore weekly in 1930, but operations were postponed owing to the low metal prices at that time.

At Mount Isa, Queensland, production of concentrates averaging over 50 percent zinc was begun in October 1935, but shipments to Europe did not begin until early in 1936. Production at the rate of 90,000 tons of concentrates per annum is anticipated.

Belgium.—The increasing number of import duties and other restrictions on international trade in zinc are threatening the dominant position of Belgium in the European zinc trade. Belgian smelters import large quantities of zinc ore from many parts of the world and export the metal derived therefrom as slab zinc or fabricated products. Imports of ores amounted to 423,000 metric tons in 1935, or 3 percent less than in 1934. Mexico, Yugoslavia, British India, Sweden, and Newfoundland were the principal sources in 1935. Exports of slab zinc totaled nearly 93,000 tons, an increase of 15 percent over 1934. Shipments to Germany and France in 1935 were considerably less than in 1934. Exports of zinc sheets and wire declined 14 percent, amounting to 49,000 tons. About 36,000 tons of ore were exported and 10,000 tons of slab zinc imported. Apparent consumption of slab zinc declined from 112,000 tons in 1934 to 100,000 in 1935. Belgium's departure from the gold standard early in 1935 probably offset to some extent the loss of markets due to tariff and other restrictions. Toward the end of the year Vieille Montagne began operating a new electrolytic zinc plant, with an annual capacity of 6,000 tons.

Canada.—Canada's zinc production (all electrolytic) amounted to 150,000 short tons in 1935, an increase of 11 percent over 1934. Eighty percent of the total was produced at Trail and 20 percent at Flin Flon. Production at Trail increased 8 percent and that at Flin Flon 21 percent. Exports of slab zinc increased 14 percent to 135,000 tons, of which Great Britain took 82 percent and Japan 9 percent. Approximately 10,000 tons of zinc in the form of ore were exported, principally to Europe.

The Sullivan mine of the Consolidated Mining & Smelting Co. of Canada, Ltd., produced 1,861,000 tons of ore from which were obtained 227,000 tons of lead concentrates and 209,000 tons of zinc concentrates. The ore treated was of lower grade than in 1934, but recoveries were well maintained. The company reported a profit of $4,017,000 after provision for depletion and depreciation compared with $2,212,000 in 1934.

During 1935 the Hudson Bay Mining & Smelting Co., Ltd., the only zinc producer in Manitoba, mined 1,620,393 tons of ore from which (together with 233 tons of custom ore) 104,218 ounces of gold, 1,393,162 ounces of silver, 24,509 tons of copper, and 30,052 tons of zinc were produced. Operating profit (before depletion) was $3,215,000 compared with $1,550,000 in 1934.

France.—The zinc-smelting industry of France depends largely on foreign ores, of which 125,000 metric tons were imported in 1935; Spain, Mexico, Newfoundland, and Yugoslavia were the principal sources. Exports of ore in 1935 amounted to 29,000 tons, a large part of which represented ore reexported after yielding its sulphur content for the manufacture of sulphuric acid. Imports of slab zinc were 37,000 tons derived largely from Belgium, Norway, and Indochina. Consumption declined from 92,000 tons in 1934 to 88,000 in 1935. France's dependence on foreign sources of zinc has resulted in various measures designed to encourage zinc mining at home and in the French colonies, but since most of the mines are high-cost producers, little has been accomplished. Another enactment was passed by the National Assembly in July 1935, providing for a bounty to be paid to producers. This resulted in the reopening of several mines during the latter part of the year.

Germany.—The large increase in Germany's smelter production of zinc in 1935 resulted from the first full year's operation of the new electrolytic plant at Magdeburg, which treats ores from Upper Silesia formerly sent to Poland for smelting. Apparent consumption of slab zinc increased from 170,000 to 199,000 metric tons. Net imports of ore were increased considerably to meet the requirements of the smelters, but this was offset by a sharp decline in receipts of slab zinc from abroad. Consequently, Germany's net imports of zinc as ore and as metal remained at about the same level as in 1934, 120,000 tons. Imports of zinc ore declined from 127,000 to 117,000 tons, but exports declined even more—from 81,000 to 28,000 tons. Mexico, Newfoundland, Australia, and India were the principal sources of the ore imported in 1935. Virtually all the large decline in exports was due to curtailed shipments to Poland. Imports of slab zinc declined from 107,000 to 76,000 tons, principally accounted for in smaller purchases of high-grade zinc from Belgium and Poland. Exports of slab zinc amounted to only 1,300 tons compared with 10,200 tons in 1934.

The large increase in net imports of zinc ore in 1935 indicates that the program for increasing production at the domestic mines was not keeping pace with expanding smelter requirements. Although numerous projects for increasing ore production are under way, further increases in smelting capacity are also contemplated. The latter include a 20,000-ton increase in the annual capacity of existing retort plants, a 20,000-ton increase in the annual capacity of the Magdeburg electrolytic zinc plant, and the construction of a 40,000-ton smelter at Oker to treat ores from the Harz mines. It is said that the Oker plant will use the continuous vertical-retort process developed in the United States. The domestic industry is heavily subsidized by the Government, and foreign trade is strictly regulated.

India.—The Burma Corporation, Ltd., produced 78,590 long tons of concentrates averaging nearly 57-percent zinc in 1935 compared with 68,838 tons of 54-percent grade in 1934. The concentrates were shipped largely to Europe.

India has become an important consumer of metallic zinc in the manufacture of galvanized products. Imports totaled nearly 23,000 tons in 1935 compared with 16,000 tons in 1934 and 7,000 tons in 1929.

Italy.—Aided by Government subsidies and high import duties the Italian zinc industry has made steady progress toward self-sufficiency in recent years. Production in 1935 again broke all previous records, having exceeded 1934 by 6 percent, but as consumption increased from 27,000 to 35,000 tons, imports of zinc were considerably higher. During the first 9 months of 1935 they totaled 5,200 metric tons compared with 1,100 tons for the same period in 1934. Italy produces an excess of zinc ore. In 1934, 36,000 tons were exported, and in the first 9 months of 1935 over 33,000 tons were shipped. The Netherlands and Belgium were the principal customers in 1935. Further increase in Italy's production is anticipated when the new 6,000 tons per year electrolytic plant at Porto Maghera is put into operation.

Japan.—Japan is an important consumer of zinc and is supplied by domestic production and imports. Apparent consumption increased from 58,700 metric tons in 1934 to 67,800 tons in 1935, the latter being met by a domestic output of 35,000 tons and imports of 32,800 tons; 41,000 tons of zinc ore were imported in 1935 compared with 13,000 tons in 1934. A new smelter at Naoschima with a 500-ton monthly capacity commenced operations in May 1935.

Mexico.—Mine production of zinc in 1935 amounted to 136,000 metric tons compared with 125,000 in 1934. Smelter production was about 22,000 tons in 1935 leaving in excess of 100,000 tons of zinc available for export in the form of ore. Belgium reported receipts of 114,000 tons of Mexican ore in 1935, Germany 26,000 tons, United States about 23,000 tons, and France 21,000 tons, a total of 184,000 tons.

Newfoundland.—Production of zinc concentrates decreased from 162,000 short tons in 1934 to 146,000 in 1935. The zinc content was approximately 51 percent in 1935. Over 48,000 tons of 64-percent lead concentrates were produced in 1935. All of the zinc concentrates and the greater part of the lead concentrates are shipped to Europe for smelting.

Poland.—Diversion of German Upper Silesian ores from Polish smelters to the Magdeburg plant is reflected in the decline in Polish imports of zinc ore from 101,000 metric tons in 1934 to 64,000 tons in 1935; a drop of over 50,000 tons in receipts from Germany was offset in part by larger shipments from other countries. Smelter output declined 9 percent and exports of slab zinc 13 percent to 54,600 tons. German imports of Polish zinc amounted to 23,600 tons in 1935 and 40,100 tons in 1934. Giesche Spolka Akcyjna, Polish subsidiary of the Anaconda Copper Mining Co., produced 40,600 tons of zinc in 1935.

Spain.—Exports of zinc ore totaled 59,000 metric tons in 1935 compared with 56,000 tons in 1934. Zinc mining, particularly in southern Spain, has been hit hard by the depression, and Government aid has been requested frequently. During the latter part of 1935 the Government undertook a study of the industry with a view toward establishing a consortium similar to that provided for the lead industry. In January 1936 it was announced that the Government had abandoned the plan for a consortium on the grounds that domestic smelting capacity was inadequate to treat all domestic ores, but in some circles it was believed that the Government's decision was influenced by the opposition of consumers to higher prices for raw materials.

U. S. S. R. (Russia).—Russia has increased its zinc output considerably in the last few years, the annual production having risen from 11,000 metric tons in 1931 to 46,000 tons in 1935. Simultaneously imports have declined from 24,000 to 1,500 tons. Two new 50,000-ton electrolytic zinc plants are contemplated to treat complex ores of the Caucasus, Western Siberia, and the Far East.

United Kingdom.—The smelter output of zinc increased 18 percent in 1935 due largely to the operation of the new vertical retort plant of the Imperial Smelting Corporation, Ltd., at Avonmouth. Imports of zinc ores increased from 90,000 long tons in 1934 to 153,000 in 1935. Of the 1935 total Australia supplied 70 percent, Canada and Newfoundland 29 percent, and Mexico 1 percent. Consumption amounted to approximately 200,000 tons, an increase of 16 percent over 1934. Imports of slab zinc totaled 148,000 tons in 1935 compared with 131,000 tons in 1934, Canada, Belgium, and Australia being the principal sources in 1935. Exports of crude zinc and manufactures thereof amounted to 9,000 tons in 1935. The British Metal Corporation estimates the distribution of zinc consumption in the United Kingdom in 1935 as follows: Galvanized sheet, 21.2 percent; other galvanizing, 23.2 percent; brass, 23.8 percent; oxide, 17.7 percent; rolled zinc, 8.3 percent; and miscellaneous, 5.8 percent.

Effective August 27, 1935, the British customs duty on non-British unwrought zinc was revised from a flat 10-percent ad valorem to 12½s per long ton or 10-percent ad valorem, whichever is less. Under the method of administering the old duty, it was claimed that small offerings of foreign metal unduly depressed the London exchange quotation, so that Empire producers had been unable to realize any benefits from the improved statistical position of the metal in 1934. The new regulations are intended to correct this situation, reserve the British market for British producers and at the same time permit British consumers to purchase zinc at the world price. Since the old duty was established as a result of the Ottawa conference in 1934, approval of the change had to be obtained from the Governments of Canada, Australia, and India.

Yugoslavia.—Trepca Mines, Ltd., treated 593,000 metric tons of ore in 1935, from which were obtained 92,000 tons of 50-percent zinc concentrates and 64,000 tons of 79-percent lead concentrates. The ore averaged about 8.5 percent zinc, 9.0 percent lead, and 3 ounces of silver per ton. Only a small part of the zinc concentrates is treated in Yugoslavia, the major part being shipped to Belgium for smelting.

75731—36——13

LEAD AND ZINC PIGMENTS AND ZINC SALTS

By Elmer W. Pehrson and H. M. Meyer

SUMMARY OUTLINE

Sales of lead and zinc pigments in 1935 totaled $54,564,000, an increase of 13 percent over 1934. The combined tonnage of lead and zinc pigments increased 16 percent. Average values received by producers were slightly lower in 1935. Factors contributing to the increase in production in 1935 were the 19-percent increase in the dollar volume of paint sales, the 9-percent increase in the consumption of rubber, the 43-percent rise in automobile manufacture and a substantial rise in storage-battery output—all major pigment-consuming industries. The higher paint sales reflected the improvement in the building industry.

Lead pigments again fared better than zinc pigments. Total sales of all lead pigments increased 17 percent in value and 18 percent in quantity, whereas sales of zinc pigments increased only 10 percent in value and 14 percent in quantity. Larger sales were recorded by all pigments, white lead and leaded zinc oxide experiencing the largest percentage increases. Lead producers attribute this to the growing realization by paint manufacturers that lead is an indispensable ingredient in high-grade exterior paints. In this connection, it is interesting to note that several producers are now marketing a 50-percent leaded zinc oxide.

In the white-pigment field titanium products again absorbed a larger share of the market. Statistical data are not available, but it is probable that production of titanium pigments exceeded 50,000 tons in 1935. These products are used extensively in all of the white-pigment-consuming industries, but the principal use to date has been in interior paints. Here they are particularly desirable because their high hiding power makes possible a satisfactory one-coat job. Since this market has always provided the principal outlet for lithopone, producers of that product are feeling the competition from titanium pigments most keenly. Nevertheless the demand for interior paints since 1932 has been such that the lithopone producers have been able to market increasing amounts of their product in spite of the larger consumption of titanium pigments.

During the past few years there has been a large increase in the manufacture of French process zinc oxide from secondary materials. This product has been competing with oxide made from slab zinc. To meet this competition the regular producers drastically cut prices on red, green, and white seal oxides on October 1, 1935.

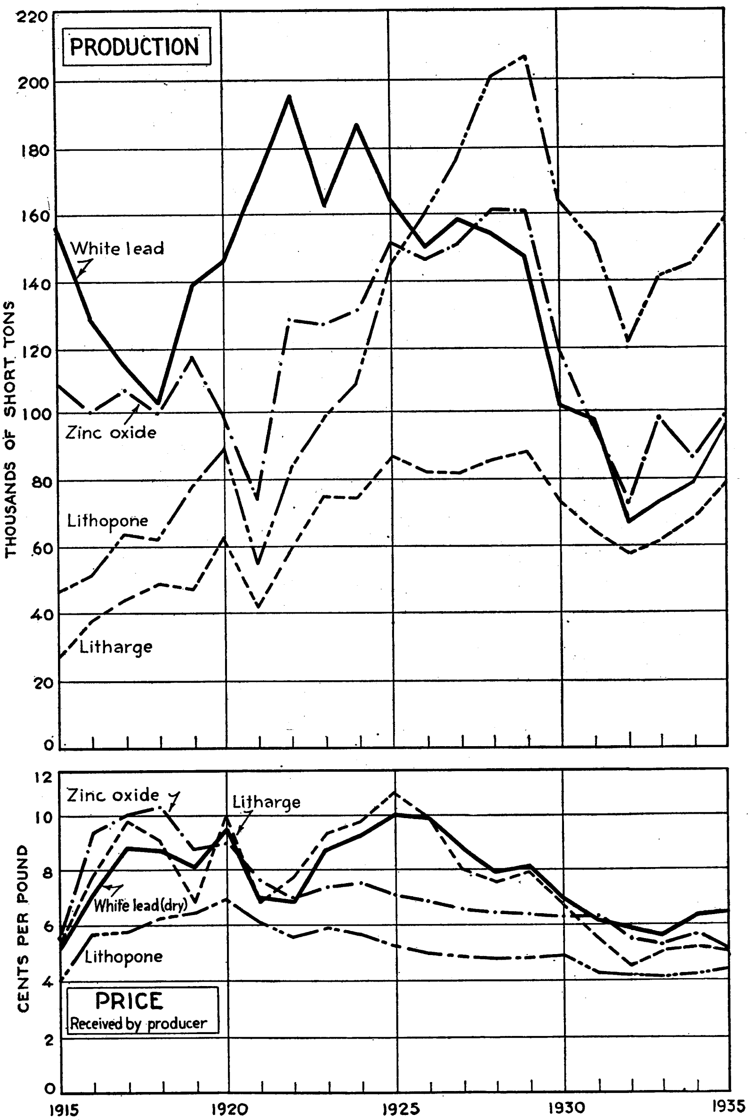

FIGURE 61.—Production and price trends of the principal lead and zinc pigments, 1915–35.

The Supreme Court decision of May 27, 1935, declaring the N. R. A. unconstitutional, ended the Codes of Fair Competition for the lead and zinc industries under which the pigment producers were operating.

Reciprocal trade agreements concluded up to the end of 1935 included the following reductions on United States import duties on lead and zinc pigments:

Lithopone containing less than 30 percent zinc sulphide.—Duty reduced from 1¾ cents per pound to 1½ cents, effective February 1, 1936.

White lead.—Duty reduced from 2.5 cents per pound to 2.1 cents, effective May 1, 1935.

Suboxide of lead.—Duty reduced from 30 percent ad valorem to "3 cents per pound but not less than 15 percent nor more than 30 percent ad valorem."

Salient statistics of the lead and zinc pigments industry of the United States, 1925–29 and 1931–35

	1925–29 (average)	1931	1932	1933	1934	1935
Production (sales) of principal pigments:						
White lead (dry and in oil) short tons	154, 483	97, 368	66, 674	72, 982	78, 734	96, 831
Litharge do	84, 845	63, 890	58, 096	61, 193	68, 733	79, 930
Red lead do	41, 362	25, 853	18, 880	21, 988	26, 743	28, 776
Zinc oxide do	154, 208	95, 700	72, 250	98, 542	87, 088	99, 697
Leaded zinc oxide do	26, 609	18, 577	14, 305	22, 868	20, 506	29, 976
Lithopone do	177, 745	151, 850	121, 667	140, 831	145, 565	159, 486
Value of products:						
All lead pigments	$60,092,000	$29,128,000	$19,133,000	$20,819,000	$24,002,000	$28, 064, 000
All zinc pigments	41,314,000	27,139,000	19,430,000	24,143,000	24,106,000	26, 500, 000
Total	101,406,000	56,267,000	38,563,000	44,962,000	48,108,000	54, 564, 000
Value per ton received by producers:						
White lead (dry)	178	124	117	112	126	124
Litharge	176	109	89	101	103	104
Red lead	193	129	111	120	123	121
Zinc oxide	133	125	110	105	113	103
Leaded zinc oxide	124	115	91	88	98	93
Lithopone	98	86	84	83	84	84
Foreign trade:						
Lead pigments:						
Value of exports	1, 346, 000	947, 000	365, 000	327, 000	404, 000	512, 000
Value of imports	30, 000	14, 000	6, 000	2, 000	4, 000	2, 000
Zinc pigments:						
Value of exports	2, 150, 000	1, 058, 000	466, 000	230, 000	395, 000	392, 000
Value of imports	931, 000	635, 000	521, 000	567, 000	373, 000	468, 000
Export balance	2, 535, 000	1, 356, 000	304, 000	[1] 12, 000	422, 000	434, 000

[1] Import balance.

PRODUCTION

In this report, sales of pigments and salts are considered to represent production, no account being taken of the stocks on hand at the beginning and end of the year. The quantities used by producers at their own plants are included under sales.

The total value of lead and zinc pigments sold by domestic producers was approximately $54,564,000 in 1935 compared with $48,108,000 in 1934. The total value of all lead pigments sold was $28,064,000 and that of all zinc pigments sold, $26,500,000. Sales of lead pigments increased 17 percent in total value and 18 percent in quantity, whereas sales of zinc pigments increased 10 percent in total value and 14 percent in quantity. The average value per ton of lead pigments sold in 1935, as reported by producers, decreased 0.8 percent, whereas the average New York quotation for pig lead increased 5 percent. Zinc pigments decreased 3.7 percent in value per ton compared with a 4-percent increase in the St. Louis quotation for slab zinc.

Lead pigments.—Production of all lead pigments increased in 1935. Production of white lead increased 23 percent but was 50 percent below the peak of 1922. Production of litharge was 16 percent higher in 1934 and was only 9 percent under the record output of 1929, and the output of red lead, which increased 8 percent in 1935, was 33 percent below 1929. Production of sublimed lead was 17 percent more than in 1934. Unit values of all lead pigments except litharge decreased in 1935.

Lead pigments sold by domestic manufacturers in the United States, 1934–35

Pigment	1934			1935		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Basic lead sulphate or sublimed lead:						
White	6,399	$677,897	$106	7,572	$727,004	$96
Blue	668	69,043	103	727	71,682	99
Red lead	26,743	3,279,013	123	28,776	3,492,141	121
Orange mineral	234	50,778	217	252	47,515	189
Litharge	68,733	7,083,569	103	79,930	8,286,339	104
White lead:						
Dry	22,569	2,838,709	126	27,972	3,481,988	124
In oil [1]	56,165	10,002,820	178	68,859	11,957,171	174

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

Lead pigments sold by domestic manufacturers in the United States, 1926–35, in short tons

Year	White lead		Basic lead sulphate or sublimed lead		Red lead	Orange mineral	Litharge
	Dry	In oil	White	Blue			
1926	37,968	111,845	12,271	1,236	42,550	813	82,540
1927	38,669	119,026	13,482	1,061	39,073	709	81,655
1928	42,049	111,923	16,002	1,234	40,497	459	85,570
1929	42,159	104,872	15,580	1,234	43,021	678	87,916
1930	32,548	69,592	10,308	1,219	32,941	356	72,578
1931	30,922	66,446	8,790	896	25 853	282	63 890
1932	19,946	46,728	5,708	549	18,880	212	58,096
1933	24,628	48,354	7,320	625	21,988	231	61,193
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

Zinc pigments and salts.—Production of all zinc pigments was higher in 1935 and the percentage increases were as follows: Zinc oxide, 14 percent; leaded zinc oxide, 46 percent; and lithopone, 10 percent. The 1935 tonnages were equivalent to the following percentages of the 1929 outputs: Zinc oxide, 62; leaded zinc oxide, 110; and lithopone, 77. Unit values of the oxides decreased in 1935 and that of lithopone was unchanged.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1934–35

Pigment or salt	1934			1935		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Zinc oxide [1]	87,088	$9,851,421	$113	99,697	$10,237,953	$103
Leaded zinc oxide [1]	20,506	2,018,935	98	29,976	2,791,808	93
Lithopone	145,565	12,235,624	84	159,486	13,470,274	84
Zinc chloride, 50° B	[2] 19,614	[2] 897,062	[2] 46	(3)	(3)	(3)
Zinc sulphate	6,783	288,180	42	7,108	324,966	46

[1] Zinc oxide containing 5 percent or more lead is classed as leaded zinc oxide.
[2] Revised figures.
[3] Figures not yet available.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1926–35, in short tons

Year	Zinc oxide	Leaded zinc oxide	Lithopone	Zinc chloride (50° B.)	Zinc sulphate
1926	146,923	23,859	159,931	47,296	6,612
1927	151,246	26,064	176,994	40,141	6,418
1928	160,904	24,223	200,468	45,669	4,733
1929	160,611	27,149	206,315	43,189	7,454
1930	119,142	17,279	164,065	29,043	6,249
1931	95,700	18,577	151,850	34,885	5,290
1932	72,250	14,305	121,667	23,524	4,252
1933	98,542	22,868	140,831	32,187	5,698
1934	87,088	20,506	145,565	[1] 19,614	6,783
1935	99,697	29,976	159,486	(2)	7,108

[1] Revised figures. [2] Figures not yet available.

CONSUMPTION BY INDUSTRIES

White lead.—About 95 percent of the white lead produced is used in the manufacture of paint. The tonnage used in this industry in 1935 was 22 percent above that in 1934 and 33 percent below that in 1929. Consumption of white lead in the ceramic industry increased 28 percent in 1935.

Distribution of white lead (dry and in oil) sales, 1932–35, by industries

Industry	1932		1933		1934		1935	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Paint	63,399	95.1	68,368	93.7	75,008	95.3	91,297	94.3
Ceramics	1,761	2.6	1,617	2.2	1,434	1.8	1,834	1.9
Other	1,514	2.3	2,997	4.1	2,292	2.9	3,700	3.8
	66,674	100.0	72,982	100.0	78,734	100.0	96,831	100.0

Basic lead sulphate.—This pigment is used largely in paint, and the quantity so used in 1935 was 18 percent above that in 1934 and 42 percent below that in 1929. In 1929 over 2,000 tons of basic lead sulphate were used in storage batteries, but in 1935 none was so used.

Distribution of basic lead sulphate sales, 1932–35, by industries

Industry	1932		1933		1934		1935	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Paints	5,689	90.9	7,072	89.0	6,611	93.5	7,770	93.6
Storage batteries	195	3.1	99	1.3	139	2.0	----------	----------
Rubber	77	1.2	161	2.0	93	1.3	155	1.9
Other	296	4.8	613	7.7	224	3.2	374	4.5
	6,257	100.0	7,945	100.0	7,067	100.0	8,299	100.0

Litharge.—The principal use of litharge is in the manufacture of storage batteries, but this outlet has been affected adversely by the growing tendency of battery makers to substitute a black oxide or suboxide of lead, which they manufacture themselves. This practice was begun in 1923, and by 1929 a total of 33,000 tons of the black oxide was being made. In 1931 the tonnage declined to about 23,000; it increased again to nearly 33,000 in 1934 but fell to 29,000 tons in 1935. In 1935 all major uses of litharge increased.

Distribution of litharge sales, 1932–35, by industries

Industry	1932		1933		1934		1935	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Storage batteries	29,365	50.5	27,327	44.6	30,024	43.7	36,067	45.1
Insecticides	11,735	20.2	11,126	18.2	12,271	17.9	14,665	18.3
Oil refining	4,793	8.3	6,070	9.9	7,614	11.1	7,869	9.8
Ceramics	2,963	5.1	5,438	8.9	6,696	9.7	6,751	8.5
Chrome pigments	2,591	4.5	3,973	6.5	6,162	9.0	7,356	9.2
Rubber	1,921	3.3	2,875	4.7	2,466	3.6	3,171	4.0
Varnish	1,360	2.3	610	1.0	414	.6	564	.7
Linoleum	169	.3	106	.2	104	.1	280	.4
Other	3,199	5.5	3,668	6.0	2,982	4.3	3,207	4.0
	58,096	100.0	61,193	100.0	68,733	100.0	79,930	100.0

Red lead.—The use of red lead in storage batteries in 1935 increased 10 percent over 1934. Its use in paint was virtually unchanged.

Distribution of red lead sales, 1932–35, by industries

Industry	1932		1933		1934		1935	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Storage batteries	10,655	56.4	12,949	58.9	15,987	59.8	17,657	61.4
Paints	6,389	33.8	7,182	32.7	8,766	32.8	8,721	30.3
Ceramics	467	2.5	715	3.2	595	2.2	867	3.0
Other	1,369	7.3	1,142	5.2	1,395	5.2	1,531	5.3
	18,880	100.0	21,988	100.0	26,743	100.0	28,776	100.0

Orange mineral.—Sales of orange mineral increased slightly in 1935. This pigment is used chiefly in the manufacture of inks and color pigments, and the tonnage involved is quite small.

Distribution of orange mineral sales, 1932–35, by industries

Industry	1932		1933		1934		1935	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Ink manufacture	58	27.4	18	7.8	24	10.2	85	33.7
Color pigments	108	50.9	96	41.6	68	29.1	125	49.6
Other	46	21.7	117	50.6	142	60.7	42	16.7
	212	100.0	231	100.0	234	100.0	252	100.0

Zinc oxide.—Total sales of zinc oxide increased 14 percent in 1935 following a decline of 12 percent in 1934. Recovery was more pronounced in rubber, floor coverings, and textiles than in paint. In the preparation of exterior paints manufacturers are using smaller proportions of zinc oxide than formerly. Of the 1935 total 42 percent was made by the French process and 58 percent by the American process. The proportion of French process oxide made from scrap zinc is increasing.

Distribution of zinc oxide sales, 1932–35, by industries

Industry	1932		1933		1934		1935	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Rubber	37,679	52.1	53,869	54.7	50,145	57.6	57,734	57.9
Paints	22,369	31.0	29,218	29.7	23,741	27.3	25,289	25.4
Floor coverings and textiles	2,837	3.9	4,087	4.1	4,781	5.5	7,179	7.2
Ceramics	1,782	2.5	2,639	2.7	2,963	3.4	4,028	4.0
Other	7,583	10.5	8,729	8.8	5,458	6.2	5,467	5.5
	72,250	100.0	98,542	100.0	87,088	100.0	99,697	100.0

Leaded zinc oxide.—This pigment is used almost entirely in the manufacture of paint. The quantity sold for that purpose in 1935 was 45 percent more than in 1934. The present trend toward higher lead content in exterior paints is reflected in the large increase in use of leaded zinc oxide in 1935. Some manufacturers now are marketing a 50-percent leaded zinc oxide.

Distribution of leaded zinc oxide sales, 1932–35, by industries

Industry	1932		1933		1934		1935	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Paints	14,072	98.4	22,488	98.3	20,376	99.4	29,632	98.9
Rubber	26	.2	46	.2	28	.1	36	.1
Other	207	1.4	334	1.5	102	.5	308	1.0
	14,305	100.0	22,868	100.0	20,506	100.0	29,976	100.0

Lithopone.—Sales of lithopone to the paint industry increased 9 percent in 1935. About 13,100 tons of lithopone were used in the manufacture of titanated lithopone in 1935 compared with 8,200 tons in 1934. Sales of high-strength lithopone increased 26 percent, whereas those of regular lithopone increased only 9 percent. Floor coverings and textiles took 31 percent more and rubber 4 percent less lithopone in 1935 than in 1934. Lithopone production capacity was reported at 235,320 tons per year in 1935 compared with 232,320 tons in 1934.

Lithopone is used extensively in interior paints, and in this field it is now subject to intense competition from titanium pigments.

Distribution of lithopone sales, 1930–35, by industries

Industry	1930 (short tons)	1931 (short tons)	1932 (short tons)	1933 (short tons)	1934 (short tons)	1935	
						Short tons	Percent of total
Paints, etc	126,076	119,446	93,465	106,995	114,472	124,615	78.1
Floor coverings and textiles	23,656	20,780	17,601	18,472	14,811	19,440	12.2
Rubber	5,997	5,833	3,955	5,078	4,596	4,435	2.8
Other	8,336	5,791	6,646	10,286	11,686	10,996	6.9
	164,065	151,850	121,667	140,831	145,565	159,486	100.0

Zinc chloride.—According to the Department of Agriculture, the consumption of zinc chloride by wood-treating plants increased to 2,040 tons in 1935. From a peak of 26,000 tons (solid basis) in 1921 consumption of zinc chloride in this field declined to 12,000 tons in 1928, 2,500 tons in 1933, and 1,600 tons in 1934. The loss of this market is due primarily to the fact that zinc chloride is soluble in water and therefore is not as effective as creosote, its principal competitor, in preserving wood exposed to moisture. From time to time various insoluble zinc preservatives have been developed, none of which has found a wide market. Recently a chromated zinc was introduced, but enough time has not elapsed to gage its effect on this market for zinc.

Complete data on total sales of zinc chloride in 1935 are not available at this time, but returns received from producers representing roughly two-thirds of the total output indicate the following distribution of sales by uses in 1935:

	Percent		Percen
Soldering flux	26	Oil refining	4
Wood preserving	25	Others	9
Dry-cell batteries	23		
Vulcanized fiber	13	Total	100

Zinc sulphate.—In 1935 producers of zinc sulphate were asked to distribute their sales according to various industries. The results of the tabulation are not very satisfactory because the distribution was incomplete. Producers sell large tonnages to jobbers and were unable to classify sales of this type further. Of the total sales of 7,108 tons, 3,385 tons were reported as sold to the rayon industry, 354 tons to electrogalvanizers, 188 tons to flotation plants, 114 tons to glue manufacturers, 106 tons to printers and dyers of textiles, and 56 tons to paint and varnish manufacturers; 2,905 tons were undistributed. A break-down of the latter figure would undoubtedly show much larger tonnages for the various uses enumerated. In 1934, for instance, 667 tons of zinc sulphate were used as a flotation reagent, according to data collected by T. H. Miller of the Bureau of Mines.

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 miscellaneous secondary materials, such as scrap and waste from various industrial processes. In 1935, 93.8 percent of the lead in lead pigments was derived from pig lead, 6.1 percent from ore, and 0.1 percent from secondary material. In 1934 for zinc pigments and salts the proportions were 63 percent from ore, 21.1 percent from slab zinc, and 15.9 percent from secondary materials. Details for 1935 were not available at the time this report was prepared.

Metal content of lead pigments and zinc pigments and salts produced by domestic manufacturers, 1934–35, by sources, in short tons

Source	1934		1935	
	Lead in pigments [1]	Zinc in pigments and salts	Lead in pigments [1]	Zinc in pigments and salts
Domestic ore	7,538	76,331	12,109	85,772
Metal	157,294	[2] 25,624	185,151	(3)
Secondary material [4]	379	[2] 19,201	144	(3)
	165,211	[2] 121,156	197,404	(3)

[1] Includes also lead recovered in zinc oxide and leaded zinc oxide. The metal content of lead acetate and lead arsenate is not available as no canvass of their production is made by the Bureau of Mines. Moreover, these salts are derived from pig lead, and their metal content has already been taken into statistical account in the figures covering lead production.
[2] Revised figures. [3] Figures not available. [4] Zinc ashes, skimmings, drosses and old metal.

In the following tables the source of the metal used in the manufacture of each pigment and salt is given. Pig lead is used exclusively, either directly or indirectly, in the manufacture of white lead, litharge, red lead, and orange mineral and to a large extent in the manufacture of basic lead sulphate. 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 sulphate, and basic lead sulphate. Some secondary lead is used in the manufacture of basic lead sulphate, and a substantial proportion of the zinc in lithopone and zinc chloride made in the United States is derived from secondary material. There was a large increase in the quantity of secondary zinc used in the manufacture of zinc oxide in 1933, 1934, and 1935. This material has displaced slab zinc in the manufacture of the French process oxide.

Lead content of lead and zinc pigments produced by domestic manufacturers, 1934–35, by sources, in short tons

Pigment	1934				1935			
	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	---------	63,593	---------	63,593	---------	83,079	---------	83,079
Red lead	---------	24,972	---------	24,972	---------	25,173	---------	25,173
Litharge	---------	66,690	---------	66,690	---------	74,724	---------	74,724
Orange mineral	---------	142	---------	142	---------	296	---------	296
Basic lead sulphate	2,789	1,897	---------	4,686	4,624	1,879	---------	6,503
Leaded zinc oxide	4,749	---------	379	5,128	7,484	---------	144	7,628
Zinc oxide	---------	---------	---------	---------	1	---------	---------	
	7,538	157,294	379	165,211	12,109	185,151	144	197,404

Zinc content of zinc pigments and salts produced by domestic manufacturers, 1934–35, by sources, in short tons

Pigment or salt	1934				1935			
	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	42,804	25,371	3,355	71,530	47,021	26,749	7,490	81,260
Leaded zinc oxide	11,478	---------	95	11,573	16,185	104	356	16,645
Lithopone	[1] 20,519	---------	10,836	[1] 31,355	[1] 20,600	---------	13,512	[1] 34,112
Zinc chloride	---------	[2] 252	[2] 4,504	[2] 4,756	---------	(3)	(3)	(3)
Zinc sulphate	1,530	1	411	1,942	1,966	---------	483	2,449
	76,331	[2] 25,624	[2] 19,201	[2] 121,156	85,772	(3)	(3)	(3)

[1] Includes zinc content of a small quantity of zinc sulphide produced.
[2] Revised figures.
[3] Figures not yet available.

PRICES

The total value and the average price received by producers from sales of lead and zinc pigments and salts are stated earlier in this chapter. The range of market quotations, as reported by the Oil, Paint, and Drug Reporter, appears in the following table. On October 1, 1935, quotations on French process zinc oxides were reduced drastically to meet competition from secondary producers and importers.

Range of quotations on lead pigments and zinc pigments and salts at New York (or delivered in the East), 1933–35, in cents per pound

Product	1933	1934	1935
Basic lead sulphate, or sublimed lead, less than car lots, barrels	5.50– 6.00	6.25	6.25
White lead, or basic lead carbonate, dry, car lots, barrels	6.00– 6.50	6.25– 6.50	6.50
Litharge, commercial, powdered, barrels	5.50– 7.00	6.00– 6.75	6.00– 7.00
Red lead, dry, 95 percent or less, less than car lots, barrels	6.50– 8.00	7.00– 7.75	7.00– 8.00
Orange mineral, American, small lots, barrels:			
Ex-white lead	10.25–11.75	10.75–11.50	9.50–11.00
Ex-red lead	9.00–10.50	9.50–10.25	9.00–10.50
Zinc oxide:			
American process, lead-free, bags, car lots	5.75	5.75– 6.50	5.00– 6.50
American process, leaded, barrels, car lots	5.75	5.75– 6.50	5.13– 6.50
French process, red seal, bags, car lots	8.63	8.38	5.50– 8.38
French process, green seal, bags, car lots	9.63	9.38	6.00– 9.38
French process, white seal, barrels, car lots	10.88	10.63	6.50–10.63
Lithopone, domestic, 5-ton lots, bags	4.50	4.50	4.50
Zinc sulphide, less than car lots, bags, barrels	13.00–13.50	10.50–13.25	10.50–11.75
Zinc chloride, works:			
Solution, tanks	2.00– 3.00	2.00	2.00
Fused, drums	4.25– 5.75	4.25– 5.75	4.50– 5.75
Zinc sulphate, crystals, barrels	2.75– 3.75	2.65– 4.50	2.65– 2.80

FOREIGN TRADE[1]

Imports of lead and zinc pigments and salts increased 26 and exports 17 percent in 1935. The export surplus increased from $419,000 to $452,000; in 1929 it was over $3,000,000. In 1933 there was an apparent import surplus.

The following table shows the value of the various pigments and salts imported and exported for 1934–35.

Value of foreign trade of the United States in lead and zinc pigments and salts, 1934–35

	1934		1935	
	Imports	Exports	Imports	Exports
Lead pigments:				
White lead	$2,790	$202,683	$1,153	$277,583
Red lead		95,521	109	98,727
Litharge	6	106,010		135,976
Orange mineral	992	(1)	368	(1)
Total	3,788	404,214	1,630	512,286
Zinc pigments:				
Zinc oxide	148,792	195,681	205,264	170,757
Lithopone	219,752	199,508	256,731	221,611
Zinc sulphide	4,062		6,073	
Total	372,606	395,189	468,068	392,368
Lead and zinc salts:				
Lead arsenate		53,059		94,448
Other lead compounds	25,598		36,598	
Zinc chloride	23,990		34,027	
Zinc sulphate	7,660		6,381	
Other zinc compounds		(1)		(1)
Total	57,248	(2) 53,059	77,006	(2) 94,448
Grand total	433,642	(2) 852,462	546,704	(2) 999,102

(1) Figures not available.
(2) Exclusive of the value of "other zinc compounds", figures for which are not available.

[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.

Lead pigments and salts.—Imports of these commodities are of negligible proportions. The most important item is the group of lead compounds, including lead acetate, lead nitrate, and others.

Lead pigments and salts imported for consumption in the United States, 1930–35, in short tons

Year	Basic carbonate white lead	Red lead	Litharge	Orange mineral	Lead compounds	Total value
1930	74	10	(1)	13	297	$66,727
1931	68	(1)	(1)	12	290	61,533
1932	29	4		4	277	52,865
1933	3	1		10	268	39,312
1934	15		(1)	5	183	29,368
1935	6	1		2	302	37,750

1 Less than 1 ton.

The principal exports are white lead, litharge, red lead, and lead arsenate. Less than 3 percent of the domestic production of white lead, red lead, and litharge was exported in 1935.

Lead pigments and salts exported from the United States, 1930–35, in short tons

Year	White lead	Red lead [1]	Litharge	Lead arsenate	Other lead compounds	Total value
1930	6,546	4,128	(2)	1,135		$1,777,169
1931	5,008	3,087	(2)	894		1,123,369
1932	1,681	493	1,493	595		461,694
1933	1,048	570	1,538	299		371,769
1934	1,561	745	972	325		457,273
1935	2,337	750	1,280	578		606,734

1 Includes litharge for 1930 and 1931 and an unknown quantity of orange mineral, 1930–33.
2 Included with red lead.

White lead and red lead, orange mineral,[1] and litharge exported from the United States, by destinations, 1932–35, in short tons

Destination	White lead				Red lead, orange mineral,[1] and litharge			
	1932	1933	1934	1935	1932	1933	1934	1935
Countries:								
Argentina	31	60	69	98	63	109	232	162
Canada	23	75	91	56	1,268	1,104	415	502
Netherlands	387	377	463	827	4			2
Netherland West Indies	3	2	10	3	3	58	(2)	81
Panama	201	26	201	205	2	68	112	52
Philippine Islands	145	138	130	190	105	164	210	287
United Kingdom	743	73	47	93	26	17	3	2
Others	148	296	550	865	515	588	745	942
Total	1,681	1,047	1,561	2,337	1,986	2,108	1,717	2,030
Continents:								
North America	326	223	477	441	1,379	1,404	759	930
South America	75	150	177	202	218	210	346	402
Europe	1,131	479	590	1,242	197	213	232	139
Asia	148	141	(2)	285	170	201	40	335
Africa	(2)	53	167	166	21	80	118	224
Oceania	1	1	150	1	1	(2)	222	(2)

1 Orange mineral is not included in this group in 1934 and 1935. Data not available.
2 Less than 1 ton.

Zinc pigments and salts.—Imports of zinc oxide and lithopone increased in 1935 and were approximately twice as large as exports. Net imports amounted to less than 2 percent of domestic production.

Zinc pigments and salts imported for consumption in the United States, 1930–35, in short tons

Year	Zinc oxide		Lithopone	Zinc sulphide	Zinc chloride	Zinc sulphate	Total value
	Dry	In oil					
1930	1,056	79	7,018	80	351	519	$831,284
1931	1,352	105	5,674	67	278	208	662,706
1932	2,515	157	4,724	33	251	131	539,380
1933	2,359	182	5,596	27	431	193	600,474
1934	1,204	64	3,927	12	382	140	404,256
1935	1,931	59	4,603	15	564	135	508,476

Exports of zinc oxide and lithopone declined slightly in 1935. Most of this trade is with North American countries, chiefly Canada.

Zinc pigments and salts exported from the United States, 1930–35, in short tons

Year	Zinc oxide	Lithopone	Zinc salts	Total value	Year	Zinc oxide	Lithopone	Zinc salts	Total value
1930	10,753	3,665	1,558	$1,956,085	1933	722	1,186	(1)	[2] $230,024
1931	5,131	3,821	1,011	1,146,395	1934	1,155	2,401	(1)	[2] 395,189
1932	1,261	3,212	299	512,559	1935	1,140	2,371	(1)	[2] 392,368

[1] Zinc salts not separately recorded.
[2] Exclusive of value of zinc salts.

Zinc oxide and lithopone exported from the United States, by destinations, 1932–35, in short tons

Destination	Zinc oxide				Lithopone			
	1932	1933	1934	1935	1932	1933	1934	1935
Countries:								
Argentina	79	16	36	35	19	12	33	74
Canada	740	286	439	453	2,883	881	1,803	1,652
Cuba	23	22	87	115	82	41	185	198
France	4	5	12	15	(1)		1	2
United Kingdom	97	36	68	56	89	132	104	138
Others	318	357	513	466	139	120	275	307
Total	1,261	722	1,155	1,140	3,212	1,186	2,401	2,371
Continents:								
North America	904	437	856	724	2,983	975	2,046	1,970
South America	94	39	48	78	44	54	116	118
Europe	116	72	66	94	95	133	125	140
Asia	61	80	41	132	1	3	1	15
Africa	5	3	12	5	1	1		2
Oceania	81	91	132	107	88	20	113	126

[1] Less than 1 ton.

GOLD, SILVER, COPPER, AND LEAD IN ALASKA[1]

(MINE REPORT)

By CHAS. W. HENDERSON

SUMMARY OUTLINE

The total output of gold, silver, copper, and lead from Alaska ores and gravels in 1935, in terms of recovered and estimated recoverable metals, was 470,116.09 fine ounces of gold, 251,269 fine ounces of silver, 15,477,000 pounds of copper, and 1,451,000 pounds of lead. This output compares with a production of 537,281.83 ounces of gold, 168,868 ounces of silver, 114,000 pounds of copper, and 1,493,000 pounds of lead in 1934 and shows a decrease of 67,165.74 ounces of gold and 42,000 pounds of lead and increases of 82,401 ounces of silver and 15,363,000 pounds of copper.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the figures given in the table that follows: Gold in 1931–32 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1835, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95, the average weighted yearly United States Government prices;[2] and in 1935 at $35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1931–32 is the average New York price for bar silver; in 1934 the Treasury buying price for newly mined silver, $0.64646464+; and in 1935 the average weighted Treasury buying price for newly mined silver, $0.71875 per ounce. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of gold, silver, copper, lead, and zinc, 1931–35

Year	Gold	Silver	Copper	Lead
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*
1931	[1] $20.67+	$0.290	$0.091	$0.037
1932	[1] 20.67+	.282	.063	.030
1933	25.56	.350	.064	.037
1934	34.95	[2] .646+	.080	.037
1935	35.00	[3] .718+	.083	.040

[1] $20.671835. [2] $0.64646464. [3] $0.71875.

[1] Figures for 1935 are preliminary; detailed data with final revisions will be released later.
[2] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

Mine production of gold, silver, copper, and lead in Alaska, 1934–35, in terms of recovered metals

Year	Gold (lode and placer)		Silver (lode and placer)		Copper		Lead		Total value
	Fine ounces	Value	Fine ounces	Value	Pounds	Value	Pounds	Value	
1934	537, 281. 83	$18, 778, 000	168, 868	$109, 167	114, 000	$9, 120	1, 493, 000	$55, 241	$18, 951, 528
1935	470, 116. 09	16, 454, 063	251, 269	180, 600	15, 477, 000	1, 284, 591	1, 451, 000	58, 040	17, 977, 294

MARKETS AND SHIPPERS

There are no smelters or refineries in Alaska. The bulk of the gold produced in 1935 was in the form of bullion from placer and lode mines sent to United States mints and assay offices. The bulk of the silver was contained in concentrates and high-grade ore shipped to the Selby (Calif.) and the Tacoma (Wash.) smelters. Because of the transportation cost, all concentrates are high grade.

The bulk of the lead production in 1935 was contained in the lead-silver-gold concentrates from the Alaska Juneau Gold Mining Co. amalgamation-concentration mill at Juneau. Most of the copper was contained in the copper-silver ore and concentrates from the Kennecott Copper Corporation and Mother Lode Coalition Mines Co. at Kennecott. Other contributors of copper (as copper-gold-silver concentrates) were the Alaska Gold & Metals Co. at Ketchikan and the Nabesna Mining Co. at Chitina. Small tonnages of gold-silver concentrate were shipped by the Alaska Empire Gold Mining Co., Hawk Inlet; Apex El Nido Mining Co., Lisianski; Chichagoff Mining Co., Chichagoff; El Primero Mining & Milling Co., Valdez; Fern Gold Leasing Co., Wasilla; Gold Standard mine, Helm Bay; Golden Horn Mining Co. (ore), Iditarod; Gold Cord Development Co., Wasilla; Hirst Chichagoff Mining Co., Kimshan Cove; and Hi Yu Mining Co., Fairbanks.

The total receipts from Alaska at the San Francisco (Calif.) Mint during 1935 were 9,895 fine ounces of gold and 1,532 fine ounces of silver, a large part of which came from J. R. Murphy, lessee of the two dredges, each equipped with 4-cubic foot buckets, of the Fairbanks Gold Dredging Corporation, Ltd., at Fairbanks. Other large depositors were the C. J. Berry Dredging Co. in the Miller House district; the Felder & Gale dredge (twenty-six 3½-cubic foot buckets) on Yankee Creek 16 miles from Takotna; and Wildberg Bros. in the Miller House district. From January to June the United States Smelting, Refining & Mining Co., Midvale, Utah, received bullion from its subsidiary, the Fairbanks Exploration Co., Fairbanks, Alaska. After June this gold went to the United States Assay Office, Seattle, Wash., as did that of the Nome division of the United States S. R. & M. Co., known as the Hammon Consolidated Gold Fields.

The United States Assay Office, Seattle, Wash., reports the following receipts from Alaska in 1935:

Deposits of bullion of original production at United States Assay Office, Seattle, during the year ended Dec. 31, 1935

District	Gold	Silver	District	Gold	Silver
	Fine ounces	*Fine ounces*		*Fine ounces*	*Fine ounces*
Circle	1,445.155	297.94	Kuskokwim	5,741.144	637.39
Cook Inlet	26,726.790	2,447.91	Nome	68,847.998	3,867.99
Copper River	4,764.799	777.93	Southeastern Alaska	123,791.219	3,683.09
Eagle	4,319.266	765.60	Tanana	150,130.674	5,646.74
Iditarod	30,675.453	4,527.75			
Koyukuk	1,443.796	81.13	Total	417,886.294	22,733.47

Important shippers of bullion to Seattle were: Alaska Empire Gold Mining Co., Juneau; Alaska Juneau Gold Mining Co., Juneau; Arctic Mines, Inc., and Arctic Circle Exploration, Inc., both in the Nome district; Cripple Creek Mining Co., Folger; Goodnews Bay Mining Co., Goodnews Bay; Walker's Fork Gold Corporation (dredge), Walkers Fork; Nelson Mining Co., Chisana district; Chichagoff Mining Co., Chitinu Mines, McCarthy; Crow Creek Gold Corporation, Anchorage; Peter Curran, Nome; Thomas J. DeVane, Iditarod district; Dry Creek Dredging Co., Nome; Fern Gold Leasing Co., Wasilla. In the Fairbanks district gold came from Ward Hansen & Keating Treasure claim at Chatanika, A. A. Zimmerman on Sourdough and Twin Creeks, Faith Creek Mining Co. on Faith Creek, Fish Creek Mining Co., Gilmore Mining Co., Gold King Mining Co., Mussano & Canning, Treasure Creek, Cleary Hill Mines Co. dragline excavator and sluices, Hi Yu Mining Co., Mutchler Bros. & Grant Irishman mine, Mohawk Mining Co., and Porcupine Mining Co. hydraulic operation on Porcupine Creek. In the Nome district, the Keewalik Mining Co. (dredge) shipped bullion in November. The dredge of the Fox Bar Dredging Co., equipped with fifty-two 2½-cubic foot buckets, was operated from July 23 to October 15. The Miners & Merchants Bank of Iditarod at Flat was agent for large quantities of bullion from the Iditarod district. The Miners & Merchants Bank of Alaska at Nome bought large quantities of gold from the Nome, Bluff, Candle, Council, Inmachuk, Kougarok, Haycock, Teller, Solomon, and Bonanza districts.

The Peters Creek Mining Co. operated bench gravels near Talkeetna by hydraulicking from June through August.

The dredge of the Spruce Creek Dredging Co. at Nome, equipped with fifty-four 2¾-cubic foot buckets was operated from June 25 to October 21.

The Willow Creek Mines, Inc., was a regular shipper of bars throughout the year from its Lucky Shot mine on Craigie Creek in the Willow Creek district at the head of Cook Inlet.

COMPANY REPORTS

The Thirtieth Annual Report of the United States Smelting, Refining & Mining Co. for the year ended December 31, 1935, contains the following comments on its Alaska operations:

At Fairbanks, Alaska, the five dredges were put into operation a little later than in the previous year, the first starting March 20 and all five in operation by April 1. The aggregate number of dredge days was 1,268 in 1935 compared with 1,279 in 1934, and the yardage of gravel handled was slightly less than in the previous year, but gold production was about the same. An additional power unit is now being installed to provide power for the equipment, preparation, and handling of the new areas. Additional proven areas have been acquired since the beginning of the year, and other areas are under option.

At Nome, Alaska, where the start of the dredging season is necessarily later than at Fairbanks, the three dredges were operating by July 18. The aggregate number of dredge days was 449 compared with 253 in 1934 when only two dredges were operated.

The Twenty-First Annual Report of the Alaska Juneau Gold Mining Co. for the year ended December 31, 1935 (dated Mar. 2, 1936), says:

The decline in earnings from the 1934 figure to $1,848,638.49 (before depreciation and income taxes) for the year 1935 was due entirely to a forced shut-down of operations for an equivalent of 48 days full working time. This shut-down was the result of a strike, the details of which are fully covered in the accompanying report of Superintendent L. H. Metzgar. No further trouble of this character is anticipated.

The gold assay value of the ore trammed was slightly higher in 1935 than in 1934, but this increase was offset by a slight increase in operating costs due to the mining of a larger proportion of deep-level ore, to strike expense, to the increased cost of supplies, and to the fact that the year 1935 was the first full year under the increased wage scale inaugurated July 1, 1934.

The important mine development work of the year was in those claims purchased from the Alaska Mining & Power Co.; the main haulage level was extended well into that property, and a total of 4,000 ft. of work was done. Before the end of the present year a substantial tonnage will be coming from that area. All other underground work was routine with the exception of a resumption of sinking the "53" winze in December to explore the South Orebody below the 1,000-ft. level.

The main expenditures on capital account were for new equipment for the disposal of coarse waste, consisting of three 600-ton self-dumping reversible barges and one 72-foot 275-hp. seagoing tugboat; in all this equipment cost slightly over $100,000.00. A portion of the hydroelectric generating equipment purchased from the Alaska Mining & Power Co. is being rehabilitated, and on this work there was expended about $80,000.00.

Successful progress has been made in recovering additional gold from the mill tailings, and this work will be further advanced during the coming year. However, the additional recovery from this source will not noticeably affect earnings, as it will just about offset growing costs due to governmental activities and the increased cost of labor and supplies.

Alaska Juneau Gold Mining Co., 1935

STATEMENT OF EARNINGS AND PROFIT AND LOSS FOR YEAR ENDED DECEMBER 31, 1935

Production revenue (gross recovered values):			
From 118,998 fine ounces gold		$4, 165, 784. 05	
From 77,787 fine ounces silver		56, 265. 16	
From 1,455,167 pounds lead		59, 061. 05	
			$4, 281, 110. 26
Less operating and marketing costs			2, 443, 544. 42
Gross profit from production			1, 837, 565. 84
Other revenue:			
Interest received and sundry		99, 186. 82	
Less other costs:			
Stock-transfer expense, etc	$10, 931. 20		
Outside prospects abandoned	77, 182. 97		
		88, 114. 17	
			11, 072. 65
Profit before depreciation			1, 848, 638. 49
Less main plant depreciation			135, 440. 15
Net profit before depletion			1, 713, 198. 34

Surplus at December 31, 1934 (before depletion)		$2, 868, 850. 89
		4, 582, 049. 23
Less:		
Accrued income taxes for 1935	$149, 400. 43	
Dividends paid in 1935	1, 800, 000. 00	
		1, 949, 400. 43
Surplus at December 31, 1935 (before depletion)		2, 632, 648. 80

Development work in the Perseverance mine, acquired from the Alaska Mining & Power Co., and in adjoining ground was pushed vigorously during the year. One thousand six hundred ninety-two feet of main haulage level were first driven to reach a favorable location in Perseverance ground. Since the completion of this amount of haulage level, 1,345 feet of raises have been driven, and from these raises 380 feet of intermediate crosscut and drift have been driven. The raises driven comprise two main working raises, and as soon as these raises are connected to the upper levels, providing improved ventilation and accessibility, development and preparatory work in this easterly area will be increased. The development work done in the Perseverance area in the last few months of the year shows fair values in some places, which indicates that stoping may be started a short distance above the No. 4 or main Gold Creek tunnel level.

Owing to the fact that the equivalent of 48 days of full-time operation was lost on account of a strike, the tonnage trammed and milled is less than in the previous year.

During the year, 163,800 pounds of powder were used in blasting powder drifts, and 137,575 pounds of powder were used in blasting long-hole drill stations, making a total of 301,375 pounds of powder for primary breaking, or 0.08 pound per ton trammed. Secondary breaking consumed 879,000 pounds of powder, or 0.24 pound per ton trammed. The total powder consumption for mining was 0.32 pound per ton trammed as against 0.28 pound in 1934 and 0.22 pound in 1933.

Mill.—The installation of a small tube mill and a flotation unit, to fine grind and float some of the coarser portion of the fine tailings, was completed. The operating results with this equipment showed a small profit. Further experimental work indicating that a small additional recovery of gold might be effected by fine-grinding and treating by flotation more of the fine tailings, a 10-cell, 500-ton flotation unit, together with the necessary classifier and auxiliary equipment, was installed. For preliminary work, one of the ball mills already installed will be adapted to fine grinding and used in this work. This installation was completed just at the close of the year, and further experimental work on a large scale is now under way.

Labor.—There was an abundant supply of labor, more skilled miners applying for work than for several years past. Applications by letter continue to be received, but as in the past only those men applying in person were hired. Forty-three days of operation, from May 22 to July 4, inclusive, were lost on account of a strike forced by a minority of the employees. On May 22, after the company would not agree to most unusual and unreasonable demands, the Alaska Mine Workers' Union, then comprised of a minority of employees and represented by a committee of 19, called a strike. With some 200 active members, this organization effectively picketed the approaches to the property for a time. No strike vote was taken by this union, either before or after the strike was called. During the month following the cessation of operations, the majority of the employees signified a desire to work. On June 24, in the face of determined and active opposition of the minority, 510 former employees made application to return to work. On July 5th part-time operations were resumed. Plenty of men being available locally, full operation was under way before the end of the month. Only former employees and men applying at the office were employed in resuming operations.

Power plants.—Among the items of property acquired in the Alaska Mining & Power Co. purchase was Salmon Creek No. 1 power plant. The building at this plant was burned several years ago, and the 2-mile flume has deteriorated beyond repair. The generators are worth rehabilitation, and the pipe line is intact. This plant gets its water from a storage dam after the water has passed through Plant No. 2 and is a reliable source of winter power at times when there is a shortage at some of the other water power plants of the company. Since the saving to be effected by using water power instead of steam power justified the expenditure, it was decided early in 1935 to rehabilitate this plant and rebuild the flume. Accordingly, orders for the necessary flume material were placed at Puget Sound mills. Owing to strikes at the lumber mills, complete delivery was slow and uncertain, and consequently the construction work was only 40 percent completed before the close of the season. It is expected that this plant's rehabilitation will be completed and the plant put in operation during the 1936 season.

Gold content of ore, Alaska Juneau mine, 1935 [1]

Month [2]	Rock to mill from mine, tons		Gold recovery per ton fine milled		Gold losses per ton of tailings		Gold content of rock from mine to mill
	Ore fine milled, tons	Coarse tailings rejected, tons	In bullion	In galena concentrates	Fine	Coarse	
January	182,159	170,691	0.0498	0.0027	0.0111	0.0078	0.0367
February	181,842	153,168	.0543	.0035	.0112	.0080	.0411
March	204,625	169,085	.0590	.0042	.0109	.0079	.0441
April	198,174	171,806	.0596	.0042	.0112	.0080	.0439
May	155,267	116,463	.0609	.0041	.0112	.0080	.0470
July	153,041	103,029	.0466	.0033	.0118	.0083	.0289
August	212,079	157,141	.0522	.0032	.0104	.0076	.0410
September	203,935	154,965	.0521	.0031	.0100	.0074	.0403
October	208,120	173,980	.0537	.0033	.0099	.0074	.0398
November	195,591	134,509	.0483	.0033	.0106	.0077	.0400
December	196,642	133,348	.0492	.0032	.0105	.0076	.0406
Total and average	2,091,475	1,638,185	.0533	.0035	.0108	.0078	.0413

[1] Gold in ounces.
[2] No operations in June.

The Twenty-First Annual Report of the Kennecott Copper Corporation for the year ended December 31, 1935 (dated Mar. 24, 1936), says concerning its Alaska division:

The mines at Kennecott, Alaska, were reopened in June 1935, after a shutdown of nearly 3 years, and the mill was operated on the basis of one shift a day. Exploratory work was resumed in September on a limited scale without, however, locating any new ore showings. While it is planned to continue exploration, if no new ore bodies are discovered as a result thereof, the remaining life of the Alaska property will be only a few years.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN ARIZONA, IDAHO, MONTANA, UTAH, AND WASHINGTON[1]

(MINE REPORT)

By C. N. Gerry, T. H. Miller, and Paul Luff

SUMMARY OUTLINE

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the figures given in the table that follows: Gold in 1931–32 is figured at $20.671835 per ounce, the Treasury legal-coinage value for fine gold from January 18, 1835, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95, the average weighted yearly United States Government prices [2]; and in 1935 at $35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1931–33 is the average New York price for bar silver; in 1934 the Treasury buying price for newly mined silver, $0.64646464; and in 1935 the average weighted Treasury buying price for newly mined silver, $0.71875 per ounce. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of gold, silver, copper, lead, and zinc, 1931–35

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1931	[1] $20.67+	$0.290	$0.091	$0.037	$0.038
1932	[1] 20.67+	.282	.063	.030	.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044

[1] $20.671835. [2] $0.64646464.

[1] Figures for 1935 are preliminary; detailed data with final revisions will be released later.
[2] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35.00 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

ARIZONA

The value of the metal production in Arizona increased nearly 63 percent in 1935, due largely to the increase in the quantity of the metals and partly to the increase in the average prices of silver, copper, lead, and zinc in 1935. The greater part of the increase in value ($14,090,839) resulted from production and sales of copper (increase, $8,968,000). Incomplete reports from mines, mints, and smelters indicate that the value of recoverable gold, silver, copper, lead, and zinc produced from mines in Arizona in 1935 was approximately $37,382,989, a decided increase from $23,292,150 in 1934. There was a large gain over 1934 in the production of each of the five metals. Late returns including more exact data for the last 2 months of the year indicate larger increases in gold, silver, and copper than is shown by the estimate of production published in January. The chief reasons for the increased production in 1935 were the reopening and continued operation of part of the United Verde mine, which had been idle for nearly 4 years; the large increase in the production of copper from the New Cornelia mine at Ajo and the Miami and Inspiration mines at Miami; the substantial gain in the output of siliceous gold ore from mines at Oatman, Katherine, Mammoth, Hillside, Prescott, Cordes, and Octave; and the increase in the output of lead from the Eagle-Picher property at Ruby and the "79" mine in Gila County. Steady operations of the Eagle-Picher mine resulted in a notable zinc production from Santa Cruz County.

Mine production of gold, silver, copper, lead, and zinc in Arizona, 1931–35, in terms of recovered metals

Year	Ore, old tailings, etc.	Gold	Silver	Copper
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*
1931	13, 690, 610	126, 185. 94	3, 245, 311	401, 344, 909
1932	4, 414, 579	66, 789. 67	2, 082, 823	182, 491, 825
1933	995, 728	79, 992. 61	2, 390, 363	114, 041, 781
1934	3, 270, 242	167, 024. 12	4, 448, 474	178, 082, 213
1935 [1]	6, 775, 000	242, 680. 00	6, 622, 000	279, 700, 000

Year	Lead	Zinc	Total value
	Pounds	*Pounds*	
1931	1, 964, 112		$40, 144, 694
1932	2, 364, 300		13, 535, 935
1933	3, 442, 540	11, 024	10, 307, 749
1934	6, 877, 216	1, 810, 279	23, 292, 150
1935 [1]	15, 567, 000	6, 632, 874	37, 382, 989

[1] Subject to revision.

Gold.—The recoverable gold output from mines in Arizona in 1935 increased 75,656 ounces over the output in 1934. Gold from lode mines in 1935 was approximately 236,500 ounces compared with 160,041.86 ounces in 1934, and 6,180 ounces of gold were recovered from placers compared with 6,982.26 ounces in 1934. One floating dredge was operated on Lynx Creek in 1935, as in 1934, but its production was slightly less. Large increases in the production of gold in 1935 were shown by the United Verde, New Cornelia, Octave, Copper Queen Branch of the Phelps Dodge Corporation, Eagle-

Picher, Tyro, Hillside, Pioneer, Gold Road, Tom Reed, Portland, Ruth-Rattan, Sterling, Shattuck, Shattuck-Denn, Mammoth-St. Anthony, and Harbud (Gladstone-McCabe) properties; gold production of the Lake Superior and Arizona Lease, Sheeptanks, United Verde Extension, Big Jim, United American, Golden Belt, and Humbug mines decreased substantially. More than 59 percent of the gold output in Arizona in 1935 was recovered in copper bullion produced at the four copper smelters at Douglas, Clarkdale, Clemenceau, and Superior, and more than 24 percent was recovered as gold bullion and precipitates sold to mints and refining plants. Most of the remainder was contained in crude ore and concentrates shipped to the smelter at El Paso, Tex. Thirteen mines in Arizona each produced more than 5,000 ounces of gold; in order of output they were the Copper Queen Branch at Bisbee, the United Verde mine at Jerome, the New Cornelia mine at Ajo (all operated by the Phelps Dodge Corporation), the Tom Reed mine at Oatman, the Magma mine at Superior, the Eagle-Picher property at Ruby, the Lake Superior and Arizona Lease at Superior, the Octave mine at Octave, the Hillside property near Hillside, the Tyro mine at Katherine, the United Verde Extension mine at Jerome, the Harbud (Gladstone-McCabe) property near Humboldt, and the Gold Standard group at Katherine. These mines yielded about 170,000 ounces of gold or more than 70 percent of the State output. Other mines that produced more than 1,800 ounces of gold each in 1935 were the Tombstone Development (Tombstone group) at Tombstone, the Ruth-Rattan at Oatman, the Molybdenum Gold (New Year and Mohawk mines) at Mammoth, the Golden Turkey at Cordes, the Pioneer Gold (Pilgrim mine) near Chloride, the Shattuck-Denn at Bisbee, the Gold Road near Oatman, the Big Jim at Oatman, the Portland north of Katherine, the Sterling Gold (Richinbar mine) at Cordes, the Mammoth-St. Anthony group at Mammoth, and the Lynx Creek Placer Mine Co. (dredge) near Prescott. New mills were constructed at the Sterling property near Cordes and at the Pioneer, Arizona, Magma, and Keystone properties, all near Chloride.

Silver.—The recoverable silver output increased from 4,448,474 ounces in 1934 to about 6,622,000 ounces in 1935 and the value from $2,875,781 to $4,759,563, as the average price of silver rose from 64.646 cents an ounce in 1934 to 71.875 cents an ounce in 1935. Ore receipts at Douglas and at the Magma smelter, including those for November and December, were decidedly increased in 1935; those at Clemenceau were less, as the smelter was operated intermittently during the year. Each of four mines, led by the United Verde property, increased its silver production by 100,000 ounces. Almost 70 percent of the silver produced in Arizona in 1935 came from copper ore from the Copper Queen Branch, United Verde, Magma, United Verde Extension, and New Cornelia mines; most of the remainder came from lead-zinc ore, siliceous ore, and lead ore. Seven mines in Arizona produced more than 200,000 ounces of silver each in 1935—the Copper Queen Branch at Bisbee, the United Verde mine at Jerome, the Eagle-Picher property at Ruby, the Magma mine at Superior, the United Verde Extension mine at Jerome, the Tombstone Development group at Tombstone, and the New Cornelia mine at Ajo. Other large producers of silver were the Hillside property near Hillside, the Shattuck-

Denn mine at Bisbee, the Swastika property near Cleator, the Golden Turkey mine at Cordes, and the Belmont mine at Superior.

Copper.—The recoverable copper output in 1935 was about 279,700,000 pounds, an increase of 60 percent over the output in 1934, but far below the average annual output for the last decade. The value increased from $14,246,577 in 1934 to about $23,215,100 in 1935. The record held by Arizona of leading all States in copper output was upheld in 1935. The chief reasons for the increase of nearly 102,000,000 pounds of copper were the resumption of production at the United Verde mine and the continuous operations at the New Cornelia mine. The Inspiration mine also produced considerable copper by resuming work at the leaching plant in October. Copper smelters at Douglas, Clemenceau, and Superior continued operations during 1935, but the copper smelters at Clifton and Hayden remained idle. For many years prior to 1930 the United Verde mine held first place in Arizona in the production of gold, silver, and copper. In 1935, however, the largest producer of copper in the State was the New Cornelia mine of the Phelps Dodge Corporation at Ajo; it was followed by the Copper Queen Branch at Bisbee and the United Verde mine at Jerome (both operated by the Phelps Dodge Corporation), the Magma mine at Superior, the Miami mine at Miami, and the United Verde Extension mine at Jerome. These six properties produced about 277,000,000 pounds of copper or 99 percent of the State total, and each produced more than 19,500,000 pounds of copper. The Inspiration mine at Miami and the Shattuck-Denn property at Bisbee were also large producers of copper. In 1935 the chief increases were those made at the United Verde, New Cornelia, Miami, and Inspiration properties.

Lead.—The recoverable lead production in Arizona increased from 6,877,216 pounds in 1934 to about 15,567,000 pounds in 1935, the largest production since 1929, when 16,054,122 pounds were produced; the average annual output for the last decade was about 11,227,000 pounds. The value of the lead output in 1935 was about $622,680, an increase from $254,457 in 1934, as the average sale price of lead rose from 3.7 to 4 cents a pound. The unusually large gain in the production of lead in Arizona in 1935 was due chiefly to the marked increase in the output of lead-zinc ore from the Montana mine of the Eagle-Picher Mining & Smelting Co. at Ruby and to the increase in the shipments of first-class lead ore from the "79" mine near Winkelman. The Eagle-Picher Mining & Smelting Co. was by far the largest producer of lead in Arizona in 1935; it was followed by the "79" mine, Tombstone group (Bunker Hill property including Toughnut lease), and Tombstone Extension mine. These four properties produced 91 percent of the State output of lead. Other fairly large producers of lead were the Molybdenum Gold (Mohawk & New Year group), Mammoth-St. Anthony, Golden Turkey, and Shattuck-Denn properties.

Zinc.—For the past 2 years nearly all the zinc produced in Arizona has come from the Montana property of the Eagle-Picher Mining & Smelting Co. at Ruby, Santa Cruz County. In 1935 the company output of lead-zinc ore was nearly four times greater than its output in 1934. The 300-ton flotation-concentration plant was operated throughout the year; lead concentrates were shipped to El Paso, Tex., and zinc concentrates to Amarillo, Tex. In 1935 the company was not only the largest producer of lead and zinc in Arizona but ranked third in the production of silver and sixth in gold. The output of recoverable zinc in Arizona in 1935 was about 6,632,874 pounds valued at $287,107 compared with 1,810,279 pounds valued at $77,842 in 1934. The average sale price of zinc in 1935 was 4.4 cents a pound and in 1934, 4.3 cents a pound.

Ore output.—The output of ore, old tailings, etc., in Arizona in 1935 was about 6,775,000 tons, more than double the output in 1934. There were unusually large gains in the output of copper ore, lead-zinc ore, siliceous gold ore and old tailings, and lead ore. Nearly 5,774,000 tons (85 percent) of the total ore, etc., produced in Arizona in 1935 was copper ore; about 860,000 tons (12 percent) was gold ore and old tailings; about 2 percent was lead-zinc ore; and the remainder was gold and silver ore and lead ore. The largest producer of copper ore in 1935 was the New Cornelia mine at Ajo; the largest producer of gold ore was the Hillside mine near Hillside; the largest producer of silver ore and lead ore was the Tombstone group (Bunker Hill property) at Tombstone; and the largest producer of lead-zinc ore was the Montana mine at Ruby.

Review of chief districts.—In Cochise County, mines at Bisbee and Tombstone were active. In the Warren (Bisbee) district the Copper Queen Branch of the Phelps Dodge Corporation had a large production of gold, silver, and copper and did 47,596 feet of development. The property held first place in Arizona in the production of gold and silver and was second only to the New Cornelia Branch in the production of copper. The Shattuck Denn Mining Corporation operated the Denn group at Bisbee and produced 25,227 tons of shipping ore containing gold, silver, and copper. In addition, lessees operated the Shattuck mine and shipped 7,241 tons of lead ore. The McKenna & Scott lease on the Holbrook-Czar property of the Phelps Dodge Corporation produced gold ore of shipping grade and became an important producer of gold. The Dives mine of the Consolidated Gold Mines Co. in the Dos Cabezas district produced concentrates rich in gold, by flotation. "First-class" gold ore was shipped to the Southwestern Metals Co. "First-class" silver-lead ore was shipped from the Four Horse property in the Swisshelm district. In the Tombstone district the largest producing mine was the Tombstone group of the Tombstone Development Co. It was a large producer of gold, silver, and lead, chiefly from crude smelting ore and partly from ore treated by cyanidation and concentration. Silver-lead ore of smelting grade—2,353 tons—was shipped from the Tombstone Extension property by lessees. Considerable development was done at the Tough Nut mine leased to the United States Smelting, Refining & Mining Co., and regular shipments of lead ore, containing both gold and silver, were made throughout the year. The Herschel mine produced chiefly silver ore, treated in a small cyanidation plant, and the Commonwealth mine in the Turquoise district produced 1,768 tons of silver ore treated by cyanidation.

In Gila County there was renewed activity and production, especially in the Globe district, where leaching was resumed at the Inspiration property during the last quarter of the year. The Miami Copper Co. was active throughout 1935 and produced ore of concentrating grade from which 30,000,000 pounds of copper were recovered. The Morenci Branch of the Phelps Dodge Corporation in Greenlee County was idle, and production consisted chiefly of gold and silver ore shipped from the Starge lease.

Important operations were carried on in Maricopa County by the Ace Mining & Development Co. in the Salt River Mountains. Considerable gold was recovered from the Tiger mine and from the Vulture mine (from both ore and old tailings) near Wickenburg. Some crude ore was shipped from the Jack White property in the Winifred district.

In Mohave County an interesting feature of the year was the large production of gold from the Pilgrim mine operated by the Pioneer Gold Mining Co. An 80-ton flotation mill was operated on gold ore and the concentrates treated by amalgamation. A decided increase in the gold output of the San Francisco district resulted from operations at the Tom Reed custom cyanide mill. The Tom Reed property took fourth place in gold production in 1935. Other properties in the district that were large producers of gold were the Ruth-Rattan, Gold Road, United American, Big Jim, Pioneer, and Western Apex mines.

The Big Jim mine at Oatman, active 7 months, was a large producer of gold, but the output was only half that in 1934. Resumption of work at the Gold Road mine resulted in a large gold production from ore shipped to the Tom Reed custom mill. The Pioneer group of the Amulet Mines, Inc., at Oatman, was operated by lessees, and more than 5,000 tons of gold ore were treated at the Tom Reed mill.

In the Katherine region mines of the Gold Standard Mines Corporation produced considerable gold ore which was treated in the company cyanide mill, and the output from the Tyro mine was unusually large. The Portland mine in the Weaver district was operated by the Gold Standard Mines Corporation and became an important producer of gold. In the Wallapai district north of Chloride the majority of the production was ore from the Keystone, Diana, Tintic, and Samoa properties.

In Pima County the Phelps Dodge Corporation operated its large flotation mill at Ajo and shipped copper concentrates to Douglas. The New Cornelia Branch was the largest producer of copper in Arizona, and third in the production of gold. The mine was operated the entire year, and the output was about double that in 1934, when the property was operated only 6 months.

At Mammoth in the Old Hat district of Pinal County two important operations made a large production of gold. The Molybdenum Gold Mining Co. operated the New Year and Mohawk group, producing gold bullion and concentrates containing chiefly gold, silver, and lead, with some molybdenum and vanadium. Similar operations were conducted at the old Mammoth mine by the Mammoth-St. Anthony, Ltd. In the Pioneer district near Superior the Magma Copper Co. milled and smelted an aggregate of 259,500 tons of copper ore and produced a large quantity of gold, silver, and copper. In the same district more than 13,000 tons of gold ore were shipped by lessees from the Lake Superior and Arizona property of the Magma Copper Co., and about 7,600 tons of silver ore were shipped from the Reymert mine. More than 4,700 tons of ore containing chiefly gold and silver were shipped from the Belmont mine, and 1,143 tons of gold ore were shipped from the Queen Creek property by lessees.

The Eagle-Picher Mining & Smelting Co. operated the Montana and Ruf & Ready groups in the Oro Blanco district, and it was the largest producer of the five metals in Santa Cruz County, as well as the largest producer of lead and zinc in the State. The company operated a 300-ton flotation plant the entire year on lead-zinc ore.

In the Big Bug district, Yavapai County, the Harbud Mines Co. worked the Gladstone-McCave property all year and shipped more than 2,500 tons of concentrates containing chiefly gold. The Savoy placers at Mayer were worked the first 4 months of the year by a dry-land dredge, and about 200 ounces of gold were recovered. The Golden Turkey, Golden Belt, and Sterling (Richinbar) mines in the Black Canyon district were large gold producers in 1935 from ore treated in concentration plants. North of Hillside in the Eureka district the Bagdad Copper Corporation resumed operations, treating 3,718 tons of copper ore in a concentration plant, and the Hillside Mines, Inc., operated its 150-ton flotation-concentration plant continuously, treating more than 52,000 tons of gold and silver ore.

The chief producers in the Hassayampa district in 1935 were the Tillie Starbuck and Davis-Dunkirk mines; several thousand tons of gold and silver ore from each property were treated by flotation-concentration.

The output of the Lynx Creek district was all placer gold and silver, recovered chiefly by dredging operations at the Fitzmaurice property by the Lynx Creek Placer Mine Co. The gold output of the district decreased from 3,615.02 ounces in 1934 to about 2,883 in 1935. The Peck district is an important producer of silver, and the output increased from 44,058 ounces in 1934 to about 111,000 ounces in 1935, due chiefly to the large increase in the output of silver ore from the Swastika mine.

Production of copper ore from the United Verde Extension mine at Jerome in 1935 was decidedly less than that in 1934, but the loss was more than offset by the large output of copper ore from the United Verde mine at Clarkdale, which was operated the first 2 months of the year by the United Verde Copper Co. and the remainder of the year by the Phelps Dodge Corporation. The United Verde mine ranked second in gold and silver production and third in copper production in Arizona in 1935.

The Weaver district is a gold-producing district, and the output of gold increased decidedly from 1,084.75 ounces in 1934 to about 7,000 ounces in 1935. The chief output was gold ore from the Octave mine, treated by flotation-concentration.

The chief output in Yuma County in 1935 was gold recovered from old tailings at the Bonanza property near Salome and placer gold recovered from claims in the Plomosa, Laguna, La Paz, Dome, and Muggins Mountains district and from bars along the Colorado River. The production of gold from lode mines decreased considerably, as the Sheeptanks mine in the Kofa district, a large producer of gold in 1934, was idle in 1935.

IDAHO

The output of gold, silver, copper, lead, and zinc from mines in Idaho in 1935, in terms of recovered metals, was 83,882 fine ounces of gold, 10,241,778 fine ounces of silver, 2,096,095 pounds of copper, 158,072,370 pounds of lead, and 62,195,031 pounds of zinc. This output compares with a production in 1934 of 84,817.20 ounces of gold, 7,394,143 ounces of silver, 1,531,625 pounds of copper, 142,648,216 pounds of lead, and 49,598,651 pounds of zinc. The total value of the output in 1935 was $19,530,600 compared with $15,277,669 in 1934, an increase of $4,252,931.

The chief factors that affected the production of gold, silver, copper, lead, and zinc in Idaho in 1935 were the decrease in the output of gold from the Middle Boise district, Elmore County, the increase in the output of gold from dredging operations, the unusual increase in the output of silver from the Yankee Boy mine of the Sunshine Mining Co., the decided increase in the output of lead-zinc ore from the Morning and Page mines of the Federal Mining & Smelting Co., and the large gain in the production of zinc from the property of the Bunker Hill & Sullivan Mining & Concentrating Co.

Mine production of gold, silver, copper, lead, and zinc in Idaho, 1931–35, in terms of recovered metals

Year	Ore, old tailings, etc. (short tons)	Gold (lode and placer)		Silver (lode and placer)	
		Fine ounces	Value	Fine ounces	Value
1931	1, 299, 927	18, 361. 36	$379, 563	7, 220, 923	$2, 094. 068
1932	1, 032, 853	46, 885. 39	969, 207	6, 716, 968	1, 894, 185
1933	1, 190, 851	64, 592. 23	1, 650, 977	6, 987, 960	2, 445, 786
1934	1, 287, 182	84, 817. 20	2, 964, 361	7, 394, 143	4, 780, 052
1935 [1]	1, 512, 326	83, 882. 00	2, 935, 870	10, 241, 778	7, 361, 278

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1931	1, 144, 915	$104, 187	198, 729, 228	$7, 352, 981	39, 137, 212	$1, 487, 214	$11, 418, 013
1932	1, 143, 381	72, 033	144, 235, 067	4, 327, 052	20, 504, 234	615, 127	7, 877, 604
1933	1, 562, 234	99, 983	148. 726, 701	5, 502, 888	41, 935, 977	1, 761, 311	11, 460, 945
1934	1, 531, 625	122, 530	142, 648, 216	5, 277, 984	49, 598, 651	2, 132, 742	15, 277, 669
1935 [1]	2, 096, 095	173, 976	158, 072, 370	6. 322, 895	62, 195, 031	2, 736, 581	19, 530, 600

[1] Subject to revision.

Gold and silver produced at placer mines in Idaho, 1931–35, in fine ounces, in terms of recovered metals

Year	Sluicing		Dry-land dredges [1]		Floating dredges		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1931	1, 326. 51	497	(2)	(2)	[2] 3, 887. 01	[2] 1, 351	5, 213. 52	1, 848
1932	4, 161. 28	857	(2)	(2)	[2] 8, 278. 40	[2] 2, 969	12, 439. 68	3, 826
1933	5, 147. 97	1, 164	781. 16	149	17, 360. 77	5, 930	23, 289. 90	7, 243
1934	8, 155. 62	2, 350	3, 248. 70	593	15, 852. 05	5, 585	27, 256. 37	8, 528
1935 [3]	7, 235. 00	1, 523	895. 00	984	23, 640. 00	9, 593	31, 770. 00	12, 100

[1] Drag-line and power-shovel excavators with sluices or special amalgamators.
[2] Figures for floating dredges include those for dry-land dredges; separate figures not available.
[3] Subject to revision.

Gold.—The output of recoverable gold in Idaho in 1935 decreased only 935 ounces from the output in 1934. All the decrease came from lode mines, as the output from placers, especially from dredging operations, increased more than 4,500 ounces. The largest decrease in the output of gold was reported by the St. Joseph Lead Co., operating the Boise-Rochester property at Atlanta, and the output of the Yellow Pine Co. at Stibnite also declined. The largest increase in the output of gold came from the Gold Hill (Talache) mine at Quartzburg. Nine floating dredges were working in Idaho in 1935 compared with five in 1934. New floating dredges were constructed at the Wharton property near Centerville by the Grimes Co. near Idaho City, and by the Jordan Creek Placers near Silver City. The Idaho Gold Dredging Co. (two dredges) and the Warren Creek Dredging Co. operated their plants near Warren all year, and the dredges of the Gold Dredging, Inc., at Pierce, the Little Smoky Dredging Co. near Fairfield, and the Mount Vernon Mining Co. at Elk City were operated part of the year.

The total production of gold recovered by nine bucket dredges in 1935 was 23,640 ounces, a decided increase from 15,852 ounces from five dredges in 1934; the placer output recovered by other methods was 8,130 ounces, a decrease of 3,274 ounces. The production of gold from lode mines in 1935 was 52,112 ounces compared with 57,560.83 ounces in 1934. A decrease of more than 8,000 ounces of gold from the St. Joseph Lead property was partly offset by increases at the Gold Hill, Golden Anchor, Placer Basin, Homestake (Penman), Orogrande-Frisco, and Grunter mines. The largest producers of gold in Idaho in 1935 were the St. Joseph Lead Co. (Boise-Rochester mine) at Atlanta, Idaho Gold Dredging Co. at Warren, Yellow Pine Co. at Stibnite, Warren Creek Dredging Co. at Warren, Gold Hill (Talache) mine at Quartzburg, Gold Dredging, Inc., near Pierce, the Grimes Co. (dredge) near Idaho City, Lone Pine mine at Golden, Wharton Placers (dredge) near Centerville, Golden Anchor mine at Burgdorf, Come-Back mine at Pioneerville, Gnome mine near Elk City, American Consolidated Mining & Milling Co. (Grunter mine) near Shoup, Placer Basin mine near Council, Jordan Creek Placers (dredge) near Silver City, Little Smoky Dredging Co. near Fairfield, and the Penman Mines Corporation (Homestake mine) near Orogrande.

Siliceous gold ore, old tailings, etc., yielded about 47,885 ounces of gold in 1935, compared with 55,468.36 ounces in 1934, and represented 57 percent of the total gold; placers yielded 38 percent; and the remaining 5 percent came from other classes of ore (chiefly gold and silver and lead-zinc). Of the total gold produced from lode mines (52,112 ounces) 45 percent was recovered from treating gold ore and old tailings by amalgamation and concentration; 21 percent was recovered from treating gold ore by straight concentration; 16 percent was recovered by treating gold ore by amalgamation; 4.6 percent was recovered by treating gold ore and old tailings by cyanidation; and 4 percent was recovered from crude gold ore shipped direct to smelters.

The Boise Basin district in Boise County is one of the chief gold-producing districts in Idaho, and the output of gold from lode mines increased from 4,197.71 ounces in 1934 to about 8,300 ounces in 1935. The gain was due chiefly to the large production of gold ore, treated by amalgamation, from the Gold Hill (Talache) mine at Quartzburg. The output of gold from placers in the Boise Basin district in 1935 was about the same as that in 1934 (4,934.42 ounces). More than 71 percent of the placer output was recovered by two floating dredges—one working the Wharton placers on Grimes and Granite Creeks near Centerville and the other working claims also on Grimes Creek near Pioneerville. Most of the remainder of the placer production was recovered by hydraulic and sluicing operations at the Gold Hill property near Idaho City.

The Middle Boise district in Elmore County has been the largest producer of gold in Idaho since the St. Joseph Lead Co. began milling gold ore in February 1932 by amalgamation and flotation concentration. The output of gold in the district in 1935 was 3 percent less less than the output in 1934.

The output of gold from the Warren district in Idaho County increased from 15,486.61 ounces in 1934 to about 16,200 ounces in 1935. Nearly all the gold (96 percent) was recovered by dredging operations on Warren Creek.

The Yellow Pine district in Valley County is another important gold-producing district in Idaho. The Yellow Pine Co., operating the Meadow Creek group near Stibnite, is the chief producer in the district; the company treated more than 50,000 tons of gold-antimony ore by flotation concentration in 1935. The gold output of the district decreased from 10,491.36 ounces in 1934 to about 8,380 ounces in 1935.

Other districts in Idaho that produced 1,000 to 3,500 ounces of gold each in 1935 were the Seven Devils in Adams County, Little Smoky in Camas County, Pierce in Clearwater County, Marshall Lake, Orogrande, and Ten Mile in Idaho County, Mineral Hill in Lemhi County, and Carson in Owyhee County. Nearly all the gold produced in the Seven Devils district was recovered from gold ore of smelting grade from the Placer Basin mine. The output of gold from the Little Smoky, Pierce, and Carson districts was nearly all placer gold recovered by dredging operations; and the gold produced from the other districts was recovered from gold ore treated either by amalgamation, cyanidation, or amalgamation and concentration.

Silver.—Idaho was again the largest producer of silver in the United States, followed by Montana and Utah. The output of recoverable silver in Idaho in 1935 was 10,241,778 ounces compared with 7,394,143 ounces in 1934. For the first time in recent years the silver output exceeded the average annual output of the last decade (8,285,300 ounces). The value increased from $4,780,052 in 1934 to $7,361,278 in 1935, due chiefly to the increase in the average sale price of silver from 64.6+ cents an ounce in 1934 to 71.875 cents an ounce in 1935. All the large producers of silver in Idaho increased their output in 1935 over 1934, but the increase from the Yankee Boy mine of the Sunshine Mining Co. east of Kellogg was especially noteworthy; the company increased its silver output from 3,456,568 ounces in 1934 to 5,876,908 ounces in 1935 and was again the largest silver producer in the United States. Other large producers of silver were the Hecla, Bunker Hill & Sullivan, Morning, Crescent, Page, and Gold Hunter mines, all in the Coeur d'Alene region, Shoshone County. Mines in the Coeur d'Alene region produced 9,894,308 ounces of silver in 1935 (97 percent of the State total) compared with 7,062,640 ounces in 1934. Most of the remainder of the silver was produced from mines in the Middle Boise district, Elmore County; Boise Basin district, Boise County; Bay Horse district, Custer County; Lakeview district, Bonner County; Yellow Pine district, Valley County; and Washington district, Washington County.

Of the total silver produced in Idaho in 1935, 61 percent was recovered from silver ore (chiefly classified as copper-lead ore in 1934); 23 percent was recovered from lead-zinc ore; 14 percent from lead ore and old tailings; and the remaining 2 percent chiefly from siliceous ores. Ore and old tailings treated in concentration plants yielded more than 96 percent of the total silver output.

Copper.—The output of recoverable copper increased from 1,531,625 pounds, valued at $122,530, in 1934 to 2,096,095 pounds, valued at $173,976, in 1935. More than 59 percent of the total copper produced in Idaho in 1935 was recovered from silver ore; 25 percent was recovered from lead-zinc ore; and most of the remainder from lead ore and old tailings. Mines in Shoshone County produced nearly 95 percent of the State output of copper in 1935, and more than half of it came from the Sunshine mine; it was followed by the Bunker Hill & Sullivan, Morning, Hecla, and Crescent mines.

Lead.—The output of recoverable lead increased from 142,648,216 pounds, valued at $5,277,984, in 1934 to 158,072,370 pounds, valued at $6,322,895 in 1935; the average annual output for the last decade was 222,358,150 pounds. In 1917, the year of record lead output, mines in Idaho produced 393,559,521 pounds of lead. The largest increase (more than 14,000,000 pounds) in the output of lead in 1935 was reported from the Morning mine of the Federal Mining & Smelting Co. Substantial increases in lead output were also reported from the Page (Federal Mining & Smelting Co.), Hecla, Star, Sidney, and Frisco mines. The largest decrease in lead (about 4,000,000 pounds) was recorded from the Golconda mine; the output of lead from the Bunker Hill & Sullivan, Gold Hunter, and Clayton Silver properties also decreased considerably. About 70 percent of the total lead produced in Idaho in 1935 was recovered from lead-zinc ore, and nearly all the remainder was recovered from lead ore and old tailings. There was an increase of about 14,139,000 pounds of lead from lead-zinc ore and an increase of about 815,000 pounds from lead ore and old tailings. In 1935 the Morning mine of the Federal Mining & Smelting Co. was the largest lead producer in Idaho, a position held for many years by the Bunker Hill & Sullivan Mining & Concentrating Co.; the Bunker Hill & Sullivan mine ranked second in lead, and the Hecla mine was third. These three properties, each producing more than 41,500,000 pounds of lead, were followed by the Page, Gold Hunter, Frisco, Blackhawk, Star, Golconda, Sidney, Clayton Silver, and Hope mines. All the output of lead in Idaho in 1935 except about 1,445,000 pounds was produced from the Coeur d'Alene region. Most of the remainder was produced from mines in the Bay Horse district, Custer County, and the Pend d'Oreille district, Bonner County.

Zinc.—The output of recoverable zinc was 62,195,031 pounds, valued at $2,736,581 in 1935 compared with 49,598,651 pounds, valued at $2,132,742 in 1934. The average annual output of zinc for the last decade was 54,871,777 pounds. Nearly all the increase in the production of zinc in Idaho in 1935 was due to the increase in the output of lead-zinc ore. More than 82 percent of the zinc produced in Idaho in 1934 was recovered from lead-zinc ore from the Morning and Bunker Hill & Sullivan mines; the output of zinc from each property increased more than 5,000,000 pounds. Substantial increases in zinc production were also recorded from the Star, Sidney, and Page mines, but there was a decided decrease in zinc from the Golconda mine. The Star and Sidney mines again became producers of lead-zinc ore in November after being inactive for several years. The Morning mine of the Federal Mining & Smelting Co. continued to be the largest producer of zinc in Idaho, followed by the Bunker Hill & Sullivan, Frisco, Page, Star, Golconda, Sidney, and Hecla mines, all in the Coeur d'Alene region. A little zinc was also recovered from ore mined in the Warm Springs and Mineral Hill districts, Blaine County, and in the Lakeview district, Bonner County.

Ore output.—About 1,512,300 tons of ore, old tailings, etc., were produced from mines in Idaho in 1935 compared with 1,287,182 tons in 1934. There were substantial increases in the output of lead-zinc ore, silver ore, and gold ore, and there was also an increase in the output of lead ore. More than 81 percent of the ore came from mines in the Coeur d'Alene region, and 15 percent was gold ore and old tailings from the Boise-Rochester, Yellow Pine, Orogrande-Frisco, Gold Hill, Grunter, Lone Pine, Homestake, and Gnome mines. More than half (805,285 tons) of the material from mines in the Coeur d'Alene region was lead-zinc ore, and nearly all the remainder was lead ore and old tailings and silver ore.

Gold ore.—The output of gold ore, old tailings, etc., in Idaho in 1935 was 261,356 tons, an increase of 61,535 tons over the output in 1934. This large increase was due chiefly to the production of gold ore from the Orogrande-Frisco property in the Orogrande district, Idaho County; the increase in the output of gold ore from the Gold Hill (Talache) mine in the Boise Basin district, Boise County; and the treatment of old tailings from the Boise-Rochester property in the Middle Boise district, Elmore County. The largest producer of gold ore and old tailings in Idaho in 1935 was the St. Joseph Lead Co., operating property in the Middle Boise district, Elmore County; it was followed by the Yellow Pine property in the Yellow Pine district, Valley County, the Orogrande-Frisco group near Orogrande, and the Gold Hill (Talache) mine at Quartzburg. These four properties produced nearly 59 percent of the total output of gold ore, old tailings, etc. Other properties that produced more than 3,000 tons of gold ore each were the Grunter in the Mineral Hill district, Lemhi County; the Lone Pine in the Ten Mile district, Idaho County; the Homestake and Gnome in the Orogrande district, Idaho County; the War Eagle in the Robbins district, Idaho County; and the Gold Hill in the Mineral Hill district, Lemhi County.

Gold and silver ore.—The output of gold and silver ore (379 tons) was produced chiefly from the Come-Back mine in the Boise Basin district, Boise County.

Silver ore.—In recent years the ore from the Sunshine and Crescent mines was classified as copper-lead ore, but in 1935 the classification was changed to silver ore, which accounts for the large increase in the State output of silver ore in 1935 over 1934. The output of ore from the Sunshine mine in 1935 increased 51,846 tons over the output in 1934, and there was also an increase in the output of ore from the Crescent mine. These two properties near Kellogg, Shoshone County, produced more than 95 percent of the State output of silver ore.

Copper ore.—Nearly all the copper ore (728 tons) produced in Idaho in 1935 came from the Copper Queen mine near Tendoy, Lemhi County, and from the old Empire mine near Mackay, Custer County.

Lead ore.—The output of lead ore and old tailings in Idaho in 1935 was 259,777 tons, an increase of 19,312 tons over the output in 1934. The gain was due almost entirely to the increase in the output of lead ore from the Hecla mine at Burke, Shoshone County. This mine and the Gold Hunter mine at Mullan, also in Shoshone County, produced 92 percent of the total output of lead ore and old tailings. The Clayton Silver (Camp Bird) mine in the Bay Horse district, Custer County, and the Hope mine in the Pend d'Oreille district, Bonner County, each produced more than 4,500 tons of lead ore. About 94 percent of the total output of lead ore and old tailings was treated in concentration plants, and the recovered lead increased from 33,198,441 pounds in 1934 to 33,946,784 pounds in 1935. Crude lead ore of smelting grade amounted to about 15,000 tons, and the recovered lead was 11,990,800 pounds compared with 12,122,080 pounds in 1934.

Lead-zinc ore.—The output of lead-zinc ore in Idaho in 1935 was 805,506 tons, an increase of 81,520 tons over the output in 1934. This large gain was due chiefly to the increase in the production of lead-zinc ore from the Morning, Page, and Frisco mines and to the reopening of the Star and Sidney mines. Nearly all the output of lead-zinc ore came from mines in Shoshone County, and the entire production was treated in flotation-concentration plants. The Bunker Hill property was again the largest producer of lead-zinc ore in Idaho, followed by the Morning mine of the Federal Mining & Smelting Co.; these two properties produced 81 percent of the total output of lead-zinc ore. Other large producers were the Page, Frisco, Golconda, Star, Blackhawk, and Sidney mines. The largest decrease (more than 40,000 tons) in the output of lead-zinc ore was reported by the Golconda Lead Mines.

SHOSHONE COUNTY

COEUR D'ALENE REGION

Mine production of gold, silver, copper, lead, and zinc in the Coeur d'Alene region, Shoshone County, Idaho, 1934–35, and total, 1884–1935, in terms of recovered metals

Year	Lode mines	Placers	Ore, old tailings, etc.	Gold	Silver
			Short tons	*Fine ounces*	*Fine ounces*
1934	24	113	1,071,059	3,965.35	7,062,640
1935	26	110	1,227,889	2,740.00	9,894,300
Total, 1884–1935			(1)	356,023.93	292,544,529

Year	Copper	Lead	Zinc	Total value
	Pounds	*Pounds*	*Pounds*	
1934	1,472,275	140,662,811	49,597,628	$12,159,340
1935	1,975,546	156,627,454	62,107,700	16,369,235
Total, 1884–1935	88,799,094	[2] 4,600,763	[2] 513,627	776,471,362

[1] Figures not available.
[2] Short tons.

MONTANA

The output of gold, silver, copper, lead, and zinc from Montana ores and gravels in 1935, in terms of recovered metals, was 150,557.60 fine ounces of gold, 9,355,854 fine ounces of silver, 154,920,759 pounds of copper, 31,224,175 pounds of lead, and 109,544,932 pounds of zinc. These figures compare with a production in 1934 of 97,445.95 fine ounces of gold, 4,006,468 fine ounces of silver, 63,265,000 pounds of copper, 20,010,000 pounds of lead, and 61,442,256 pounds of zinc. The total value of the 1935 output was $30,921,403, more than double the value ($14,439,363) of the output in 1934.

The following table, giving a production summary for the last 5 years, indicates that there were substantial increases in 1935 over 1934 in the output of all five metals, especially in copper and silver. Most of the increases were recorded in the Butte or Summit Valley district, where the copper and zinc mines were operated regularly during the year, but there were also substantial increases at numerous gold- and silver-mining districts in the State.

Mine production of gold, silver, copper, lead, and zinc in Montana, 1931–35, in terms of recovered metals

Year	Ore, old tailings, etc.	Gold	Silver	Copper
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*
1931	2,085,683	40,112.16	3,829,837	184,555,735
1932	765,014	40,602.01	1,686,213	84,847,349
1933	862,486	57,822.20	2,660,700	65,476,375
1934	1,066,952	97,445.95	4,006,468	63,265,000
1935 [1]	2,367,105	150,557.60	9,355,854	154,920,759

Year	Lead	Zinc	Total value
	Pounds	*Pounds*	
1931	8,860,186	13,494,986	$19,575,053
1932	2,157,766	4,393,034	6,856,737
1933	13,163,432	41,448,905	8,827,569
1934	20,010,000	61,442,256	14,439,363
1935 [1]	31,224,175	109,544,932	30,921,403

[1] Subject to revision.

Gold.—The recoverable gold output in Montana in 1935 was valued at $5,269,516, compared with $3,405,736 in 1934. Lode mines produced 124,831.80 fine ounces of gold and placers 25,725.80 fine ounces compared with 71,902.06 fine ounces and 25,543.89 fine ounces, respectively, in 1934. The large Yuba dredge on Gold Creek near Pioneer, Powell County, was again the largest producer of gold in Montana; it was operated at a normal rate throughout the year, and its output was substantially the same as in 1934. The removal of the dredge in Ophir Gulch near Avon, also in Powell County, after al available dredging ground in the vicinity had been treated, resulted in a sharp decrease in gold from the Ophir district. There was also a decrease in placer gold from the Montana City area, Jefferson County, due to a shut-down at the Winston Brothers plant while the equipment was being moved to a new location on Prickly Pear Creek. These losses, however, were more than offset by the output from two new dredging plants—the Porter Brothers dredge, which started operations near Helena in November, and the dry-land dredge at the Humphreys Gold Corporation, operating in Alder Gulch just below Virginia City, Madison County. There were 468 placers operated in Montana in 1935 compared with 654 placers in 1934.

There was an increase of nearly 52,000 ounces of gold from lode mines. Some of this increase came from copper ore and lead-zinc ore, but most of it was due to large increases at properties treating siliceous gold ore. Large increases in gold output were reported by all the following producers of gold in Montana in 1935, named in order of output: Pioneer dredge, Gould (Standard Silver-Lead Mining Co.), Spring Hill, August (Little Ben Mining Co.), Jardine, Golden Messenger (United Gold Mines Co.), Anaconda Copper Mining Co. (copper and zinc mines), Humphreys dredge, Comet (Basin Montana Tunnel Co.), Mammoth (Liberty Montana Mines Co.), and Ruby Gulch properties.

Silver.—The value of the recoverable silver output increased from $2,590,040 in 1934 to $6,724,520 in 1935. Silver from the Butte properties (copper and zinc claims) at the Anaconda Copper Mining Co. was more than double that in 1934 and accounted for 61 percent of the total increase in the State. Important increases in silver were also reported at the Trout, Emma, Flathead, Comet, Quartz Hill, and Granite Bimetallic properties. These producers, named in order of output, accounted for 89 percent of the total silver produced in Montana in 1935.

Copper.—The value of the recoverable copper output in Montana increased from $5,061,200 in 1934 to $12,858,423 in 1935. Nearly all of the increase came from copper claims of the Anaconda Copper Mining Co. at Butte, which were operated continuously during 1935; in 1934 the mines were closed for nearly 5 months due to labor strikes. Other large producers of copper in Montana in 1935 were the Trout, Emma, and Comet mines—all producers of lead-zinc ore.

Lead.—The value of the recoverable lead produced in Montana increased from $740,370 in 1934 to $1,248,967 in 1935, due chiefly to increases in the output of lead-zinc ore from the Orphan Girl and Emma mines at Butte, both operated by the Anaconda Copper Mining Co. Other large producers of lead were the Comet mine near Basin, the slag fuming plant at East Helena, and the Trout mine at Philipsburg. There was a decrease in lead from the Jack Waite mine in Sanders County, operated by the Federal Mining & Smelting Co.

Zinc.—The recoverable zinc produced in Montana in 1935 was valued at $4,819,977 compared with $2,642,017 in 1934. Most of the zinc came from the Orphan Girl and Emma mines at Butte and the slag fuming plant at East Helena, all operated by the Anaconda Copper Mining Co. Other large producers of zinc were the Trout, Comet, Jack Waite, and Silver Prince mines.

Ore output.—The output of ore and old tailings was 2,367,105 tons compared with 1,066,952 tons in 1934. Most of the increase was in copper ore and lead-zinc ore from Butte, but there were also increases in lead-zinc ore from Philipsburg and Basin and in siliceous ore from many gold-producing districts in the State. There were 727 lode mines and 468 placers operating in Montana in 1935 compared with 583 lode mines and 654 placers in 1934.

UTAH

The output of gold, silver, copper, lead, and zinc from Utah ores and gravels in 1935, in terms of recovered metals, was 184,658.60 fine ounces of gold, 9,206,368 fine ounces of silver, 129,515,253 pounds of copper, 127,013,525 pounds of lead, and 62,203,591 pounds of zinc. These figures compare with a production in 1934 of 136,581.52 fine ounces of gold, 7,111,417 fine ounces of silver, 86,024,925 pounds of copper, 116,153,945 pounds of lead, and 56,396,279 pounds of zinc. The total value of the 1935 output was $31,647,393 compared with $22,975,534 in 1934, an increase of $8,671,859 (37.74 percent); the value of the 1935 output was 64 percent of the average annual output ($49,449,492) for the decade 1926–35.

The following table, giving a production summary for the last 5 years, indicates substantial increases in 1935 over 1934 in the output of all five metals, especially in copper and silver. Most of the increases were in the Bingham or West Mountain district, largely as a result of increased output by the Utah Copper Co. and the United States Smelting, Refining & Mining Co.

Mine production of gold, silver, copper, lead, and zinc in Utah, 1931–35, in terms of recovered metals

Year	Ore, old tailings, etc.	Gold	Silver	Copper
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*
1931	8,954,617	198,740.12	8,290,966	151,236,505
1932	3,768,542	135,256.35	6,962,097	64,964,111
1933	4,116,935	109,129.55	5,669,197	73,583,130
1934	5,076,735	136,581.52	7,111,417	86,024,925
1935 [1]	7,771,568	184,658.60	9,206,368	129,515,253

Year	Lead	Zinc	Total value
	Pounds	*Pounds*	
1931	158,423,453	74,581,072	$28,970,974
1932	125,552,966	59,331,888	14,398,593
1933	117,376,556	59,489,193	16,324,369
1934	116,153,945	56,396,279	22,975,534
1935 [1]	127,013,525	62,203,591	31,647,393

[1] Subject to revision.

Gold.—The value of the recoverable gold output increased more than 35 percent—from $4,773,524 in 1934 to $6,463,051 in 1935. Gold from mines in the Bingham district increased 32,040.39 ounces in 1935, due chiefly to large gains at the Utah Copper, United States & Lark, and Boston Consolidated properties. Gold from the Park City region increased 4,345.51 ounces, chiefly from increases of the Park Utah Consolidated and Park City Consolidated properties. There was a decrease of nearly 6,600 ounces of gold from the Eureka Standard mine, but gains at the Centennial-Beck, Mammoth, and Victoria properties offset this loss and caused an increase of 1,043.40 ounces of gold from the Tintic district. There was an increase of 10,803.94 ounces of gold from mines in Tooele County, due entirely to the greatly increased output of siliceous ore from the Consolidated Mercur property of the Lewiston Peak Mining Co. in the Camp Floyd district. The Utah Copper mine was again the largest producer of gold in Utah in 1935, followed by the United States & Lark, Eureka Standard, and Consolidated Mercur properties.

Silver.—The value of the recoverable silver output increased from $4,597,280 in 1934 to $6,617,077 in 1935, a gain of $2,019,797 (nearly 44 percent). Silver from the Bingham district increased 802,878 ounces, from the Tintic district 688,513 ounces, and from the Park City region 505,206 ounces. Important increases in silver output were reported at the United States & Lark, Tintic Standard, Park City Consolidated, and Utah Copper properties, but there was a decrease from the Silver King Coalition mine, which dropped to third place in silver production in Utah in 1935, following the United States Smelting, Refining & Mining Co. and the Tintic Standard Mining Co.

Copper.—The recoverable copper output in Utah in 1935 was valued at $10,749,766 compared with $6,881,994 in 1934, an increase of $3,867,772 (56.20 percent). The output from the Utah Copper property at Bingham increased 50 percent and represented 91 percent of total copper for the State in 1935. Other important copper producers were the United States & Lark, Boston Consolidated, Utah-Delaware, and Ohio Copper properties, all in the Bingham district.

Lead.—The value of the recoverable lead output increased from $4,297,696 in 1934 to $5,080,541 in 1935, an increase of $782,845 (18.22 percent). Lead from the Bingham district increased 7,746,602 pounds, due entirely to the greater output from the United States & Lark property, as the output from the Utah-Delaware, Utah-Apex, and Niagara properties decreased. There were also increases in lead output from the Tintic, Park City, and Rush Valley districts. The United States Smelting, Refining & Mining Co. was by far the largest producer of lead in Utah in 1935, followed by the Silver King Coalition, Bluestone, and Tintic Standard properties.

Zinc.—The value of the recoverable zinc output in Utah increased from $2,425,040 in 1934 to $2,736,958 in 1935, an increase of $311,918 (12.86 percent). Most of the increase was from the United States & Lark group at Bingham and the Hidden Treasure mine in the Ophir district, Tooele County. There was a heavy decrease in zinc production at the Silver King Coalition mine, but an increased output from the Park City Consolidated mine and the resumption of production at the Park Utah Consolidated property, both at Park City, held the total zinc output from the Park City region nearly equal to that of 1934. The United States & Lark group at Bingham was again the chief producer of zinc in Utah, followed by the Silver King Coalition, Hidden Treasure, West Calumet, and Park City Consolidated properties.

Ore output.—There were 196 lode mines and 26 placers operating in Utah in 1935 compared with 190 lode mines and 28 placers in 1934. The lode mines produced 7,771,568 dry tons of ore and old tailings compared with 5,076,735 tons in 1934. Most of the increase was in copper ore from Bingham, but there were also substantial increases in siliceous gold ore and in lead-zinc ore. Placer mines produced 255.80 fine ounces of gold and 32 fine ounces of silver in 1935 compared with 128.04 fine ounces of gold and 17 fine ounces of silver in 1934.

The following table compares the production from the chief mining areas in Utah in 1934 and 1935. Additional details of production by counties and mining districts, ore classification, and methods of treatment will be published in the chapter on Utah in the statistical appendix to Minerals Yearbook, 1936.

Mine production of gold, silver, copper, lead, and zinc in the principal mining regions of Utah in 1934 and 1935

[In terms of recovered metals]

Mining district or region	Ore	Gold	Silver
	Short tons	*Fine ounces*	*Fine ounces*
Bingham or West Mountain:			
1934	4,502,819	77,385.21	2,652,994
1935	7,055,341	109,425.60	3,455,872
Tintic:			
1934	159,998	36,380.80	1,976,223
1935	200,849	37,424.20	2,664,736
Park City:			
1934	160,903	3,660.69	1,995,050
1935	206,954	8,006.20	2,500,256
Tooele County:			
1934	224,887	10,779.06	362,478
1935	277,988	21,583.00	390,528

Mining district or region	Copper	Lead	Zinc
	Pounds	*Pounds*	*Pounds*
Bingham or West Mountain:			
1934	83,585,788	64,839,973	33,221,628
1935	126,120,964	72,586,575	35,992,614
Tintic:			
1934	1,146,951	11,430,324	17,488
1935	1,764,229	11,665,375	30,546
Park City:			
1934	555,375	24,720,298	19,385,093
1935	697,530	26,360,250	19,318,864
Tooele County:			
1934	437,963	14,323,838	3,556,256
1935	730,590	15,224,375	6,295,977

WASHINGTON

The output of gold, silver, copper, lead, and zinc from Washington ores and gravels in 1935, in terms of recovered metals, was 9,682.40 fine ounces of gold, 52,320 fine ounces of silver, 86,700 pounds of copper, 206,150 pounds of lead, and 2,160 pounds of zinc. These figures compare with a production in 1934 of 8,301.83 fine ounces of gold, 44,120 fine ounces of silver, 13,900 pounds of copper, 581,298 pounds of lead, and 3,852,419 pounds of zinc. The output from placer mines in 1935 was 1,492.40 fine ounces of gold and 256 fine ounces of silver compared with 1,773.45 fine ounces of gold and 317 fine ounces of silver in 1934.

The large decreases in the output of lead and zinc were due to the continued inactivity of the Josephine property of the Pend Oreille Mines & Metals Co. at Metaline Falls. These decreases were partly offset by substantial increases in gold output from the Aurum and Blaine Republic properties at Republic, the Bodie mine near Wauconda, and the Boundary Red Mountain mine in Whatcom County. The gain in copper output was due to the reopening of the Trinity property of the Royal Development Co. north of Leavenworth.

Mine production of gold, silver, copper, lead, and zinc in Washington, 1931–35, in terms of recovered metals

Year	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc	Total value
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1931	92,049	2,904.19	22,410	202,503	2,771,116	9,947,495	$565,498
1932	42,272	5,082.13	17,412	5,524	1,842,267	4,489,334	300,263
1933	53,984	4,562.68	18,520	5,781	1,680,430	6,738,169	468,653
1934	47,902	8,301.83	44,120	13,900	581,298	3,852,419	506,945
1935 [1]	32,115	9,682.40	52,320	86,700	206,150	2,160	392,026

[1] Subject to revision.

Gold.—The output of recoverable gold in Washington increased from 8,301.83 fine ounces in 1934 to 9,682.40 fine ounces in 1935. Gold from lode mines increased 1,661.62 ounces, but gold from placers decreased 281.05 ounces. As in recent years, most of the gold from lode mines came from siliceous ore mined near Republic, Ferry County. The group of claims controlled by the Aurum Mining Co., comprising the Lone Pine, San Poil, Surprise, Black Tail, and others, was the largest producer of gold and silver in Washington in 1935; the properties were operated by lessees, and the ore was shipped to Tacoma, Wash., and Trail, B. C., for smelting. The Blaine-Republic Co. was also an important producer of gold ore; some of the ore was treated by cyanidation, and the remainder was sent to Tacoma for smelting. These large gains in gold output from the Republic district were offset by a decrease of nearly 1,400 ounces from the Knob Hill mine, which was closed in May 1935. As a result the district output (4,446.34 ounces of gold) was virtually the same as in 1934. The Bodie mine near Wauconda, Okanogan County, was the second largest producer of gold in Washington in 1935; the mine was operated by the Northern Gold Corporation, and several thousand tons of gold ore were treated by amalgamation and concentration. The First Thought mine near Orient, Stevens County, was again an important gold producer, and the Boundary Red Mountain mine in Whatcom County south of Sardis, B. C., was reopened and operated by the International Gold Mines, Ltd. As in the past, most of the placer production came from operations along the Columbia River, chiefly in Stevens County, and from the Swauk district, Kittitas County.

Silver.—The output of recoverable silver increased from 44,120 ounces in 1934 to 52,230 ounces in 1935. Nearly half of the 1935 production came from siliceous gold ore from mines in the Republic district, and most of the remainder came from three producers of siliceous silver ore in Stevens County. The largest producers of silver in Washington in 1935 were the Aurum, Deer Trail, Daisy, Old Dominion, Royal, Blaine-Republic, and Big Silver properties.

Copper.—Most of the recoverable copper produced in Washington in 1935 came from the Trinity property of the Royal Development Co. in Chelan County north of Leavenworth. The property was reopened in the last quarter of the year, and copper ore was treated in the flotation plant which had been idle since it was constructed and operated for a short time in 1930. A little copper material (mill clean-up) was shipped from the Sunset property at Index, and gold ore yielding considerable copper was shipped from the Morning Star mine near Danville.

Lead and zinc.—The Pend Oreille Mines & Metals Co. continued exploration and development work at the Josephine mine near Metaline Falls, Pend Oreille County, but no lead-zinc ore was produced or milled in 1935, resulting in a sharp decrease in lead and zinc from this source. Most of the lead produced in Washington in 1935 came from crude ore of smelting grade shipped from the Electric Point and Gladstone Mountain mines near Northport in Stevens County.

Ore output.—There were 60 lode mines and 170 placers operating in Washington in 1935 compared with 62 lode mines and 210 placers in 1934. The lode mines produced 32,115 tons of ore compared with 47,902 tons in 1934. The decrease was entirely in lead-zinc ore, as the production of siliceous ores increased from 19,420 tons in 1934 to

31,080 tons in 1935. Crude material shipped to smelters amounted to 15,301 tons and the remainder (16,814 tons) was treated at milling plants. Eight gold and silver mills (six amalgamation, one cyanidation, and one amalgamation and flotation) treated 13,230 tons of ore, and five concentrating mills (two flotation and three gravity concentration) treated 3,584 tons.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN CALIFORNIA[1]

(MINE REPORT)

By Charles White Merrill and H. M. Gaylord[2]

SUMMARY OUTLINE

The output of gold, silver, copper, lead, and zinc from California ores, gravels, and re-treated tailings in 1935, in terms of recovered metals, is estimated to be 888,510 fine ounces of gold valued at $31,097,850, 1,199,500 fine ounces of silver valued at $862,141, 1,965,000 pounds of copper valued at $163,095, 1,650,000 pounds of lead valued at $66,000, and 264,000 pounds of zinc valued at $11,616, a total value of $32,200,702 for the five metals. In 1934 California mines yielded 719,064 fine ounces of gold valued at $25,131,287, 844,413 ounces of silver valued at $545,883, 569,068 pounds of copper valued at $45,525, 823,168 pounds of lead valued at $30,457, and 721,719 pounds of zinc valued at $31,034, a total value of $25,784,186 for the five metals.

The quantity and value of all the metals except zinc increased substantially. Gold increased 24 percent in quantity and value, silver 42 percent in quantity and 58 percent in value, copper 245 percent in quantity and 258 percent in value, and lead 100 percent in quantity and 117 percent in value; zinc decreased 63 percent in quantity and value. The estimated value of the metal output in 1935 exceeded that for 1934 by $6,416,519 (25 percent) and was the largest for any year since 1917. The quantity of gold produced in 1935 exceeded that for any year since 1917, and its value exceeded that for any year since 1862. Gold provided the principal revenue of metal miners in California; it accounted for 97 percent of the total value of the output of the five metals in 1935.

[1] Figures for 1935 are preliminary; detailed data with final revisions will be released later.
[2] The assistance of O. Y. Sharman is acknowledged.

Because of the enormous productivity of its Grass Valley-Nevada City district, Nevada County continued to be the leading metal-producing county of the State. Substantial outputs were also reported from many other counties, including Sacramento and Yuba, the most productive gold-dredging counties of the State; Amador, which contains the two deepest lode mines of the Far West; Calaveras and Eldorado, both on the Mother Lode; Sierra, which contains high-grade gold ore in the Alleghany district; and Kern, again restored as a leading gold producer because of the activity in the Mojave district. Moreover, most of the counties of the State yielded some nonferrous metals during 1935.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the figures given in the table that follows: Gold in 1931–32 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1835, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95, the average weighted yearly United States Government prices;[3] and in 1935 at $35.00 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1931–33 is the average New York price for bar silver; in 1934 the Treasury buying price for newly mined silver, $0.64646464+; and in 1935 the average weighted Treasury buying price for newly mined silver, $0.71875 per ounce. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of gold, silver, copper, lead, and zinc, 1931–35

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1931	[1] $20.67+	$0.290	$0.091	$0.037	$0.038
1932	[1] 20.67+	.282	.063	.030	.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044

[1] $20.671835. [2] $0.64646464.

Mine production of gold, silver, copper, lead, and zinc in California, 1931–35, in terms of recovered metals

Year	Gold (lode and placer)		Silver (lode and placer)		Copper	
	Fine ounces	Value	Fine ounces	Value	Pounds	Value
1931	523,135.09	$10,814,162	867,818	$251,667	12,931,995	$1,176,812
1932	569,166.99	11,765,726	493,533	139,176	1,417,876	89,326
1933 [1]	613,578.85	15,683,075	402,591	140,907	990,380	63,384
1934	719,063.92	25,131,284	844,413	545,883	569,068	45,525
1935 [2]	888,510.00	31,097,850	1,199,500	862,141	1,965,000	163,095

Year	Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	
1931	3,757,256	$139,018	159,865	$6,075	$12,387,734
1932	2,417,416	72,522			12,066,750
1933 [1]	761,156	28,163	290,214	12,189	15,927,718
1934	823,168	30,457	721,719	31,034	25,784,183
1935 [2]	1,650,000	66,000	264,000	11,616	32,200,702

[1] Includes copper recovered from copper concentrates produced in 1930 but not marketed until 1933.
[2] Subject to revision.

[3] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35 per ounce under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

Gold.—The production of recoverable gold in California in 1935 is estimated at 888,510 fine ounces valued at $31,097,850, an increase of 24 percent in quantity and value over 1934. Exact figures are not available on the proportionate contributions of lode and placer mines, but enough data have been collected to indicate substantial increases from both sources. In 1934 lode mines accounted for approximately 62 percent of the State yield; the remaining 38 percent came from placers. Nevada County continued to be the principal producer of gold in 1935; the bulk of its production came from the lode mines of the Grass Valley-Nevada City district. Sacramento County was the second largest producer of gold in the State, because of the great productivity of the gold dredges in the Folsom district. The Mother Lode continued to be most productive in Amador County. Dredging, principally along the Yuba River in Yuba County, accounted for much of the large gold production there. Eldorado County derived the most of its gold output from the part of the Mother Lode included within its boundaries. Although the section of the Mother Lode in Calaveras County was the principal contributor to that county's gold output, considerable production also was reported from the lode mines in its East Belt district and from placer operations in the Camanche district. In Kern County the rapidly developing mines in the Mojave district and the rehabilitated properties in the old Randsburg district accounted for the large gold production of the county. Sierra County was important as a producer of gold largely because of the output of the Alleghany district. Among the other large gold-producing counties were Shasta and Mariposa, which depended chiefly on lode mines for their yield; Merced, Trinity, Butte, and Stanislaus, which derived most of their gold from placer mines; and Siskiyou and Placer Counties, where the production was more evenly divided between lode and placer deposits.

The following is a list of companies (or mines) operating lode gold mines, arranged roughly in order of their importance as producers: Empire Star Mines Co., Ltd. (Nevada County), Idaho Maryland Mines Corporation (Nevada County), Iron Mountain property of the Mountain Copper Co., Ltd. (Shasta County), Lava Cap Gold Mining Corporation (Nevada County), Argonaut Mining Co., Ltd. (Amador County), Kennedy Mining & Milling Co. (Amador County), Carson Hill Gold Mining Corporation (Calaveras County), Big Canyon mine of the Mountain Copper Co., Ltd. (Eldorado County), Cardinal Gold Mining Co. (Inyo County), Original Sixteen to One Mine, Inc. (Sierra County), Montezuma Apex Mining Co. (Eldorado County), Tropico mine (Kern County), Central Eureka Mining Co. (Amador County), Golden Center mine (Nevada County), Anglo-American Mining Corporation, Ltd. (Kern County), Middle Fork Gold Mining Co. (Eldorado County), Central Tailings Co. (Amador County), Pacific Mining Co. (Mariposa County), Beebe Gold Mining Co. (Eldorado County), Spanish Mining Co. (Nevada County), Golden Queen Mining Co. (Kern County), Kenton mine (Sierra County), Lucky Boy Mining Co. (Calaveras County), Gold Reserve mine (Eldorado County), Diltz mine (Mariposa County), and Walker mine (Plumas County).

The following are leading gold producers from placers in California, arranged roughly in order of their output in 1935: Natomas Co. (Sacramento County), Yuba Consolidated Gold Fields (Yuba County), Capital Dredging Co. (Sacramento County), Snelling Gold Dredging Co. (Merced County), Gold Hill Dredging Co. (Sacramento County), La Grange Gold Dredging Co. (Stanislaus County), Arroyo Seco Gold Dredging Co. (Amador County), Yuba Consolidated Gold Fields (Merced County), Merced Dredging Co. (Merced County), Calaveras Central (Calaveras County), Trinity Dredging Co. (Trinity County), Gold Bar Dredging Co. (Trinity County), Cal-Oro Dredging Co. (Siskiyou County), Northern California Mines Co. (Trinity County), Oroville Gold Dredging Co. (Butte County), and Wyandotte Gold Dredging Co. (Butte County).

Besides these larger mines many smaller producers worked lode and placer properties. Another source of much gold in California was the itinerant miner who usually works property that he does not own. Since the depression many people lacking other employment have panned for gold by hand in the streams of California with the hope of extracting enough to furnish the bare necessities of life. Although the average income of this class of miners has been pitifully small, a few of the more fortunate ones have picked up rich pockets. Exact figures are not available as to the number engaged in itinerant placer mining, but probably more than 10,000 individuals tried this method of solving their personal unemployment problem during the year.

Silver.—Production of recoverable silver in California in 1935 is estimated at 1,199,500 fine ounces valued at $862,141 compared with 844,413 fine ounces valued at $545,883 in 1934. This represents an increase of 42 percent in quantity and 58 percent in value. Virtually all the silver in California was produced as a byproduct of gold mining. The companies producing the largest quantities, listed approximately in the order of their importance, were as follows: Lava Cap Gold Mining Corporation (Nevada County), Empire Star Mines Co. Ltd. (Nevada County), Spanish Mining Co. (Nevada County), Walker Mining Co. (Plumas County), Golden Queen Mining Co. (Kern County), and Coyote mine (San Bernardino County). This list contains some of the leading gold mines of the State. The Walker mine is principally a copper producer, and although the Coyote mine derived most of its revenue from silver its gold was an important byproduct. Many smaller properties, most of which were gold mines, including some placers, supplied the remainder of the silver. Dredges, all of which were operated primarily for gold, found silver a profitable byproduct.

Copper.—The estimated output of recoverable copper in California was 1,965,000 pounds valued at $163,095 in 1935, compared with 569,068 pounds of copper valued at $45,525 in 1934. This is an increase of 245 percent in quantity and 258 percent in value. The Walker Mining Co. in Plumas County, which reopened the Walker mine in August, was by far the most important producer of copper ore and was the only large copper mine operating in the State. Small quantities of copper were derived from the smelting of concentrates produced at gold mines, particularly in the Grass Valley-Nevada City area.

Lead.—The production of recoverable lead in California in 1935 is estimated to be 1,650,000 pounds valued at $66,000 compared with 823,168 pounds valued at $30,457 in 1934, an increase of 100 percent in quantity and 117 percent in value. Inyo County continued to be a leading producer of lead-bearing ore, but considerable lead was derived from gold concentrates, particularly in the Grass Valley-Nevada City district.

Zinc.—The estimated production of recoverable zinc in California was 264,000 pounds valued at $11,616 in 1935 compared with 721,719 pounds valued at $31,034 in 1934. Zinc was the only one of the five metals whose output decreased in 1935 compared with 1934; the decline was 63 percent in quantity and in value. Inyo County was the leading producer of zinc as well as of lead.

MINING INDUSTRY

The production of gold in California has accounted for more than 95 percent of the combined value of the output of gold, silver, copper, lead, and zinc in the State in recent years. Consequently, the rising price of gold since 1933 and the low prices for the base metals have greatly stimulated activities in the gold-bearing areas of California. Many of the old gold mines of the State have increased production, and prospecting and development have been exceedingly active. In fact, the gold-mining industry and its dependent businesses have become bright spots in the industrial life of California. The bringing into production of the Golden Queen mine in the Mojave district in 1935 completes the cycle from strike to large production in less than 3 years. Although no other strikes have been comparable with that on Soledad Mountain, the reopening of mines added a number of names to the list of large gold producers in California.

One of the most interesting developments in California has been the use of dragline excavators for delivering auriferous gravels to washing plants. This new method started during the depression when contractors owning earth-moving equipment found themselves unable to keep their plants busy. They turned to small patches of gold-bearing gravel, many of which were too small to justify installation of the conventional type bucket dredges and too low-grade to be worked by other methods. Dragline excavators are used to dig the gravel, which is treated in one of several types of washing plants; the most popular type is similar to the devices found on the older floating dredges and is mounted on a floating barge. A dragline excavator stands on dry land and digs the gravel lying between it and the washing plant, which follows in the channel excavated.

An important factor in the mining industry has been the large increase in employment and buying that has resulted from the prospecting, development, and equipping of new properties. Such activities appear, if anything, to be gaining momentum, and in 1936 there should be considerable expansion of the gold-mining industry of California. Moreover, improved base-metal prices may cause owners of copper, lead, and zinc properties to follow the example of the Walker Mining Co. in reopening mines.

A major revival in the hydraulic gold-mining industry is anticipated from liberal legislation now being considered. Moreover, the financing of retaining dams for hydraulic tailings by the Federal Government appears much less remote than in former years. The hydraulic gold industry in California has languished for almost half a century because of adverse legislation.

METALLURGIC INDUSTRY

Data now available do not include much information on the metallurgic industry of California in 1935. It appears, however, that virtually all the mills that were operating in 1934 continued to operate in 1935 and that thousands of tons of milling capacity were added during the year. Many old mills were expanded, and special equipment was added to increase their percentage of recovery. Flotation and cyanidation were used more extensively at the gold mines of the State. A relatively small amount of California ore is shipped to smelters, and as a result the mills of the State treat a large volume of ore and old tailings. Considerable custom milling was done, particularly in Kern County and along the Mother Lode. The only smelter in the State is the lead smelter and refinery plant of the American Smelting & Refining Co. at Selby, Contra Costa County.

REVIEW BY COUNTIES AND DISTRICTS

ALPINE COUNTY

Very little metal was produced in Alpine County in 1935, but some development work was reported. One hundred feet of tunneling and open-cut work were done at the Lost Sleigh mine. The Calpine Corporation drove a 350-foot tunnel and did some diamond-drill prospecting. Both of these operations were in the Monitor district.

AMADOR COUNTY

Amador County continued to be one of the chief mining counties of the State. Gold was the most important metal produced in point of value; most of it was derived from lode mines, although some placer gold was recovered in the Lancha Plana district.

East Belt district.—Several mines were operated in the district, and others were prospected and developed. Eighty-nine ounces of gold were recovered by hydraulic mining from an ancient river-bed deposit at the Elephant mine, where ditches and water-storage facilities were reported built in addition to the mining. More than 500 feet of development work were done on the Tom and Dick Somerset property in preparation for future production. A substantial output of gold was reported from the Peterson mine; 1,200 tons of ore yielding $15,000 in gold were reported mined at the Fort Ann. The Pioneer property was closed down in consequence of litigation during 1935.

Lancha Plana district.—In the Lancha Plana district the Lancha Plana Gold Dredging Co. did no dredging during 1935 but cleaned up its plant and reworked some of the accumulated black sands, which yielded 520 ounces of gold. Considerable prospecting was carried on, and a new electric dredge equipped with eighty-five 6-cubic foot buckets and having a capacity of 3,500 cubic yards per day was built on the Mokelumne River below Camanche. This company employed an average of 10 men throughout the year. The Lancha Plana Hydraulic Mines Co. produced some gold by hydraulicking.

Mother Lode district.—The part of the Mother Lode that passes through Amador County contains several of the largest and deepest gold mines in the State. The most important are the Argonaut Mining Co., Ltd., at Jackson, the Kennedy Mining & Milling Co. at

Martell, and the Central Eureka Mining Co. at Sutter Creek. Labor trouble in this area, which started in 1934, continued in the early months of 1935. As a result production in the district was somewhat curtailed. The Argonaut mine is developed by an inclined shaft 6,000 feet deep and is the deepest mine in California. Its ores are treated in a 300-ton, 60-stamp, amalgamation-concentration mill; the tailings go to a cyanide plant.

The Kennedy mine is also one of the deepest mines of the State, the bottom of its shaft being approximately a mile below the surface. Its ores were treated by amalgamation in a stamp mill, followed by concentration. A large cyanide plant was added during the year. The Amador Metals Reduction Co. operated a custom mill and treated ore and concentrates from many mines in the district. The Central Eureka Mining Co. was another large producer in this area. This annual report of the company for the year ended April 1, 1936, states that 39,350 tons of gold ore were milled during the year, from which $179,959 in gold and silver were recovered by amalgamation and $87,624 by smelting concentrates. The average value of the concentrates recovered was $6.80 per ton milled, and the average value of the tailings $1.11 (a gross value per ton milled of $7.91), and the recovery was 85.93 percent. The average value of the concentrates per ton was $97.51. A substantial production was reported from the Fuller mine. The Arroyo Seco Gold Dredging Co. operated an electric dredge on Arroyo Seco Creek, equipped with eighty-three 6-cubic foot buckets, having a capacity of 6,500 cubic yards per day. Operations were started in the middle of May and continued throughout the year; more than 7,000 ounces of gold were produced. The dredge crew averaged 13 men. A small dragline was operated at the Lessley Ranch, but the deposit was reported to be worked out before the end of the year.

BUTTE COUNTY

Placer gold recovered by dredging was the most important item in the metal production of Butte County in 1935.

Butte Creek district.—Most of the output of the Butte Creek district in 1935 was from placer mines. The Kelly Hill mine produced 131 ounces of gold.

Cherokee district.—The New Era drift mine continued to be the largest producer in the district. Prospecting and development work, notably by the Cherokee Drift Mining Co., assured further important production for 1936.

Enterprise district.—The Golden Hope property was abandoned in July; approximately 10,000 yards of stream gravel were treated with a dragline outfit.

Forbestown district.—The Pacific Mining Co. was the principal operator in this district during 1935.

Magalia district.—Numerous small producers were active in this district. Among the most important were the Bennett and Dix mines, both drift properties, and the Springer Consolidated, a lode mine. The C. H. Hintz mine began operating in July. A steam shovel was used for loading, and trucks delivered the gravel to the washing plant; approximately 78,000 cubic yards of material were handled and over 1,000 ounces of gold recovered.

Merrimac district.—The only mines reported as active in this district were placers.

Oroville district.—The largest production of gold and silver in Butte County in 1935 came from the placers of the Oroville district; dredging was the leading method of recovery. The Wyandotte Gold Dredging Co. operating on Wyandotte Creek handled 558,000 yards of stream gravel with two dragline outfits and recovered 3,616 ounces of gold. Both the dragline excavators and the floating washing plants were powered with Diesel engines. Twelve men were employed during the latter months of the year, but a larger crew worked during the earlier months. The Yuba Consolidated Gold Fields operated a large electric dredge 1 mile north of Rio Bonito. The Oroville Gold Dredging Co. also produced ore in the district. An electric dragline outfit working at Feather River Bar near Oroville treated approximately 50,000 cubic yards of gravel in less than 3 months. A power shovel, operating on ancient river-channel material at the Lund brick plant and using trucks to transport the gravel to a stationary washing plant, treated approximately 10,000 yards of gravel. Another dragline was operated by the Honcut Gold Mines Co. on Little Honcut Creek. A floating washing plant, treating gravel delivered to it by a Diesel-powered dragline shovel, operated late in the year on the Gianella property. In addition a number of small producers reported a substantial production from drift mines and small placers.

Palermo district.—The Cinco Mineros Co., operating a dragline excavator and floating washing plant, was a leading producer in the district late in 1935. The Palermo Dredging Co. also made a large output.

Stirling City district.—Some small placers were reported to be operating in this district.

Yankee Hill.—The Surcease mine continued to be the outstanding producer of lode gold in the county. Approximately 10,000 tons of ore were mined and treated by cyanidation and concentration; the concentrates were shipped to the Selby smelter.

CALAVERAS COUNTY

Calaveras County was one of the principal gold-producing counties of the State, largely because of the mines in its Mother Lode area.

Camanche district.—Several new developments in the Camanche district may lead to an important output of gold in 1936. The Gold Gravel Products, Inc., continued to operate its placer adjoining the town of Wallace on the east. Gravel was excavated at this mine with a power shovel and treated in a stationary washing plant. The Comanche Gold Dredging Co. operated a floating dredge connected to buckets during the last 4 months of 1935 and handled almost 500,000 cubic yards of ancient-river-bed gravels. The Camanche Placers, Ltd., installed a small floating dredge which treated 120,000 cubic yards of stream gravel during the last quarter of the year. The Calaveras Holding Trustees, Ltd., using a gasoline-power shovel, truck transportation, and sluices, worked a small amount of gravel during the summer months.

Campo Seco district.—Several small operators reported production in the Campo Seco district. The Spring Valley Mining Co., one of the important producers in 1934, did not operate in 1935.

East Belt district.—A number of small operations were reported in the East Belt area. The Lucky Boy property produced 88 tons of ore from which were recovered 107 ounces of gold; in addition, 190 feet of drifting and shaft sinking were done. The Heckenborn mine reported a small production and the driving of 100 feet of development workings. Drift mining on an ancient channel at the Golden Chief mine yielded 18 ounces of gold. The Johnstone gold mine reported 600 feet of development work and a small output of gold and silver. The Mar-John mines in the Washington section of the East Belt reported a substantial output. Five hundred feet of development and a small output of high-grade ore were reported for the Little Gulch mine. The Golden Share mine produced 90 ounces of gold, mainly from crude ore shipped to the Shelby smelter.

Jenny Lind district.—The Royal mine produced some ore during 1935. Dredging was done at the South Gulch property throughout the year. A small dragline dredge using Diesel power treated 250,000 cubic yards of gravel.

Mother Lode district.—As a result of one of the largest rehabilitation programs of 1934, the Carson Hill mine at Melones in the Mother Lode district began 1935 as one of the leading producers of gold in California. A large amount of ore was produced, 8,000 feet of development drifts and crosscuts were driven, and a gyratory crusher was added to the mill. The Tonopah Belmont Development Co., lessee of the Vallecito Western mine, employed an average of over 20 men during 1935 and produced a large quantity of gold by drift mining on an ancient river bed. In March a major fault was encountered in the main gangway to the east which completely cut off the gravel channel. The channel was not picked up again to the east of the fault until December 18. The Vista property of the Russell Gold Mining Co. south of Angels Camp was a small producer of gold; approximately 1,200 feet of development drifts were driven in 1935.

The Osborn mine was operated by the Belmont Osborn Gold Mining Co. and produced 125 ounces of gold from 866 tons of impounded tailings. In July, operation of the mine was undertaken by the Engels Copper Mining Co.; gold production was stopped, and development for future operation was begun. The Flume House mine worked 2,000 yards of ancient-river-bed gravel by drift mining. The work, however, was principally development, and a larger output of gravel and gold was expected during 1936. An average of seven men was employed. The Golden River, another drift mine, was developed throughout the year, and a substantial output of gold reported. The Rising Star drift mine was also prospected and developed. The Rio Vista Quartz & Placer Patent was renamed the Patsy-Bob mine and worked during the latter half of the year. A small stamp mill was built for pilot work. The Boundary Cone drift mine was prospected and worked by an average of 14 men throughout the year; a small output was tested.

DEL NORTE COUNTY

No large outputs were reported from mines in Del Norte County in 1935, but a number of small producers and "snipers" operated.

ELDORADO COUNTY

Eldorado County continued to be one of the principal gold-producing counties of the State. Most of its output came from mines on the Mother Lode.

East Belt district.—Many small properties were operated in the East Belt area, and much development work was reported at these mines.

Mother Lode district.—The Sliger property operated by the Middle Fork Gold Mining Co. mined more than 30,000 tons of ore in 1935, from which were extracted almost 7,000 ounces of gold. Development work amounted to 2,550 feet, and an average of about 50 men was employed at the property throughout the year. A 125-ton concentration and flotation mill built in 1932–33 was operated throughout 1935 and treated an average of 90 tons daily. The Black Oak mine in Garden Valley continued as a gold producer. The Ruby Consolidated mine reported 100 feet of development work and the extraction of 67 ounces of gold from 190 tons of ore. The Beebe property operated by the Beebe Gold Mining Co. produced 55,383 tons of ore, which were treated by flotation; the concentrates were reground and cyanided to yield 6,096 ounces of gold and 763 ounces of silver. An average of 46 men was employed throughout 1935, but almost twice as many men were on the pay roll at the end as at the first of the year. Rebuilding in the mill and 1,585 feet of developing work were done. A little ore was produced at the Slate Mountain property from prospecting and development work. A large output of gold and an extensive development campaign were reported at the Montezuma mine. The Landecker drift mine, operating on an ancient river bed, yielded considerable gold. The property was closed down during the latter months of the year. At the Blue Rock property 132,000 cubic yards of placer and hydraulic tailings were treated by dredging and yielded 949 ounces of gold. During the first 6 months of the year an average of 13 men was employed. An electric dredge having thirty-eight 3-cubic foot buckets and a capacity of 1,400 yards per day was used. Besides the gold and silver recovered, the quicksilver used in the plant increased, as small quantities were reclaimed from the reworking of the gravels. About 2,000 tons of gold ore were extracted from the Amazon mine by 10 men working 5 months. The Maple Leaf mine produced 182 ounces of gold early in 1935. In July the mine was taken over as a State relief project; production during the remainder of the year was negligible. Considerable development and construction work was done on the Robert Veerkamp ranch; a small quantity of gold was produced. The Pilot Hill Mining Co. started a development campaign at the Boulder claim during the latter months of 1935. The Patterson drift mine was renamed the "Garibaldi" and used a little labor, mostly for development. A 1-yard gasoline shovel with a capacity of 100 cubic yards an hour was used on the River Bar Lotus property to load stream gravel for sluicing. The Big Canyon mine 4½ miles south of Shingle Springs was an important producer in the district. The Gold Reserve property was one of the large producers of the district and employed an average of about 50 men throughout the year. The ore was treated by the aerated or oxygenated mercury cyanide process, a method of treatment patented as the Vandercook gold and silver recovery process in January 1935. The company reported that the process was a marked improvement over the orthodox cyanide method and was particularly adapted to complex ores. Although the heads exceeded $4.00 a ton, the tailings were consistently below 10 cents a ton and the milling costs did not exceed 70 cents a ton.

FRESNO COUNTY

The principal metals produced in Fresno County in 1935 were gold and silver.

Friant district.—The largest production in the Friant district was made by the Grant-Service Rock Co.,Consolidated, which produced gold as a byproduct of the washing of sand and gravel for construction.

HUMBOLDT COUNTY

Numerous small mines were operated in Humboldt County in 1935, mainly on placer ground.

IMPERIAL COUNTY

A little precious metal was produced at various properties in Imperial County in 1935, and a number of desert placers were worked.

Cargo Muchacho district.—Ten thousand tons of Tumco mine tailings from the Cargo Muchacho district were treated in a 40-ton cyanide leaching plant, and 742 ounces of gold and 544 ounces of silver were recovered. The Cargo Muchacho, Padre, and Madre mining claims were reopened during 1935. Almost 4,000 tons of old tailings were treated in a 50-ton cyanide plant made by reconstructing an old flotation and amalgamation mill. No ore was extracted from the mines, but retimbering done in 1935 will make possible an output in 1936.

Pot Hole district.—Three hundred tons of ore were mined by the Pot Hole Mining & Development Co., which also drove 200 feet of development headings.

INYO COUNTY

Cerro Gordo district.—The Estelle Mines Corporation worked the Cerro Gordo, Morning Star, and Estelle mines and produced a little shipping ore from the first property. A small amount of development work was reported at the Morning Star mine. The ore carried zinc and gold, but most of the values were in lead and silver. The Santa Rose Mines Development Co. shipped several lots of ore from the Santa Rosa property; the company went into receivership near the end of the year. A small crew made two shipments of silver-lead-zinc ore from the Leary mine in the early months of 1935.

Chidago district.—The Cardinal Gold Mining Co., operating the Cardinal mine, produced 50,085 tons of crude ore that yielded 1,548 tons of concentrate. The ore was treated in a 150-ton flotation plant on the property. Concentrates were shipped to the Midvale smelter, and 14,350 ounces of gold and small quantities of silver, copper, and lead were recovered. Development work amounted to 1,984 feet.

Chloride Cliff district.—The Golden Circle mine produced a small quantity of gold and silver during the year. The Rose-Galena property was worked by lessees. A little gold ore from the Lost Burro mine was shipped for smelting during the year.

Coso district.—Considerable work on the McCloud mines during 1935 included the installation of a 25-ton pilot amalgamation mill. Failure to develop enough ore caused the mine to be shut down and the machinery removed during December.

Fish Springs district.—The Cleveland mine was the principal producer in this district. Old tailings were treated by concentration at the Commetti mines, and some development work was done underground.

Modoc district.—The Orondo mines yielded a substantial output of gold throughout the year.

South Park district.—The Golden Treasure mine produced a small quantity of shipping ore, from which were recovered 333 ounces of gold and small quantities of silver, copper, and lead.

Union district.—Small operations were reported in the Union district.

White Mountain district.—Development and metallurgical experimenting were reported at the Poleta mine in this district; some ore and tailings were treated.

KERN COUNTY

Kern County continued to be the principal nonferrous metal producer in the southern part of the State. New discoveries were made and developments undertaken in the Mojave district and old properties were reopened in the Randsburg district.

Agua Caliente district.—The Hart mine produced 115 tons of ore; 350 feet of developement headings were done during 1935. Considerable development work and production were reported at the Aunt Rosa mine in the same district.

Black Bob district.—A small amount of gold was reported produced at the Cedar mine.

China Grade district.—The Kern Rock Co., Ltd., produced some placer gold incidental to the operation of its gravel plant.

Clear Creek district.—Several small gold mines were operated in the Clear Creek district.

Cove district.—The Big Blue mine was the principal producer in this district.

Greenhorn Mountain district.—It was reported that a number of small gold-lode mines were operated in this district.

Long Tom district.—In the Long Tom district a number of small producers were reported.

Mojave district.—The discovery by Holmes on the Soledad Mountain in 1933 started more productive activity than any other strike in California in recent years. The ground where the discovery was made is now occupied by the Golden Queen Mining Co., the principal producer in the district. A large number of men were employed throughout the year on development, mining, and construction work; a substantial output of gold ore containing some silver was reported. A 300-ton cyanide plant employing countercurrent decantation was constructed in 1935 and began operating in October of that year. Almost 2 miles of development headings were driven during the year. A large number of lessees worked on the Elephant-Eagle group of claims adjoining the Golden Queen Co. property. The Elephant-Eagle Co. also operated a 50-ton amalgamation and cyanide mill and did some custom milling from May until the end of the year. Several other mines, including the Bobtail, the Soledad Extension, and the Star Light were worked during 1935; most of the mining was done by lessees. In the Bowers Hill area of the Mojave district several leases were being operated, including work on the Yellow Dog and Desert Gold properties. Several properties were under development, and some production was reported in the Middle Buttes section of the district where the Cactus Queen, Silver Prince, and Middle Buttes properties were the scenes of the principal operations. A fourth section of the district, referred to as the Rosamond Hills, included several producing properties, the most important of which was the Tropico mine operated by Burton Bros. This property produced over 11,000 tons of ore, from which 3,670 ounces of gold and 10,980 ounces of silver were recovered. A 100-ton cyanide plant for treating the ore of the mine and doing a large custom business was situated on the property. An average of 40 men was employed throughout the year at the mine and mill. The custom ore gathered from over 200 operations in the surrounding area was delivered to the mill in trucks.

Pioneer district.—A number of small operations, both lode and placer, were reported in the Pioneer district in 1935.

Rademacher district.—The Indian Wells Valley reported considerable development work and some production at their property.

Randsburg district.—Many leasers were reported working the various mines of the Randsburg district. Included in this district are the mines adjacent to the towns of Randsburg, Johannesburg, Red Mountain, and Atolia. The Anglo American Mining Corporation, Ltd., which operated the Yellow Aster and Big Dike mines, was the largest concern in the district. The company cyanide plant, built to treat the tailings accumulated by prior operations at the Yellow Aster mine, was completed and began operating in September 1935. By the end of the year it had treated 80,662 tons of accumulated tailings and 11,577 tons of current mill tailings, which together yielded bullion valued at $95,377.

The Buckboard mine produced a small quantity of ore, which was treated in the nearby Baltic mill. The Minnehaha mine produced 925 tons of gold ore. The Big Butte property of the Butte Lode Mining Co. was one of the larger producers in the district. This company mill did some custom work. A small output was reported at the Consolidated property. Several different operators worked at the Merced mine during the year. For a time the property was worked by the Rand District Cooperative Mining Unit, a State relief project that gave employment to about 25 men. In the eastern part of the district near Atolia extensive placer operations were carried on by several companies for the recovery of tungsten as well as gold. The larger part of this gold-tungsten placer area extends from Kern into San Bernardino County.

Red Rock district.—Small dry placers were reported as being mined in this district.

Woody district.—Some activity was reported in the lode mines of the Woody district.

LASSEN COUNTY

Hayden Hill district.—The Hayden Hill district was the principal producing area in Lassen County and the Juniper mine reported the argest amount of work done. The Juniper mine produced 760 tons of ore, which was treated in a 25-ton cyanide plant built during the year. Two hundred feet of shaft were sunk and 1,200 feet of development drifting driven. Approximately 20 mill men were on the pay roll during the last few months of the year.

LOS ANGELES COUNTY

Big Susanna district.—A considerable quantity of ore was shipped from the Big Susanna mine, a new discovery in this area.

Cedar district.—The Governor mine about 3 miles north of Acton was the principal producer in this district. The ore from the mine was hauled by truck to the company mill south of Acton for treatment.

Pacoima Canyon district.—The Allison mine produced over 2,000 tons of gold ore, from which over 200 ounces of gold were extracted.

San Gabriel district.—Many small placer operations were reported in San Gabriel district, but the yield of gold was not very large.

Valyermo district.—The Big Horn Mining Co. did a large amount of development and construction work and produced a considerable quantity of gold ore from its mine as well.

MADERA COUNTY

Hildredth district.—Reports were received on several small operators in the Hildredth district.

Potter Ridge district.—Both quartz and placer mines were operated in this district, but their output was small. The Enterprise mine amalgamated over 1,000 tons of ore and recovered more than $10,000 worth of gold. An average of about 10 men was employed throughout the year, and 345 feet of development headings were driven.

MARIPOSA COUNTY

Colorado district.—No large operations were reported in this district, although a number of small lode gold mines were operating.

Hite Cove district.—The Original and Ferguson mine operated by the San Juan Ramsey Co., lessees, produced over 1,000 tons of ore, from which over 350 ounces of gold were extracted.

Hunter Valley district.—The Ruth Pierce and the Lovely Rogers mines were the principal producers reported from the Hunter Valley district in 1935.

Kinsley district.—The Texas Hill mines employed six men throughout the year and produced over 500 tons of gold ore.

Mother Lode district.—The extension of the Mother Lode into Mariposa County provides it with its principal source of mineral wealth. Many small mines were being operated and developed in this district in 1935, and a few placer claims were worked. The Pine Tree and Josephine mine treated 33,000 tons of ore from which over 6,500 ounces of gold were recovered. The pay roll averaged about 50 men throughout the year, and over 2,700 feet of development work were driven. The Doss mine handled almost 3,000 tons of ore that averaged a little over $4 a ton. A 20-ton stamp mill employing amalgamation was built during 1935 on the Black Spider property and treated 480 tons of gold ore during the year. Approximately 2,800 yards of ancient riverbed were sluiced at the Good Hope mine.

Quartzburg district.—Many small lode gold mines were operated in this district during 1935.

Whitlock district.—The Golden Key group, formerly known as the Austin group, was operated by the Golden Key Mining Co. during 1935. One hundred and fifty tons of ore and 20 tons of old tailings were amalgamated during the year, producing over 200 ounces of gold. Most of the work was done by lessees.

MERCED COUNTY

The only mining reported in Merced County in 1935 was at placers in the Snelling district where several dredges were operating. Dredges produced virtually the entire output of the county. Principal operators were the Yuba Consolidated Gold Fields, operating two dredges; Snelling Gold Dredging Co., operating two dredges; and Merced Dredging Co., with one dredge. The first two companies added a dredge each to their equipment during 1935.

MONO COUNTY

Bodie district.—Several small operations were reported in the Bodie district during 1935. The Blue Point property produced 315 tons of ore, which was amalgamated.

Chidago district.—An average of three men developed and produced a small quantity of gold ore on the Long Chance property.

NEVADA COUNTY

Preliminary reports indicate that Nevada County continues to be the leading producer of nonferrous metals in California. By far the most important metal produced was gold.

Canada Hill district.—The Ragon mine, including the Ragon and Hilda claims, was the principal producer in this district. Four hundred and seventy-three tons of ore were treated by amalgamation, gravity concentration, and flotation with cyanidation of tailings and the reground concentrates. An average of 15 men was employed during the latter half of the year.

French Corral district.—Several small operations were reported in this district in 1935.

Grass Valley-Nevada City district.—This district led in production of gold in California and was one of the most important gold-producing regions in the United States, as well. The Lava Cap Gold Mining Corporation produced 63,220 tons of ore from its Lava Cap mine. Development work done during 1935 included sinking 450 feet of shaft and driving 11,170 feet of other development headings. One hundred and eighty men were on the pay roll during the latter part of the year, most of whom were employed underground. The gold output was 20,474 ounces and silver production 183,081 ounces. The Empire Star Mines Co., Ltd., operated the Empire, Pennsylvania, North Star, Murchie, and Zeibright mines. From the Empire, Pennsylvania, and North Star mines 231,647 tons of ore were taken and milled the average recoverable gold content of which was 0.347 ounce per ton. This is to be compared with 250,766 tons at 0.370 ounce in 1934 and 201,566 tons at 0.380 ounce in 1933. In addition, lessees mined approximately 20,000 tons of ore of 0.452-ounce gold content per ton from the North Star during the year. Development footage included 23,117 feet of drifts, crosscuts, and raises and 1,599 feet of diamond drilling. Another of the large producers of the district was the Idaho-Maryland Mines Corporation, which operated throughout the year. The Republic Gold Mining Corporation, operating the Empress mine, produced 46,635 tons of ore that yielded 6,671 ounces of gold and 68,781 ounces of silver. The concentrate produced also contained a small quantity of copper and lead. An average of over 60 men was employed at the property throughout the year. A 200-ton flotation mill was operated, and over 1,300 feet of development headings were driven. The Hoge mine, owned by the Great Northern Gold Mines, Inc., was operated by lessees throughout the year and produced considerable gold ore. The Bradley Mining Co. operated the San Juan mine.

Washington district.—The Davis placer was operated throughout the year and produced over 500 ounces of gold. Western Gold, Inc., worked the Relief Hill property from March through June. A small output was reported from the Ancho-Erie mine. The principal producer in the district was the Spanish mine worked by the San Francisco Commercial Co.

You Bet district.—A number of small placer operators were working in the You Bet district.

PLACER COUNTY

Auburn district.—A dry-land dredging outfit utilizing a 1-cubic yard dragline excavator operated on the Allan mine from May to the end of the year. The Jasper-Stacy Co. operated a dragline and floating washing plant on the Recalp Co. property but spent a considerable part of the time in construction and rebuilding. Regular operation was reported to have begun on January 1, 1936.

Dairy Farm district.—The Dairy Farm Gold Corporation operated the Dairy Farm mine 11 miles north of Lincoln, its shipping point. Over 30,000 tons of ore were treated in a 100-ton cyanide plant, 2,392 ounces of gold and 2,952 ounces of silver having been recovered during 1935. An average of 15 men was employed throughout the year.

Dutch Flat district.—The Trixie mine was worked by drift mining throughout the year and produced approximately 200 ounces of gold. The Black Hawk lode mine in the same district was operated throughout the year.

Forest Hill district.—A large number of placers were operated in the Forest Hill district in 1935. The Three Queens lode property began operating in September and produced a considerable quantity of gold before the close of the year. The Goldfield Consolidated Exploration Co. hydraulicked 60,000 cubic yards of Tertiary stream gravel at the Small Hope mine.

Gold Run district.—The Oakwood Placer Mining Co. constructed a dragline dredge outfit during the early months of 1935 and from April 1 to the end of the year treated 200,000 cubic yards of ancient-riverbed material. Almost 1,000 ounces of gold were recovered, and an average of 12 men was employed after the dredge started working.

Iowa Hill district.—A number of small placer operations was reported in this district. The Gleason drift mine produced over 300 ounces of gold from 1,500 tons of gravel.

Last Chance district.—Mining in the Last Chance district included a number of placer operations. The Glenn mine, which was in the hands of lessees, produced over 100 ounces of gold from ancient-riverbed gravels by drift mining.

Michigan Bluff district.—The American Bar mine, operated by the Industrial Engineering & Equipment Corporation, produced over 1,000 tons of gold ore during the year. An average of seven men worked throughout the year, opening up the Burns Channel property which produced a small quantity of gold incidental to the development work.

Opir district.—The Auburn-Chicago Mining Co., operating the Auburn-Chicago mine, extracted almost 3,000 ounces of gold and 7,000 ounces of silver from 6,825 tons of ore. The crew working at the property was increased during the year and averaged 51 men during December.

PLUMAS COUNTY

Butte Valley district.—A number of small properties were reported as operating in this district. The Yankee Bar, Riverside, and Marion Creek placer claims yielded 63 ounces of gold from April to the end of the year by sluicing ancient-river-bed material.

Crescent Mills district.—The Brilliant property was operated during 1935 by power shovel and sluicing. The Indian Valley Mining Co., Inc., treated a considerable quantity of ore from its lode mine and drove over 1,000 feet of development headings. The Gold Stripe mine also produced in 1935, with an output of 300 tons of ore.

Genessee district.—The Walker mine, the principal mineral producer in Plumas County as well as the largest copper mine in the State, began to repair the mine and reduction plant in August 1935, and shipments of concentrate were resumed in October. The mine had been idle for approximately 3½ years, having been closed in February 1932 because of low-metal prices. The operating company, the Walker Mining Co., is a subsidiary of the Anaconda Copper Mining Co., for the reason that 50.42 percent of the stock of the former company is owned by the International Smelting & Refining Co., all of whose stock, in turn, is owned by the Anaconda Copper Mining Co.

Lights Canyon district.—The Lucky S property was operated from April through June and produced about 100 ounces of gold by sluicing decomposed quartz ledge outcrops.

Other districts.—Considerable activity was reported in the quartz and placer mines of other districts of the county, particularly La Porte, Johnsville, Quincy, North Fork of the Feather River, and Saw Pit Flat.

RIVERSIDE COUNTY

Bendigo district.—The Mountaineer Mining Co., which operates a gold lode mine, was the largest producer in the Bendigo district; an amalgamation and flotation mill was built during the year. An average of about 20 men was employed until the mine closed in November.

Chuckawalla district.—The Red Cloud mine, operated by the S & W Mine Development Co., produced a small output, but most of the work done there was developmental. The Chuckawalla Development Co. worked the Chuckawalla gold mine for a short time.

Monte Negro district.—The Zula Queen property of the Sunrise Mines, Inc., was developed by driving approximately 500 feet of drifts and raises during the year.

Pinacate district.—Considerable gold ore was treated by amalgamation at the Hoag mine.

Pinon district.—The Lost Horse Mining Co. treated about 100 tons of ore at its Lost Horse mine in the Pinon district. The Dicky Boy gold mine was operated from March until the end of the year and shipped a few hundred tons of gold ore to a custom mill. The principal producer in the district was the Gold Crown Mining Co., Ltd., which operated the Gold Crown and Nightingale claims throughout the year. The company cyanide plant treated 6,752 tons of ore, which yielded a large quantity of gold and some silver. A 150-foot shaft was sunk, 740 feet of drifts and 150 feet of raises were driven. An average of about 30 men was employed at the property throughout the year.

SACRAMENTO COUNTY

Virtually all the gold produced in Sacramento County came from dredging operations in the Folsom district, where the Natomas Co., the Capital Dredging Co., and the Gold Hill Dredging Co. were the principal operators. The Natomas Co. exceeded all previous records in number of yards handled by its dredges and in gross receipts from its operations, according to its printed annual report for the year ended December 31, 1935. Gold-bearing material excavated totaled 21,756,593 cubic yards, an increase of 3,313,340 yards over 1934. Moreover, the per-yard cost of operations was the lowest in the history of the company. At the beginning of the year five dredges were in operation, but on April 18 a sixth dredge was put in service. The total recovery of gold for the year was 65,296 fine ounces. All of the dredges were of the floating, connected-bucket type powered by electricity.

The Capital Dredging Co., a subsidiary of the Yuba Consolidated Gold Fields, operated three electric floating dredges in the Folsom district. The yardage treated and the quantity of gold recovered were both very large. The Gold Hill Dredging Co. also operated a large dredge all year at the Russi ranch, 2 miles from Folsom; a second dredge worked during the latter part of the year on the Laird ranch near Loomis. The Grey Wing Extension drift mine of the Grey Wing Extension Mining Co. worked ancient-river-bed material from January 1 to April 1935. Eight hundred tons of material were handled and a small quantity of gold was recovered.

SAN BERNARDINO COUNTY

Barstow district.—The Smith property was the principal mine reported operating in the Barstow district A small quantity of gold was produced from 107 tons of ore.

Buckeye district.—A number of small lode gold mines reported operations in the Buckeye district in 1935.

Calico district.—Several small operations were reported in the Calico district, including the reworking of some old tailings by cyanidation.

Dale district.—The Supply group, worked by the Supply Mining Co., shipped 665 tons of gold ore to the custom mill of the Gold Crown Mining Co., Ltd., at Twenty-nine Palms. Six hundred feet of drifting and 90 feet of shaft sinking were included in the company development program for 1935.

Holcomb district.—A number of small placer operations were reported in this district. The Holcomb Valley Placer Mines, Ltd., extracted 45 ounces of gold from 1,500 yards of bench gravel during the fall of the year.

Ivanpah district.—Operations in the Ivanpah district included the working of the Vanderbilt property, at which it was estimated that 1,017 tons of ore and 100 tons of tailings were treated for gold and silver.

Ord Mountain district.—The Camp Rock Placer Co. reported the washing of 4,360 yards of bench gravel and the recovery of 60 ounces of gold during 9 months.

Randsburg district.—Although the larger part of the Randsburg district lies in Kern County, an important part extends eastward into San Bernardino County. The Black Hawk mine and custom mill produced some gold and silver during 1935. The Coyote mine shipped 914 tons of ore and milled 1,700 tons during 1935. The principal values at this mine are in silver, though the revenue derived from gold is not unimportant. The Kelly mine of the California Rand Mining Co. was worked by lessees during the year and produced a considerable quantity of gold and silver. The Atolia Rand Placers, Inc., operated from March to the end of the year and recovered considerable quantities of tungsten concentrate and gold.

Silver Mountain district.—The Triangle Mining & Milling Co. mined a small quantity of gold ore from the Mojave Boy property.

Slate Range district.—Forty tons of ore from the Sunset mine were treated during 1935.

Triple Mountain district.—Many small operators were reported working in this district in 1935.

SAN DIEGO COUNTY

Several small operations were reported in the county, principally in the Julian and El Cajon districts.

SAN JOAQUIN COUNTY

A number of gold-dredging operations were reported in San Joaquin County in 1935. The largest was in the Clements district, where the Mikes Gulch property yielded 2,779 ounces of gold from 704,747 cubic yards of stream gravel and old tailings. The property was worked with a Diesel-powered dragline-dredge outfit having a capacity of 3,000 yards per day. An average of 13 men was employed from March 10 to November 26.

SANTA CRUZ COUNTY

The reopening of the Stribling mine, which had not been worked since 1893, was reported in the Empire Grade district. A small quantity of gold was recovered, and 40 feet of drift were driven on the vein.

SHASTA COUNTY

Centerville district.—The Richstrike Gold Mines, Ltd., operated the Yankee John property until October 1935. During this period 1,039 tons of ore were mined, and 190 ounces of gold and a small quantity of silver were extracted. About 18 men were employed.

French Gulch district.—The J. H. Scott Co. operated the Halcyon mining claims and the Milkmaid mine during 1935; this company owned the former group and held the latter under bond and lease.

A small quantity of gold ore was produced and treated. Several other properties were worked in this district.

Igo district.—A dry-land dredge was operated from May to October in this district.

Iron Mountain district.—The Mountain Copper Co., Ltd., was the largest producer of gold, silver, and copper in Shasta County in 1935. It operated the Iron Mountain and the Hornet mines, the latter producing principally pyrites used for the manufacture of sulphuric acid at the company chemical plant at Martinez, Contra Costa County.

Muletown district.—The city of Redding leased its Blue Gravel property to Larsen Bros., who extracted a small quantity of gold from 10,000 cubic yards of river-bed gravel by steam-shovel and drift mining. The Pioneer Dredge Co. worked a dragline outfit in this district and produced a large quantity of gold.

Other districts.—Seven and a half miles west of Cottonwood a small dredge with dragline excavator treated approximately 60,000 yards of gravel and recovered 326 ounces of gold. Operation was begun in October and 10 men were employed during the last 3 months of the year. Several small dragline and dry-land dredging outfits worked in various parts of the county, and hundreds of snipers washed ground on various streams when water conditions permitted.

SIERRA COUNTY

Alleghany district.—The Original Sixteen to One Mine, Inc., was the outstanding producer in the Alleghany district in 1935 as it was in 1934. Its ore was treated by amalgamation and concentration in a 100-ton ball mill and 20-stamp mill plant, which was operated throughout the year. The gold bullion produced was shipped to the mint and the concentrates to the Selby smelter. Virtually all the values were in the form of gold. The Golden Bear Mines, Ltd., worked a drift mine on the primary channel of an ancient river bed late in 1935 and produced 179 ounces of gold. The ore from the Kenton mine was treated in the company mill, built in 1934. The property produced a large quantity of dry and siliceous gold ore. The Ruby mine treated 1,500 tons by amalgamation and flotation and spent a considerable sum of money in new development.

Downieville district.—A number of small surface and drift placer properties were reported to be working in this district during 1935. Some gold-lode properties also were operated.

Sierra City district.—The Sierra Buttes mine was worked by the Hayes Co. and produced a smal quantity of gold ore. Several other lode and placer operations were reported in this area.

SISKIYOU COUNTY

The gold output from Siskiyou County came from a very large number of operations, most of which were very small and were located on placer ground.

Dillon district.—The Homestake mine hydraulicked a substantial yardage of auriferous gravel during 1935.

Elliott Creek district.—A small hydraulic operation was carried on for 3 months on Mecca placers Nos. 1 and 2.

Klamath River district.—Many placer operations were reported in this district. Sluicing on the Ladd property yielded a small quantity of gold. The Nigger Creek mine was hydraulicked during the spring months. Ancient-river-bed gravels were worked by drift mining at the Housier Hill mine and yielded 54 ounces of gold. The Shorty Lewis mine was worked during the first 17 weeks of the year with one hydraulic giant.

North Central district.—A considerable quantity of gold was shipped by the Gold Ball Mining Co. A dragline excavator and steam shovel worked on the Tony Lund property during a ew months of 1935 The Mount Vernon mine treated 683 tons of gold ore by amalgamation with gravity concentration and produced 230 ounces of gold. A crew of four men was employed throughout the year. The New York Mine Co., Inc., worked the New York group of quartz mines and milled the ore produced in its 100-ton flotation plant, which was built during the year. A considerable amount of underground development work also was done. The Cal-Oro Dredging Co., work ng the Cal-Oro mine, was one of the larger producers in the district. This company operated an electric dredge of the conventional type and having a capacity of 3,000 cubic yards per day. A million yards of gravel were worked during the year and 3,684 ounces of gold recovered.

Salmon River district.—Some prospecting and test work was carried on at the Madrone lode gold mine during 1935. The O'Connell Gold Mines, Ltd., provided a small tonnage of old tailings for cyaniding. The Gold Bar, formerly called the Whistle Bear, was in operation as a drift mine during part of the year. The King Solomon Mines Co. operated the King Solomon gold-lode mine and did extensive exploration work by trenching with caterpillars and bulldozers. A crew of 35 men was used most of the year, but during November and December the number was a little more than doubled. A giant was used for mining ancient-river-bed gravel at the Hickox property during the first half of 1935. The same type of operation was carried on at the Banner property as well as at the Jefferson Mines Consolidated and the S. T. S. mine. The lessees operated the White Bear mine of the Mayland Mining Co. on a royalty basis and produced 880 tons of gold ore, which was treated by amalgamation with concentration. The Stenshaw-on-Klamath Gold Mining Co. hydraulicked 8,000 cubic yards of ancient-river-bed and bench gravels on the Stenshaw property.

Scott River district.—Banks & McGinnis, Inc., operated the Turk gold-quartz mine in the Scott River district during 1935. A 40-ton amalgamation and concentration mill was completed during the year. The Northern California Goldfields, Inc., worked the Morrison-Carlock mine, a dry and siliceous gold property; the gold was recovered by amalgamation.

STANISLAUS COUNTY

La Grange district.—The La Grange Gold Dredging Co., operating the La Grange mine, was the most important mining operation in the county. This company had one electric dredge with a capacity of 8,000 cubic yards per 24 hours and worked almost 3,000,000 cubic yards of stream gravel during 1935. Over 8,000 ounces of gold were produced, and an average of 30 men was employed by the company.

TRINITY COUNTY

Coffee Creek district.—At the Yellow Rose mine 1,000 tons of old tailings were treated during the latter months of the year. The Trinity Gold Mines, Inc., worked the Golden Jubilee property and treated 2,613 tons of ore by cyanidation, with a yield of 580 ounces of gold. About 500 feet of development work were done at this property during the year. A small quantity of gold was recovered at the Geneva mine.

Helena district.—The Chicksan Oil Co., Ltd., worked the Enterprise mine; over 2,000 tons of ore were mined, from which 1,332 ounces of gold were recovered by amalgamation, gravity concentration, and flotation. Eight hundred feet of development work were driven. The M. R. K. Mining Co. operated the Osborn Hill claims of the North Fork Placers group by the hydraulic method. Over 300 ounces of gold were recovered from 110,000 cubic yards of ancient-river-bed gravels.

Junction City district.—Hydraulic mining was carried on from January through June and during December at the property of the Canyon Placers, Inc.

Lewiston district.—The Brown Bear mine of the Brown Bear Mines Corporation was operated during 1935; a considerable amount of development work as well as production was accomplished. Lessees worked the Five Pines property for gold. The Pansy mine produced 66 ounces of gold from gravel by the hydraulic method. The Trinity Dredging Co. was one of the large operators in the district; the company had one electric dredge with a capacity of 3,000 cubic yards per 24-hour day.

New River district.—A dredge was operated by the Gold Bar Dredging Corporation throughout the year on stream gravel and ancient-river-bed material.

Weaverville district.—The Redding Creek Placers, Ltd., worked their property in this district by hydraulicking. Over 40,000 cubic yards of stream and bench gravels were treated, and almost 400 ounces of gold were recovered from February to June, inclusive.

TUOLUMNE COUNTY

The Mother Lode passes through Tuolumne County and contributes greatly to its mineral wealth. The Mother Lode mines in this area, however, are not nearly so productive as those in the counties farther north.

Columbia district.—The Shoestring Mining Co. produced 850 tons of gold ore, which was amalgamated. The company drove 790 feet of development headings during the year and installed electric power for its mill and other equipment. Some work was done on the Lazar property.

East Belt district.—The Columbus Gold Mining Co. operated the Columbus mine throughout the year and produced a large quantity of dry and siliceous ore, which was treated by amalgamation and concentration. Another producer in this district was the Jigger Bill's Brother mine, at which a small quantity of gold was produced.

Mother Lode district.—The Quartz Hill Mining Co., operating the Heslep mine, produced about 5,000 tons of gold ore, which was treated at a 40-ton flotation plant built during the year. As the plant was operated only during the last 4 months of the year, a much larger output is expected for 1936.

YUBA COUNTY

Poverty Hill district.—The First Chance mine worked for 2 months and produced 24 ounces of gold by sluicing 600 cubic yards of virgin gravel.

Smartsville district.—The Gold Exploration Mining Co. operated the Blue Point drift mine in this area. The mine was under development throughout the year, and it was reported that the company intends to continue prospecting the property. The Archimedes Gold Dredging Co. also operated in this district.

Strawberry Valley district.—A small output was reported from the Eagleville mine operated by the Associated Miners. A fire at the property hindered production, but the metallurgical process was changed from amalgamation to flotation during the year.

Yuba River district.—By far the largest operation in the district was that of the Yuba Consolidated Gold Fields, which had five large gold dredges working throughout the year in the area. The material treated included stream gravel, bench gravel, ancient river beds, and old tailings; a large pay roll was maintained throughout the year.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN COLORADO

(MINE REPORT)

By Chas. W. Henderson and A. J. Martin

SUMMARY OUTLINE

The total output of gold, silver, copper, lead, and zinc from Colorado ore and gravels in 1935, in terms of recovered and estimated recoverable metals, was 349,280.80 fine ounces of gold, 4,696,064 fine ounces of silver, 14,654,000 pounds of copper, 11,345,000 pounds of lead, and 2,403,000 pounds of zinc. This output compares with a production in 1934 of 324,923.32 ounces of gold, 3,475,661 ounces of silver, 11,294,000 pounds of copper, 8,435,000 pounds of lead, and 1,544,000 pounds of zinc. There were 870 lode mines and 842 placers producing in 1935, a decrease of 59 lode mines and 125 placers from 1934. The smaller number of lode mines in 1935 than in 1934 is due to a decrease in the number of mines, prospects, and dumps producing less than 25 tons of ore, each of which is counted in this report as a producing mine if the material sold yielded any recovered metal. The decrease in the number of placers is accounted for by the fact that, although there was a substantial increase in total placer production, more of the yield in 1935 was from large-scale operations and fewer individuals were engaged in sluicing and panning.

The total recorded output from Colorado ores and gravels from 1858 to 1935, inclusive, all in terms of recovered metals has been, according to Chas. W. Henderson, 36,079,558 ounces of gold, 672,346,106 ounces of silver, 356,418,430 pounds of copper, 4,636,222,583 pounds of lead, and 2,236,859,985 pounds of zinc.

75731—36——17

Court decision on disposal of mill tailings.—Early in 1935 a decision was made by the Supreme Court of Colorado seriously affecting the future operation of mills in Colorado. Litigation in 1934 between farmers and miners of Clear Creek Valley on the question of dumping mill tailings into the stream was carried in 1935 to the Supreme Court of Colorado, which first decided as follows:

We therefore affirm the finding of the trial court in part and remand the cause with directions to enter a decree making the injunction full, complete, and permanent.

On rehearing, the Supreme Court ruled March 14, 1935, as follows:

In the original opinion, the thing enjoined is pollution. On rehearing, it has been argued, in substance, that the introduction of any quantity of extraneous matter into this stream would be a violation of the injunction. That does not follow. For the purposes of this case, the word "pollution" means an impairment, with attendant injury, to the use of the water that plaintiffs are entitled to make. Unless the introduction of extraneous matter so unfavorably affects such use, the condition created is short of pollution. In reality, the thing forbidden is the injury. The quantity introduced is immaterial. A primary duty rests upon one introducing such extraneous matter into this stream, to prevent damage arising from such introduction, either from his acts alone, or in conjunction with those of others. Failing in this, he must answer at his peril.

The District Court of Jefferson County gave final judgment and decree on April 12, 1935, as follows:

NOW, THEREFORE, IT IS ORDERED, ADJUDGED, AND DECREED: That defendant * * *, its agents, employees, representatives, successors, and assigns are hereby fully and permanently enjoined and restrained from discharging slimes or tailings into Clear Creek or into any tributary thereof in such manner that the said slimes or tailings will be carried into and pollute the water of Clear Creek or any tributary thereof, to such an extent that either from such acts alone or in conjunction with those of others the same will cause impairment with attendant injury to the use of the water that the plaintiffs are entitled to make.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the figures given in the table that follows: Gold in 1931–32 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1835, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95, the average weighted yearly United States Government prices;[1] and in 1935 at $35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1931–33 is the average New York price for bar silver; in 1934 the Treasury buying price for newly mined silver, $0.64646464+; and in 1935 the average weighted Treasury buying price for newly mined silver, $0.71875 per ounce. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of gold, silver, copper, lead, and zinc, 1931–35

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1931	[1] $20.67+	$0.290	$0.091	$0.037	$0.038
1932	[1] 20.67+	.282	.063	.030	.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	[3] .718+	.083	.040	.044

[1] $20.671835. [2] $0.64646464. [3] $0.71875.

[1] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

Mine production of gold, silver, copper, lead, and zinc in Colorado, 1931–35, in terms of recovered metals

Year	Mines producing			Ore sold or treated (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Total		Fine ounces	Value	Fine ounces	Value
1931	340	195	535	1,036,562	233,299.75	$4,822,734	2,195,914	$636,815
1932	478	335	813	935,895	317,927.95	6,572,154	1,860,408	524,635
1933	614	286	900	845,495	242,827.70	6,206,676	2,186,140	765,149
1934	929	967	1,896	1,309,187	324,923.32	11,356,070	3,475,661	2,246,892
1935	870	842	1,712	1,770,984	349,280.80	12,224,828	4,696,064	3,375,296

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1931	8,165,000	$743,015	13,768,000	$509,416	32,373,000	$1,230,174	$7,942,154
1932	7,398,000	466,074	4,299,000	128,970	218,000	6,540	7,698,373
1933	9,667,000	618,688	4,803,000	177,711	2,569,000	107,898	7,876,122
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

Gold and silver produced at placer mines in Colorado, 1931–35, 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
1931	[2] 777.32	[2] 121	(2)	(2)	266.90	69	1,044.22	190
1932	[2] 1,376.79	[2] 283	(2)	(2)	1,122.02	288	2,498.81	571
1933	2,046.85	480	464.70	69	2,813.96	711	5,325.51	1,260
1934	4,086.39	855	3,594.34	533	7,292.26	1,828	14,972.99	3,216
1935	7,058.74	1,523	7,998.55	1,329	4,305.71	1,116	19,363.00	3,968

[1] Dragline and power-shovel excavators with sluices or special amalgamators.
[2] Figures for sluicing and hydraulic include those for dry-land dredges.

Gold.—The production of gold in Colorado in 1935, in terms of recovered metal, was 349,280.80 fine ounces valued at $12,224,828, an increase of 24,357.48 ounces in quantity and $868,758 in value over 1934. In 1935 the Cripple Creek district contributed 124,324.00 ounces (35.59 percent of the State total). Park County yielded 71,942.86 ounces (20.60 percent); Boulder, 22,631.20 ounces (6.48 percent); Gilpin, 21,027.00 ounces (6.02 percent); Clear Creek, 16,371.00 (4.69 percent); San Juan, 16,128.00 ounces (4.62 percent); Lake, 15,980.20 ounces (4.58 percent); Ouray, 12,520.03 ounces (3.58 percent); San Miguel, 11,774.32 (3.37 percent); and Rio Grande, 8,119.00 (2.32 percent). The largest increases in quantity were 13,278.59 ounces in Gilpin County and 6,917.94 ounces in Rio Grande. The largest decreases were 13,924.78 ounces in Park County and 3,625.90 ounces in Teller. Dry and siliceous ores yielded 90.04 percent of the total gold, copper and copper-lead ore 2.47 percent, lead and lead-zinc ore 1.94 percent, and placers 5.54 percent.

Placer mines yielded 19,363.00 fine ounces of gold in 1935, an increase of 4,390.01 ounces over 1934. Summit County produced 4,848.80 ounces, principally from the operation of two dredges on

Blue River in the Breckenridge district; Park County, 4,808.06 ounces, mainly from drift mining on the Alma placers and from a power shovel-Ainlay bowl installation in the Tarryall district; and Jefferson County, 4,623.14 ounces, nearly all from the operation of a traction dry-land dredge on Clear Creek near the Jefferson, Clear Creek, and Gilpin County lines. Lake, Gilpin, and Boulder Counties followed in importance of output from placers. A group of adjoining counties, including Adams, Arapahoe, Denver, Douglas, and Elbert, on the plains just east of the mountains, produced 223.68 ounces from numerous small, individual sluicing and panning operations. The other counties producing placer gold in 1935 were Chaffee, Clear Creek, Costilla, Delta, Eagle, Fremont, Grand, Gunnison, Jackson, La Plata, Mesa, Moffat, Montrose, Ouray, Routt, San Juan, San Miguel, and Teller.

Silver.—The production of silver in Colorado in 1935, in terms of recovered metal, was 4,696,064 fine ounces valued at $3,375,296, an increase of 1,220,403 ounces in quantity and $1,128,404 in value over 1934, compared with an increase of 1,289,521 ounces in quantity and $1,481,743 in value from 1933 to 1934. In 1935 Eagle County produced 2,792,270 ounces (59.47 percent of the State total); Mineral, 499,680 ounces (10.64 percent); San Juan, 282,418 ounces (6.01 percent); Ouray, 226,183 ounces (4.82 percent); and Pitkin, 174,208 ounces. The largest increases were 849,986 ounces in Eagle County, 116,330 ounces in Ouray, 105,994 ounces in San Miguel, and 53,103 ounces in Pitkin. Among the important producing counties the only decrease was 20,594 ounces in San Juan County. Dry and siliceous ores yielded 35.64 percent of the total silver, copper and copper-lead ore 59.52 percent, lead and lead-zinc ore 4.74 percent, and placers 0.08 percent.

Copper.—The production of recoverable copper in Colorado in 1935 was 14,654,000 pounds valued at $1,216,282, an increase of 3,360,000 pounds in quantity and $312,762 in value over 1934. Eagle County produced 13,183,000 pounds (90 percent of the State total); next in order were San Juan (624,000 pounds), Ouray (253,000 pounds), Clear Creek (130,000 pounds), San Miguel (105,000 pounds), and Park (92,000 pounds). The largest increases were 3,364,000 pounds in Eagle County and 41,300 pounds in Ouray. The only important decrease was 195,300 pounds in San Juan County.

Lead.—The production of recoverable lead in Colorado in 1935, reckoned as lead in lead bullion and in leaded zinc oxide, was 11,345,000 pounds valued at $453,800, an increase of 2,910,000 pounds in quantity and $141,705 in value over 1934. In 1935 Lake, Park, and San Juan Counties each produced more than 1,000,000 pounds. The other important producing counties were San Miguel, 860,200; Ouray, 857,200; Clear Creek, 558,000; and Pitkin, 543,300 pounds. Dry and siliceous ores yielded 61 percent of the total lead; lead ore, 28 percent; lead-zinc ore, 8 percent; and copper-lead ores, 3 percent.

Zinc.—The zinc-bearing ores and concentrates marketed from Colorado in 1935 contained 2,403,000 pounds of recoverable zinc valued at $105,732, an increase of 859,000 pounds in quantity and $39,340 in value over 1934. Lead-zinc sulphide ore shipped from Lake County to the pigment plant at Coffeyville, Kans., contained most of the zinc recovered from ore mined in the State in 1935; the remainder was produced from zinc concentrates (a byproduct of dry silver ore from Pitkin County) shipped to Amarillo, Tex., and from lead-zinc ores shipped from Dolores, Lake, and Ouray Counties to reduction plants in Utah.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1935, by counties, in terms of recovered metals

County	Mines producing			Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Total	Fine ounces	Value	Fine ounces	Value
Adams		19	19	45.34	$1,587	7	$5
Arapahoe		33	33	60.26	2,109		
Boulder	218	17	235	22,631.20	792,092	34,048	24,472
Chaffee	14	32	46	1,551.83	54,314	7,392	5,313
Clear Creek	145	81	226	16,371.00	572,985	100,935	72,547
Costilla		1	1	2.00	70		
Custer	6		6	.80	28	7,648	5,497
Delta		1	1	1.20	42		
Denver		59	59	39.34	1,377		
Dolores	7		7	655.54	22,944	71,040	51,060
Douglas		27	27	71.80	2,513		
Eagle	14	7	21	9,909.86	346,845	2,792,270	2,006,944
Elbert		2	2	6.94	243		
Fremont	1	11	12	43.83	1,534	7	5
Gilpin	109	154	263	21,027.00	735,945	77,824	55,936
Grand		3	3	2.83	99		
Gunnison	25	13	38	2,058.60	72,051	10,055	7,227
Hinsdale	4		4	145.20	5,082	992	713
Jackson		7	7	18.57	650		
Jefferson		48	48	4,623.14	161,810	640	460
Lake	49	28	77	15,980.20	559,307	114,766	82,488
La Plata	15	4	19	2,180.54	76,319	16,928	12,167
Larimer	3		3	66.94	2,343	57	41
Las Animas	1		1	.11	4	14	10
Mesa		11	11	8.74	306		
Mineral	7		7	21.51	753	499,680	359,145
Moffat	1	10	11	127.00	4,445	53	38
Montezuma	2		2	273.06	9,557	562	404
Montrose		58	58	301.09	10,538	82	59
Ouray	11	8	19	12,520.03	438,201	226,183	162,569
Park	33	77	110	71,942.86	2,518,000	62,294	44,774
Pitkin	4		4	1.06	37	174,208	125,212
Rio Grande	1		1	8,119.00	284,165	12,423	8,929
Routt		8	8	32.00	1,120	8	6
Saguache	7		7	738.43	25,845	4,640	3,335
San Juan	15	4	19	16,128.00	564,480	282,418	202,988
San Miguel	28	23	51	11,774.32	412,101	172,932	124,295
Summit	28	88	116	5,475.63	191,647	12,669	9,106
Teller	122	8	130	124,324.00	4,351,340	13,289	9,551
	870	842	1,712	349,280.80	12,224,828	4,696,064	3,375,296
Total, 1934	929	967	1,896	324,923.32	11,356,070	3,475,661	2,246,892

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Adams							$1,592
Arapahoe							2,109
Boulder	18,000	$1,494	49,000	$1,960			820,018
Chaffee	22,000	1,826	100,000	4,000			65,453
Clear Creek	130,000	10,790	558,000	22,320			678,642
Costilla							70
Custer	4,000	332	37,100	1,484			7,341
Delta							42
Denver							1,377
Dolores	25,000	2,075	280,500	11,220	283,000	$12,452	99,751
Douglas							2,513

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1935, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Eagle	$13,183,000	$1,094,189	309,000	$12,360			$3,460,338
Elbert							243
Fremont							1,539
Gilpin	59,000	4,897	230,000	9,200			805,978
Grand							99
Gunnison			66,800	2,672			81,950
Hinsdale	1,000	83	3,200	128			6,006
Jackson							650
Jefferson							162,270
Lake	61,000	5,063	2,581,700	103,268	1,848,000	$81,312	831,438
La Plata			23,400	936			89,422
Larimer							2,384
Las Animas			100	4			18
Mesa							306
Mineral			351,800	14,072			373,970
Moffat	6,000	498					4,981
Montezuma							9,961
Montrose							10,597
Ouray	253,000	20,999	857,200	34,288	22,000	968	657,025
Park	92,000	7,636	1,908,500	76,340			2,646,750
Pitkin			543,300	21,732	250,000	11,000	157,981
Rio Grande	45,000	3,735					296,829
Routt							1,126
Saguache	18,000	1,494	61,500	2,460			33,134
San Juan	624,000	51,792	2,418,200	96,728			915,988
San Miguel	105,000	8,715	860,200	34,408			579,519
Summit	8,000	664	105,500	4,220			205,637
Teller							4,360,891
	14,654,000	1,216,282	11,345,000	453,800	2,403,000	105,732	17,375,938
Total, 1934	11,294,000	903,520	8,435,000	312,095	1,544,000	66,392	14,884,969

Gold and silver produced at lode mines in Colorado in 1935, by counties, in terms of recovered metals

County	Ore sold or treated	Gold	Silver
	Short tons	*Fine ounces*	*Fine ounces*
Boulder	85,518	21,853.00	33,984
Chaffee	1,287	1,307.80	7,342
Clear Creek	88,762	16,161.60	100,896
Custer	236	.80	7,648
Dolores	1,082	655.54	71,040
Eagle	210,587	9,850.80	2,792,256
Fremont	7	1.20	
Gilpin	357,402	20,208.40	77,600
Gunnison	5,246	2,018.94	10,048
Hinsdale	97	145.20	992
Lake	58,686	14,264.20	114,240
La Plata	11,585	2,167.40	16,928
Larimer	46	66.94	57
Las Animas	1	.11	14
Mineral	9,312	21.51	499,680
Moffat	19	.20	46
Montezuma	81	273.06	562
Ouray	43,414	12,498.00	226,176
Park	121,740	67,134.80	61,454
Pitkin	15,880	1.06	174,208
Rio Grande	34,946	8,119.00	12,423
Saguache	4,650	738.43	4,640
San Juan	177,373	15,788.40	282,240
San Miguel	81,584	11,726.92	172,914
Summit	995	626.83	11,421
Teller	460,448	124,287.66	13,287
	1,770,984	329,917.80	4,692,096
Total, 1934	1,309,187	309,950.33	3,472,445

Gold and silver produced at placer mines in Colorado in 1935, 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
Adams	45.34	7					45.34	7
Arapahoe	60.26						60.26	
Boulder	361.28	31	416.92	33			778.20	64
Chaffee	244.03	50					244.03	50
Clear Creek	114.42	23	94.98	16			209.40	39
Costilla	2.00						2.00	
Delta	1.20						1.20	
Denver	39.34						39.34	
Douglas	62.84		8.96				71.80	
Eagle	5.56		53.50	14			59.06	14
Elbert	6.94						6.94	
Fremont	42.63	7					42.63	7
Gilpin	622.41	191	196.19	33			818.60	224
Grand	2.83						2.83	
Gunnison	39.66	7					39.66	7
Jackson	18.57						18.57	
Jefferson	103.14	16	4,520.00	624			4,623.14	640
Lake	77.92	14	1,638.08	512			1,716.00	526
La Plata	8.14		5.00				13.14	
Mesa	8.74						8.74	
Moffat	126.80	7					126.80	7
Montrose	301.09	82					301.09	82
Ouray	22.03	7					22.03	7
Park	3,862.57	765	945.49	75			4,808.06	840
Routt	32.00	8					32.00	8
San Juan	339.60	178					339.60	178
San Miguel	47.40	18					47.40	18
Summit	423.66	110	119.43	22	4,305.71	1,116	4,848.80	1,248
Teller	36.34	2					36.34	2
	7,058.74	1,523	7,998.55	1,329	4,305.71	1,116	19,363.00	3,968
Total, 1934	4,086.39	855	3,594.34	533	7,292.26	1,828	14,972.99	3,216

[1] Includes dragline and power-shovel excavators with sluices or special amalgamators.

REVIEW BY COUNTIES AND DISTRICTS

ADAMS COUNTY

To date the metal output of Adams County has consisted of gold and silver recovered from sand and gravel bars of Clear Creek, which heads in Clear Creek and Gilpin Counties and flows eastward through Jefferson County into Adams County just north of the city limits of Denver. The production in 1935 was from small sluicing and panning operations along the creek and was sold by the operators chiefly in lots of less than 2 ounces to bullion dealers in Denver, but the output of five deposits averaging 3.58 crude ounces 0.826 fine in gold and 0.154 fine in silver was sold to the Denver Mint.

ARAPAHOE COUNTY

Most of the output of Arapahoe County in 1935, as in 1934, was derived from small placer operations on Cherry and Dry Creeks and their tributaries southeast of Denver, but a few small lots were produced by individuals sluicing and panning on the Platte River and Little Dry Creek south of the city limits of Denver. Bullion dealers in Denver furnished a market for most of the gold, as all but two miners sold their gold before they accumulated the minimum of 2 ounces required for a deposit at the mint.

BOULDER COUNTY

Boulder County produced 22,631.20 ounces of gold, 34,048 ounces of silver, 18,000 pounds of copper, and 49,000 pounds of lead in 1935 compared with 17,536.48 ounces of gold, 57,171 ounces of silver, 21,400 pounds of copper, and 69,000 pounds of lead in 1934. There were 218 operating lode mines and prospects in the county in 1935, of which 116 produced only small lots of ore, ranging from less than one-half ton to 25 tons.

The St. Joe Mining & Milling Co. purchased ore throughout 1935 at its sampler at Boulder, principally from operators in Boulder County, but received some ores from Gilpin and Larimer Counties. The company reshipped the ore to the Golden Cycle mill at Colorado Springs. The mining and milling operations of the St. Joe Mining & Milling Co. are described in the district reviews. Much of the ore mined in Boulder County and most of the concentrates produced were shipped direct to the Golden Cycle mill or to the A. V. smelter at Leadville. Some high-grade ore was sent to the small gold and silver refinery of the Colorado Smelting & Refining Co. at Denver, and placer bullion was sold to the Denver Mint.

Boulder district.—Sluicing operations on Boulder Creek within the city limits of Boulder yielded 14.42 ounces of bullion 0.883 fine in gold and 0.119 fine in silver in 1935.

Central district (Jamestown).—In 1935 lessees on the Wano group continued to ship ore to the Golden Cycle mill at Colorado Springs. Two cars of gold-silver-copper ore from the Copper Blush mine and one lot of less than a car of gold-silver-copper concentrates produced by test mill runs on ore from the Golden Age group were shipped to the copper smelter at Garfield, Utah. The Associated Metal Mines, Inc., unwatered the 235-foot level of the John Jay mine, cleaned out and retimbered 300 feet of drifts, and did construction work on a 40-ton flotation plant. Ore produced during the year was sold to the Golden Cycle mill. Other producing mines in the Central district included the Alice, Cracker Jack, Fourth of July, Gray Eagle, Last Chance, Mount Pleasant, and Smuggler.

Gold Hill district.—In 1935 the Boulder Mill, Inc., built and equipped a 100-ton, custom-ore reduction mill on the old Black Cloud mill site at Salina. The mill was operated, but not at full capacity, from September through December. Crushing is done by a Universal 15- by 24-inch jaw crusher and grinding by a No. 64½ Marcy ball mill. Undersize from a 10-mesh screen at the ball mill is conveyed over 100 square feet of carpet launder and run over two No. 6 Wilfley roughing tables. Tailings from the tables are returned to the classifier, from which the overflow feeds into a 6-foot conditioner tank. Discharge from the conditioner tank goes to a 10-cell Stearns-Roger flotation machine. Concentrates from the flotation machine go to a thickening tank in closed circuit with a two-disk, 6-foot, American continuous filter. Carpet launder concentrates go over a half-size Wilfley concentrating table to an amalgamating pan. Most of the ore treated in 1935 came from the Richmond, Ingram, and Woodland mines, operated by the Mines Development Corporation, Ltd., with smaller tonnages from the Nancy, Logan, and Fairfax mines. The 100-ton flotation mill of the St. Joe Mining & Milling Co. on Left Hand Creek was operated continuously throughout the year on company ores, mainly from the Grand Republic mine (mentioned under Sugar Loaf district).

The Slide Mines, Inc., continued to mine and mill ore from its properties opened by the Corning Tunnel. The ore is treated in the 60-ton gravity- and flotation-concentration mill built in 1933 at the mouth of the tunnel. The equipment of the mill was given in Minerals Yearbook, 1935. The Gold Hill Developments, Ltd., retimbered the 520-foot shaft at the Fairfax mine, did 200 feet of drifting, and produced and shipped 1,022 tons of ore. The most important other producing mines in the district in 1935 were the Atlanta, Belle, Big Horn, Emancipation, Gardner, Goldsmith Maid, Grant, Homestake, Home Sweet Home, Little Johnnie, Nil Desperandum, Sakhrat, Prussian, Scotia, St. Joe, Washburn, and Winona. The United Empire Gold Mines Co. by December 31, 1935, completed construction work and installation of equipment for a 125-ton gravity- and flotation-concentration mill at its property at Sunshine. The mill was placed in operation early in 1936. The equipment consists of one Hardinge-Hadsel 20- by 6-foot grinding unit, two 10-section 25- by 6-foot rag plants, five No. 6 Wilfley tables, one Hardinge 6- by 14-foot classifier, and one 6-cell Denver Equipment No. 18 flotation machine. This company controls a consolidated group of old patented claims, the best known of which are the American, Interocean, Osceola, Monongahela, and White Crow. Small sluicing operations on Left Hand and Four-Mile Creeks yielded a little placer gold.

Grand Island district (Cardinal, Caribou, Eldora, and Nederland).—During 1935 the Rocky Mountain Gold Mines, Inc., repaired mine workings and buildings at its Boulder County group and installed new flotation and other equipment in the mill. Lessees shipped gold-silver-lead ore from parts of the mine to the A. V. smelter at Leadville and to the Golden Cycle mill at Colorado Springs. Gold ore was shipped from the Enterprise dump to the Golden Cycle mill and from the Mogul Tunnel dump to the sampler at Boulder. The Blue Bird and Caribou mines produced small lots of silver ore. Miscellaneous shipments of gold ore were made from other properties in the district, including the Anchor, Annie Paul, Norway, Rosalind, and Stranger. Placer gold was recovered by individuals sluicing on Beaver Creek.

Magnolia district.—Substantial shipments of gold ore were made in 1935 from mines and dumps in the Magnolia district. The principal producers were the Ben C. Lowell, Cash, Hereafter, Keystone, Lady Franklin, Little Pittsburg, Mountain Lion dump, Senator Hill, New Year-Fortune group, Poorman, Rocky Mountain-Mammoth, and Sac and Fox. The Magnolia Consolidated Mines Co. rebuilt the old mill at the KeKeonga mine to a 50-ton flotation plant and made a test run on dump material during the year.

Sugarloaf district.—The Grand Republic mine of the St. Joe Mining & Milling Co. was the largest producer of gold in Boulder County in 1935. The output came from stopes on the 50-foot level, which is opened by the shaft started in 1934 (to be sunk to a depth of 500 feet). Other levels at 100, 160, and 220 feet were established during the sinking of approximately 160 feet in 1935, and some development work was done on the 100-foot level. The ore was hauled to the company 100-ton flotation mill on Lefthand Creek (Gold Hill district) for concentration; part of the concentrates produced were sold to the Golden Cycle mill and part to the A. V. smelter at Leadville. The heads into the mill averaged 0.24 ounce of gold and 0.214 ounce of silver per ton and the concentrates 3.898 ounces of gold and 3.276 ounces of silver per ton. Lessees were active at the Poorman group, the second largest producer of gold in the district in 1935. Most of the ore was shipped to the Golden Cycle mill at Colorado Springs, but some was sold to the sampler at Boulder. At the Nancy and Wood Mountain groups lessees maintained a substantial output of ore, nearly all of which was shipped to the Golden Cycle mill. The other most important producers were the Amalgam Thief, Dime, Empress, Franklin, Livingston, Logan, Lord Byron, Milan, Recluse, Sugarloaf, and Tamborine. A lessee of the Metals Production Co. 100-ton flotation-gravity concentration mill at Wallstreet treated small lots of custom ore from nearby properties. Continuous operation in 1935 of a power shovel and movable washing and amalgamating plant at the Colby-Giggey placers yielded the bulk of the output of placer gold from the district.

Ward district.—In 1935 the Ward-Big Five Gold Mining Co. operated the Big Five 50-ton flotation-gravity concentration mill intermittently. Much of the tonnage treated was low-grade stope filling, put through the mill to test mill equipment and recovery efficiency. The total ore treated was 2,651 tons assaying 0.131 ounce of gold per ton (assays not made for silver); concentrates produced totaled 106 tons and assayed 1.65 ounces of gold and 2.20 ounces of silver per ton, 1.2 percent copper, and 41 percent iron. A lessee at the Milwaukee mine shipped 124 tons of ore assaying 1.26 ounces of gold and 0.40 ounce of silver per ton to the Golden Cycle mill at Colorado Springs. Other producers of more than 25 tons were the Morning Star, Nelson, Newmarket, and White Raven.

CHAFFEE COUNTY

Arkansas River district (Buena Vista, Salida).—Small sluicing and panning operations by eight individuals along the Arkansas River from Buena Vista south to the Fremont County line yielded 17.46 fine ounces of gold in 1935.

Chalk Creek district (Romley, St. Elmo).—In 1935, as for several years past, lessees at the Mary Murphy mine produced most of the output of metals from Chaffee County from gold-silver-lead-copper-[zinc] ore shipped to custom mills or smelters for treatment. The only other production made from the Chalk Creek district in 1935 was a small lot of gold-silver-lead ore shipped to the Leadville smelter from the property of the Philip Carey Mining & Milling Co.

Four Mile district.—Several shipments of gold ore were made by a lessee at the Little Annie C. C. group in 1935. A little placer gold was recovered from streams in the district by sluicing and panning.

Granite district.—Lode mines in the Granite district in 1935 shipped small lots of ore from the Aztec, Granite Tunnel, Juniper, Marion Bell, Thunderbird, and Trafalgar properties. Placer gold was recovered from the Franklin, Georgia Bar, Lost Canyon, Old Channel, and other placers near Granite.

Monarch-Garfield district.—In 1935 a lessee shipped 10 tons of lead-silver-copper ore from the Santa Rosa claim of the Madonna group to the Leadville smelter.

Riverside district.—The Mount Harvard group produced 87 tons of ore containing 44.10 ounces of gold, 780 ounces of silver, 10,628 pounds of lead, 9,599 pounds of zinc, and 2,246 pounds of copper in 1935. The ore was trucked by the owners to the Leadville smelter. Small lots of ore were shipped from the Big Chief and Lucky Day claims to the Golden Cycle mill at Colorado Springs.

Turret district.—Lessees at the old Independence mine cleaned out 190 feet of underground workings, of which they retimbered 75 feet, and made several shipments of copper-gold-silver ore in 1935.

CLEAR CREEK COUNTY

Alice district (*Yankee, Lincoln*).—The Alice district produced 13,642 tons of ore, yielding, in terms of recovered metals, 1,443.20 ounces of gold, 4,359 ounces of silver, 24,650 pounds of copper, and 10,700 pounds of lead in 1935 compared with only 374 tons of ore, yielding 127.81 ounces of gold and 79 ounces of silver in 1934. Most of the increased output in 1935 was due to renewed operations at two former producing mines, the Alice in the upper Fall River district and the Lombard on Fall River 6 miles northwest of Idaho Springs. The lessee of the Alice property reopened the mine, repaired underground timbering and built and equipped an 80-ton amalgamation-flotation concentration mill, which was operated continuously after September 1. The products of the mill were amalgamation gold-silver bullion and copper-gold-silver concentrates. At the Lombard mine, opened by four adits—800, 1,200, 2,500, and 4,000 feet long, respectively—and equipped with a 100-ton stamp amalgamation-gravity and flotation concentration mill, ore was shipped to custom mills for treatment until August, when the amalgamation and gravity concentration units of the Lombard mill were placed in operation. The mill treated a daily average of about 30 tons thereafter for 110 days in 1935. The Gold Anchor mill, equipped with 10 stamps, apron plates, and a Wilfley table, was used to treat ore from the Lalla mine. The Reynolds stamp mill was operated intermittently for about 6 months on ore from the Reynolds mine. Other smaller producing mines in the district were the Clara, Ethel A, Mesa Verde, San Juan, and Sweet Home.

Argentine district.—A 50-ton flotation mill was built and made ready for operation at the Santiago mine in 1935, and a small amount of gold was produced from shipments of crude ore. A test run of 300 tons of ore, chiefly from the Tobin group, was made in the Waldorf gravity-concentration mill built in 1935. The equipment includes a Blake 10- by 15-inch jaw crusher, Marcy 3- by 8-foot rod mill, and a D–O No. 2 table. The gold-silver-lead concentrates produced were sold to the A. V. smelter at Leadville. Lead-silver ore was shipped from the Gold Belt mine to the sampler at Idaho Springs, and ore of the same type was shipped from the National and Hamill mines to the A. V. smelter.

Empire district.—The Odell 100-ton cyanide plant 1½ miles north of Empire, built in 1935 (set in operation in July) to treat ore from the Crown Prince-Atlantic-Comet group, was the largest producer of gold in Clear Creek County in the year. The property comprises a group of claims consolidated and developed in 1934–35 by the Odell Mines, but the name of the operating company was changed to Minnesota Mines, Inc., as of January 1, 1936. The mine is opened by a 2,700-foot tunnel and 3,150 feet of drifts, winzes, and crosscuts, of which 2,875 feet were driven in 1935. The equipment of the mill includes one Wheeling 125-ton jaw crusher, one amalgamation pan, two Colorado Iron Works ball mills (one 5- by 5-foot and one 4- by 10-foot), two Wilfley tables, two Akins classifiers, four Dorr thickening tanks, one Portland filter, and three Dorr agitation tanks.

Idaho Springs district.—In 1935, the Clear Creek Gilpin Co. continued to purchase ores and concentrates at its sampler at Idaho Springs from operators in both Clear Creek and Gilpin Counties. The low-grade ores purchased were treated in the company's 75-ton flotation-concentration mill, run in connection with the sampler. The Argo mill, leased by the King Kong Mines in June 1934, was operated continuously in 1935 at a reduced rate on company and custom ores until December 18, when it was closed. The ore was treated by coarse crushing and fine grinding followed by amalgamation (free gold caught on mats and amalgamated in pans) and flotation concentration. In October the Ruth Co. completed and placed in operation a new 25-ton custom mill at Idaho Springs. The Gold Center (formerly Gustafson) mill in Gilpin County treated ore chiefly from the American Girl mine. The Alma Lincoln Mining Co. was the leading producer of metals in the Idaho Springs district in 1935. During the year the company installed new equipment to increase the capacity of its flotation mill from 50 to 100 tons per 24 hours, built a new 1,000-foot surface tram and new ore bins, and did considerable development work in the mine. The ore produced in 1935 came from the Lincoln (lower levels) and Elliot-Barber mines. The mill treated 23,253 tons of ore yielding 2,160 tons of gold-silver-lead-copper-[zinc] concentrates containing 3,345 ounces of gold, 10,362 ounces of silver, 45,536 pounds of copper, and 124,087 pounds of lead. The Tar Heel Mining Co. continued shipments of crude ore from the upper levels of the Lincoln mine.

The Midwest Gold Mines operated the Mattie group most of the year; the ore was treated in the amalgamation-concentration mill on the property. Lessees on the North American group, opened by the Central (Big Five) adit, produced ore from the Bald Eagle, Edgar, and Fulton mines; the Fulton yielded the bulk of the output. At the Bismark mine, a steady producer in 1935, a new 35-ton concentration mill was completed near the end of the year. Among other producing mines were the Brighton, Golden Edge, Kangaroo, Oregon, P. T., Red Jacket, Shafter, Specie Payment, Standard, and Stephens placer. The Bruce Consolidated Mining Co., operating the Bruce-Dierks-Orinoco group, repaired 300 feet of shaft timbering, sank 40 feet, and drove about 1,500 feet of drifts, crosscuts, and raises in 1935. The mine is opened by a crosscut tunnel 3,000 feet long, about 2,000 feet of drifts, and a 300-foot shaft. The company built and equipped a 150-ton concentration-flotation mill which was placed in operation in January 1936.

Montana district.—In 1935 lessees at the Red Elephant group of mines at Lawson cleaned out old drifts and tunnels and did about 200 feet of development work; they extracted 150 tons of ore which, with approximately 350 tons of dump material, was milled in the 50-ton flotation mill on the property. Miscellaneous lots of ore totaling approximately 800 tons, brought in from various mines and prospects in Clear Creek and Gilpin Counties, were concentrated at the Dumont mill, operated part of the year by a lessee as a custom plant. A few lots of silver-lead ore were shipped from the American Sisters dump and Princess of India and De Capriva (Climax) mines. Small lots of smelting ore, chiefly gold-silver ore, were shipped from other properties in the district.

Trail district.—After the Byron Mining Co. suspended operations at the Freeland group of mines in March 1935 the property was idle until May, when lessees started mining on a small scale and continued production to the end of the year. Most of the output of ore was treated in the 45-ton flotation-gravity concentration mill at the mouth of the drainage tunnel near Dumont. The product of the mill was gold-silver concentrates containing some lead and copper. Ore from the Phoenix mine was trucked to the Argo mill at Idaho Springs for treatment. The output from the Wheatland, Little Champion, Miller Tunnel, Turner, and other producing mines and prospects in the district was sold to the sampler at Idaho Springs or to the Golden Cycle mill at Colorado Springs.

COSTILLA COUNTY

Grayback district.—The only metal produced in Costilla County in 1935 was 2.01 fine ounces of gold recovered by sluicing operations at the Last Chance No. 3 placer in Grayback Gulch.

CUSTER COUNTY

Hardscrabble district (Westcliffe, Silver Cliff).—A lessee at the King of Carbonates mine shipped several cars of lead-silver ore, and the May Leasing Co. shipped a car of ore of the same type from the Passiflora mine. The ore from both properties was sold to the Leadville smelter. The output from other properties in the district comprised small lots of ore from the Bull Domingo dump, Del Norte mine, and Maine No. 2 mine.

Rosita Hills district.—The only output from the Rosita Hills district in 1935 was 6 tons of silver-gold ore shipped by a lessee on the property of the Southern Colorado Mining Co.

DELTA COUNTY

A small quantity of gold was produced by placer miners sluicing on the Gunnison River in Delta County in 1935.

DENVER COUNTY

Small individual sluicing and panning operations within the bounds of the city and county of Denver in 1935 yielded 39.34 fine ounces of gold, nearly all of which was sold in lots of less than 1 ounce to bullion buyers in Denver. In addition, dealers, assayers, and refiners in Denver purchased 1,688 fine ounces of gold, mostly placer bullion, produced in other western mining districts. The Colorado Smelting & Refining Co. continued to purchase gold-silver precipitates and small tonnages of high-grade gold and silver ores and concentrates from other districts for treatment at its plant in Denver. The plant is equipped with a Denver Quartz Mill jaw crusher, Chilian-type mill, Wilfley table, and two reverberatory refining furnaces.

DOLORES COUNTY

Pioneer district (Rico).—Most of the ores shipped from Rico in 1935 were zinc-lead-copper-silver-gold sulphide ores, with silver the metal of chief value. The ore was shipped crude to milling plants or smelters at Midvale or Tooele, Utah, or to the smelter at Leadville, Colo. Producers were the Depression-Dolly, Mines Leasing Syndicate on the Burns mine, Gold Anchor group, Hicks Lease on the Rico Townsite, Rico Consolidated Mining Co., Rico Enterprise Mining Co., and Union Carbonate group.

DOUGLAS COUNTY

A lessee of placer ground in Lemon Gulch 23 miles southeast of Englewood, using a two-compartment hydraulic jig equipped with a gasoline-powered, 1½-inch centrifugal pump, operated from May 1 to October 1 and recovered 12.39 crude ounces of gold 0.992 fine. Sluicing operations at the Happy Canyon placer from April 8 to July 29 yielded 9.58 ounces of gold 0.993 fine. Sluicing and panning operations in Newlin and Russellville Gulches and on Cherry and Dry Creeks yielded small lots of placer bullion which were sold to dealers in Denver.

EAGLE COUNTY

Burns and McCoy district.—The Gately placer operation, working bench gravel near the Colorado River about 5 miles west of McCoy and equipped with a gasoline tractor and "bulldozer" and sluices, was active from January through May 1935, during which time about 20,000 cubic yards of gravel were handled, yielding 64.99 crude ounces of bullion 0.820 fine in gold and 0.170 fine in silver. Prospectors recovered small lots of placer gold by panning and sluicing along the Colorado River.

Red Cliff district (Battle Mountain).—The principal producer of silver and copper in Colorado in 1935, as in 1934, and an important producer of gold, was the Eagle mine of the Empire Zinc Co. (New Jersey Zinc Co.) through its output of copper-iron-silver-gold sulphide smelting ore shipped to the Garfield (Utah) smelter from ore bodies in the Leadville limestone formation, dipping northeastward under Battle Mountain near Red Cliff. The company 600-ton flotation mill built partly underground in Eagle Canyon below Gilman was not operated in 1935. Shipments of gold ore were made to the Leadville smelter or to the Golden Cycle mill from other mines in the Red Cliff district, including the Alligator, Ben Butler, Ground Hog, Pine Martin, and Star of the West (high-grade gold ore).

ELBERT COUNTY

In 1935 a small quantity of placer gold was produced from test runs of machinery installed at placer ground on the Gannon Ranch on Gold Run Creek and from a small sluicing operation on Ronk Creek.

EL PASO COUNTY

GOLDEN CYCLE MILL

The Golden Cycle mill at Colorado Springs, El Paso County, has been operated continuously as a custom plant since it was built in 1907. The principal source of ore supply has always been the Cripple

Creek district, which produces gold-[silver]-sulphotelluride ores—pyrite and tellurides, mainly calavarite, with siliceous gangue. The mill started as a 1,200-ton, roast-amalgamation-cyanidation mill and ran without important changes in the flow sheet until 1927, when supplementary equipment was installed to treat gold-pyrite ores and concentrates, siliceous silver ores, and miscellaneous ores produced outside the Cripple Creek district in an all-sliming cyanidation circuit without preliminary roasting. In 1929 a 300-ton flotation-concentration unit was added to treat any ores offered, including zincky ores. The mill ceased paying for zinc and ceased making zinc concentrates in 1930. After the advance in the price of gold in 1933–34 and the resulting greatly increased tonnage of gold ores in the Cripple Creek and other districts served by the mill, new crushing equipment was installed, the tanks were enlarged to increase the capacity of the cyanide plant, and a new building was constructed into which were moved all previously used concentrating equipment and enough new equipment to raise the capacity of the flotation mill to 450 tons a day. By February 1935 the combined capacity of the two plants had been raised to 1,500 tons per 24 hours. A daily average of 1,376 tons was treated for 365 days in 1935.

The average grade of Cripple Creek ores, with which were mixed all iron concentrates produced in the flotation section or acquired by purchase, were treated by roasting followed by amalgamation[3] and cyanidation of the roasted product. The Cripple Creek ores are too low-grade to be roasted profitably, and nearly all ores received from other districts were concentrated and the tailings dewatered and cyanided. Bulk concentration was practiced on straight gold ores, which included the low-grade ores from the Cripple Creek district and gold ores from other districts that carried less than 5 ounces of silver per ton. Selective flotation was used on all other ores, which came largely from Boulder, Clear Creek, Gilpin, Lake, and Park Counties, with occasional shipments from other districts in Colorado, New Mexico, and Wyoming. When ore from the London gold mine of the Mosquito district, Park County, was received the flotation process was used to remove the graphitic or carbonaceous gangue material with the lead and copper, thus making high-grade gold-[silver-lead-copper] concentrates and eliminating carbon and copper, both cyanicides. The other product was an iron concentrate which, as explained above, was roasted and cyanided. The lead-copper concentrates were given preliminary cyanide treatment before shipment to the Leadville smelter. The treatment rates at the Golden Cycle mill are included under the review of the Cripple Creek district (Teller County), page 270.

FREMONT COUNTY

A small lot of gold ore was shipped from the Golden Eagle claim near Whitehorn to the Golden Cycle mill in 1935. Placer gold was recovered at placers operated by individuals along the Arkansas River from the Chaffee County line downstream to Florence and from sluicing operations on old smelter and mill tailings dumps at Florence. Construction was started during the year on a plant in which the flotation method will be used to recover the metals contained in the Florence dump of the Bee Zee Metallic Corporation.

[3] Free gold saved on light-weight canton flannel blankets and amalgamated in iron arrastre.

GILPIN COUNTY

Southern districts (Black Hawk, Central City, Nevadaville, Russell Gulch).—In 1935 "The Patch" glory hole at Nevadaville and the 2,000-ton amalgamation-gravity concentration-selective flotation mill at Central City, connected with it by a 3,250-foot aerial tramway, were operated continuously. The flotation equipment of the mill was not used, and the other equipment was not operated at capacity. The Central City Gold Mines Co., which had managed the property since July 1934, ceased operations on April 30, 1935.

The United Gilpin Corporation started operations at the property on May 1 and continued throughout 1935 at an increased rate of production. Development work done by the United Gilpin Corporation included the opening of an additional glory hole, 350 feet of drifting, 100 feet of tunneling, and electrification of 4,000 feet of the Quartz Hill tunnel. The property yielded 263,155 tons of low-grade gold ore during the year, all of which was treated by amalgamation and table concentration, from which were obtained one-half of the gold and one-fourth of the silver output from Gilpin County in 1935. The ore contains some copper and lead but not enough to add materially to its value. The Russell Gulch Mining Co., operating the Pittsburgh group, was the second largest producer in the district in 1935. The mine is equipped with a 275-ton mill in which the company treated 4,948 tons of gold ore from the Pittsburgh mine and 64,108 tons of dump ore from the Pittsburgh and Notoway dumps by gravity concentration. The product of the mill was 4,102 tons of gold concentrates, averaging about 0.82 ounce of gold and 1 ounce of silver per ton and 0.22 percent copper.

The Gregory Bates Mining Co. continued development work at its group of mines and treated 3,852 tons of ore in the Gregory-Bates mill (formerly the "Fifty" mill) at Blackhawk. The company also treated some custom ores. The mill was remodeled to include cyanidation early in 1936. At the Anchor mine the Willis Gulch Mining Co. reopened and repaired the 450-foot shaft and 900 feet of drifts and erected a 50-ton flotation mill, which was placed in operation before the end of the year. The ore contains gold, silver, lead, copper, and molybdenum (molybdenite). The flow sheet of the mill includes a unit with which the company is experimenting on selective flotation of the molybdenite mineral in an effort to produce a concentrate pure enough to be marketed. The Gold Center Mining & Milling Co. produced gold-silver-lead ore at the American Girl mine on the Queen Mineral ranch. The ore was treated by flotation in the company mill at Idaho Springs.

The Druid mine, operated continuously by lessees in 1935, was an important producer of gold and silver. The ore was sold to the Golden Cycle mill at Colorado Springs. The Diamond K Mining Corporation operated the Federal mine continuously from the time it began shipments to the Golden Cycle mill early in the year and was among the county's largest producers of gold. The War Dance Mines Co. 10-stamp mill between Central City and Blackhawk was operated most of the year and treated chiefly company ore. The Farr-Western mill at Blackhawk treated small lots of custom ore early in the year but was closed in April due to the court decision in 1935 against the dumping of tailings from the mills into the streams of the State.

The Beatrice Mining Co. added new equipment to increase the capacity of its gravity-concentration mill from 20 to 80 tons in 24 hours. The mill treated 2,000 tons in 1935, of which 400 tons were custom ore from dumps, 250 tons were mined ore from the Margaret Glennen Extension, and the remainder was dump ore from the Gregory Millsite. Among other producing mines and dumps in the southern districts in 1934 were the Foote-Simmons, Forfar, Justice, New Brunswick, Otte, Pewabic group, and War Dance. Sluicing operations by lessees at the property of the Eugene Mines, Inc., on North Clear Creek at Blackhawk yielded 203.61 fine ounces of gold and 110 fine ounces of silver. The Humphreys Gold Corporation traction dry-land dredge, which had been operating on Clear Creek in Jefferson County, entered Gilpin County on North Clear Creek in October and ran until December 3, when operations were suspended for 1935. The other output from placers in the southern districts came chiefly from individual sluicing operations on North Clear Creek and Eureka, Nevada, Russell, and other gulches.

Northern districts.—At the We Got Em and Cowboy group the Gilpin County Gold Mining Corporation, which started operations in May 1935, did 200 feet of development work and began to construct a 30-ton amalgamation-gravity concentration mill in October. The company shipped one car of gold ore to the Golden Cycle mill during the year. The only production from the Perigo group was made by the watchman who operated 5 of the 30 stamps in the Perigo mill for short periods to reduce ore produced from the Perigo mine. The other producers of 25 tons of ore or more in the northern districts were the Golden Flint, Hi-Tension Mining Co., Lone Star, Mountain Lion, Providence-Newport, and Reform. A small hydraulic operation at the Fontleroy placer and sluicing operations on South Boulder Creek and Gamble, Lump, Moon, and other gulches yielded placer gold.

GRAND COUNTY

No ore was produced from lode mines in Grand County in 1935. Placer miners sluicing on Willow Creek north of Granby recovered a little gold.

GUNNISON COUNTY

Elk Mountains district.—Silver ore from the Ruby Chief group was shipped to the Midvale (Utah) smelter, and small lots of smelting ore were shipped from the Baxter and one other property in the Elk Mountains district to the A. V. smelter at Leadville. At the Gold Dollar mine 300 tons of gold ore were reduced in a 5-foot Huntington mill and amalgamated, yielding 19.28 ounces of bullion that weighed 17.21 ounces after being smelted at the Denver Mint and had a fineness of 0.683 in gold and 0.109 in silver. Gold was produced from small sluicing operations at the Hayden-McCleod placer in Washington Gulch.

Gold Brick district (Ohio).—Operations at the Carter mine on Gold Creek were carried on continuously in 1935, but about 7 months were spent in repairing mine timbering, providing for tailings disposal, and improving the surface plant, which included rebuilding of the mill and installation of a new ball mill and classifier to raise its capacity to 150 tons per 24 hours. The mill was operated 112 days in 1935 and treated a daily average of 39 tons by amalgamation and concentration. The owners of the Wayne mine and the lessees of the Gold Monument and Raymond group did development work in the mines and shipped gold-silver-lead ore to smelters. Small lots of ore were shipped from other mines in the Gold Brick district, including the Black Hawk, Bonus, Dodson, Gem, Golden Wedge, and Victory.

Quartz Creek and Box Canon districts.—No ore was produced from the Roosevelt Gold Mines group in 1935. The only output in the Quartz Creek and Box Canon districts came from small shipments of smelting ore from the Fairview-Cleopatra and Rarus Warrior mines.

Rock Creek district (Marble).—Three tons of ore produced at the Inez group were shipped to the Leadville smelter in 1935.

Taylor Park (Tin Cup) district.—Lead ore was shipped to smelters from the Gold Cup group and one other lode mine in the district in 1935, and two small test lots of gold ore were shipped to the Golden Cycle mill from the Little Johnnie mine. Small-scale sluicing and panning in Taylor Park yielded placer gold.

Tomichi district.—Silver-lead ore was shipped from the Bill Short and one other property to the Midvale (Utah) smelter in 1935.

HINSDALE COUNTY

Galena district.—The Eldorado Gold Mining Co. did development work at the Fanny Fern group during June and July and completed a 50-ton concentration mill in August. The mill was operated about 2 weeks on low-grade ore to test the machinery and tighten the launders but remained idle the remainder of the year. One lot of silver-lead concentrates produced during the run was shipped to the Leadville smelter.

Lake district.—In 1935 development work was continuous at the Golden Wonder group by the San Juan Gold, Inc., which shipped several small lots of high-grade gold ore from the mine. The Garlock Mines Co. shipped one lot of gold-silver-lead ore from another property to the Midvale (Utah) smelter.

JACKSON COUNTY

The Pure Gold Mining Co. during July, August, and September operated its placer at Alder Gulch on Independence Mountain 20 miles northwest of Walden, obtaining 11.25 crude ounces of bullion 0.933 fine in gold. The gold was found in bench gravel, which was hauled one-quarter of a mile by truck to a stream and sluiced. About 450 cubic yards of gravel were handled during the 3 months. Other sluicing operations on Alder Gulch yielded small lots of placer gold.

JEFFERSON COUNTY

The Humphreys Gold Corporation operated its traction dry-land dredge at its Colorado Placer mine in the bed of Clear Creek continuously from March 15 to December 3 and handled 300,880 cubic yards of gravel. This company was the largest producer of gold from placers in the State in 1935. The equipment used consisted of one 1½-yard power shovel, two 2½-yard dragline excavators, and a portable screening and sluicing plant, all of which used gasoline for power. About November 1 the plant, which is working upstream, crossed the Jefferson County line, passed through a corner of Clear Creek County, and entered Gilpin County, where it was operated the remainder of the season. Individual sluicing operations along Clear Creek in Jefferson County yielded small lots of placer gold.

LAKE COUNTY

LEADVILLE DISTRICT

The Leadville district produced 58,164 tons of ore yielding, in terms of recovered metals, 13,811.51 fine ounces of gold, 109,504 fine ounces of silver, 61,000 pounds of copper, 2,575,000 pounds of lead, and 1,848,000 pounds of zinc in 1935 compared with 28,433 tons of ore yielding 14,282.09 fine ounces of gold, 83,575 fine ounces of silver, 90,400 pounds of copper, 1,047,000 pounds of lead, and 1,029,000 pounds of zinc in 1934.

One furnace of the A. V. lead bullion-leady copper matte smelter of the American Smelting & Refining Co. was operated continuously as a lead-bullion plant with subsidiary leady-copper matte plant throughout the year, and a second lead furnace was operated from March 10 to May 10 and from October 16 to the end of the year. The copper furnace installed in 1932 was not operated in 1935. Except for a small lot of ore received from New Mexico, all ores and concentrates treated in 1935 came from Colorado mines.

The bulk of the ore mined in the Leadville district was smelted direct at the A. V. smelter, but some of the ores produced at properties along the Yak tunnel and at other mines in that vicinity were concentrated at the remodeled Yak mill, which was operated part of the year as a custom mill; the output of concentrates was sold to the smelter. The Leadville Metals Milling Co. reconditioned the Leadville Zinc-Lead selective-flotation mill and concentrated several thousand tons of low-grade dump material during experimental operations to recover gold and silver. The company completed a cyanide unit in December. Gold-silver ores were shipped to the Golden Cycle mill at Colorado Springs for treatment, and specimen gold was sent to the Denver Mint. Zinc-lead sulphide ore was shipped to the pigment plant at Coffeyville, Kans., and zinc-lead-gold-silver ore to the Midvale (Utah) plant.

In 1935, as in 1934, the Ibex group was the largest producer of gold, silver, and copper in the district. Other important producing lode mines included the Ballard, Chippewa, Cord, Dolly B, Fanny Rawlings, Fortune, Highland Mary, Lilian, Monarch, Rock Hill Mines Co. property, Tribune, Valley, Venir, and Zenda Leadville Mining Co. Resurrection-Golden Contact group.

The Pan-Due Placer Co., operating a gasoline power shovel and screening and washing plant at the Norton Engelbach and Starr placer in California Gulch from August 9 to December 14, was the principal producer of placer gold in the district. The Hector placer in Buckeye Gulch, where similar equipment was installed in 1934, was operated only for a short period in 1935. Various small-scale sluicing operations by individuals in the district yielded small quantities of gold.

OTHER DISTRICTS

Alicante district.—Small lots of lead-silver-gold ore were shipped to the smelter from the Alicante and John Reed mines in 1935.

Granite district.—Several shipments of gold ore were made from the Belle of Granite lode mine in 1935. Most of the placer output of the district came from the Cureton placer on Lake Creek, where three hydraulic giants were used to handle the gravel during 2 months' operation.

Lakawanna Gulch district.—The only output from mines in the Lakawanna Gulch district in 1935 was 33 tons of gold ore shipped from the Eureka mine to the Golden Cycle mill at Colorado Springs.

St. Kevin district.—The Amity mine was operated for 10 months in 1935 and produced 326 tons of gold-silver ore which was shipped crude to the Leadville smelter. The only other output of the district was 16 tons of gold-silver-lead ore shipped to the smelter from the Griffen mine.

Tenmile (Climax, Fremont Pass) district.—The Climax Molybdenum Co. mill at Climax on Fremont Pass was operated 365 days at a daily average of 3,473 tons and produced molybdenum sulphide concentrates containing 10,186,635 pounds of elemental molybdenum.

Molybdenum production at the Climax mill in Colorado, 1924–35

	Elemental molybdenum (pounds)		Elemental molybdenum (pounds)
1924 (idle first 7 months; operated last 5 months)[4]	156, 935	1930	3, 083, 000
1925	821, 757	1931	2, 644, 399
1926	1, 057, 367	1932	1, 913, 395
1927	1, 858, 228	1933	5, 028, 695
1928	2, 957, 845	1934	8, 378, 683
1929	3, 529, 295	1935	10, 186, 635

Tennessee Pass district.—The output from the Tennessee Pass district in 1935 was gold-silver ore shipped from the Jennie June mine.

Twin Lakes district.—In the Twin Lakes district a new 20-ton amalgamation-gravity concentration mill was nearly completed at the Columbia mine, from which a 15-ton lot of gold-silver-lead oxidized ore was shipped to the Leadville smelter. The dragline-excavator, dry-land-dredge installation at the Derry Ranch placers was operated continuously in 1935, and sluicing was done at the Zaitz placer from September 1 to November 10.

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 1935.

California (or La Plata) district (Hesperus, La Plata).—In 1935 the Gold King group of the La Plata Mines Co. did development work and produced ore continuously. The ore is brought by aerial tramway to the 50-ton company mill 8,000 feet from the mine. The mill was operated one shift at a reduced rate part of the year. The gold-silver-lead-[zinc] concentrates produced and crude ore similar in character to the concentrates were sold to the Leadville smelter. The 50-ton flotation mill of the May Day Milling Co. was operated at a reduced rate on ore from the May Day mine.

Production from the Mountain Lily group comprised 21 tons of ore containing 24.94 ounces of gold and 24 ounces of silver. The Lucky

[4] Idle from April 1919 to Aug. 1, 1924.

Discovery Gold, Inc., operating the Lucky Discovery-Lucky Moon-Old Comfort group, drove 210 feet of crosscuts and drifts and a 100-foot raise in 1935. Ore sorted during development work was shipped to the Leadville smelter. Small lots of ore were shipped from other properties in the district, including the Bessie G., Muldoon, Valley View Leasing Co. property, and Black Diamond.

Vallecito district.—Two small lots of gold ore were shipped from the Bobby-Grizzly King group in 1935.

LARIMER COUNTY

The Little Mary Mason mine in the Masonville district continued to ship high-grade gold ore to the Golden Cycle mill at Colorado Springs. The mine is opened by a vertical shaft 120 feet deep and a 400-foot adit. The ore is sorted before it is shipped. Other producers in 1935 were the Carter mine in the Masonville district and the Gold King in the Manhattan district.

LAS ANIMAS COUNTY

A small lot of gold-silver-lead ore was shipped from the "Little Mattie" mine on West Spanish Peak 18 miles westerly from Aguilar.

MESA COUNTY

Sluicing along the Gunnison and Colorado Rivers yielded small lots of placer gold in 1935.

MINERAL COUNTY

Creede district.—Most of the silver mines of the Creede district, which were reopened in 1934 owing to the increase in the price paid for silver by the United States Treasury, continued active in 1935. Three of the mines that produced in 1934 had no output in 1935, but three others were reopened. Production of silver was 499,680 ounces compared with 479,890 ounces in 1934. The entire output of the district in 1935 was shipped crude to the Leadville smelter. Producing mines were the Amethyst, Commodore, Creede Mines group, Del Monte-Last Chance-New York-Pittsburg group, Eunice, Manitoba-Ontario, and Wedge (operations started Oct. 29, 1935).

MOFFAT COUNTY

Douglas Mountain district.—Nineteen tons of copper ore were shipped from the Garfield-Bromide group in secs. 9 and 16, T. 7 N., R. 101 W., sixth principal meridian, to the Garfield (Utah) copper plant in 1935.

Fourmile (*or Timberlake*) *district.*—A tractor and "tumblebug" scraper were used to move gravel to sluice boxes at the Gooly Placer Mines group, which produced most of the output from the Fourmile district in 1935. Sluicing was done at other placers on Timberlake and Fourmile Creeks, including the Alice, Amazon, K. Z., and Old Faithful.

Lay district.—Lessees at the Wallihan property on Lay Creek continued small-scale placer operations in 1935.

MONTEZUMA COUNTY

The Red Arrow Gold Corporation shipped 81 tons of ore containing 270 ounces of gold and 562 ounces of silver from its Red Arrow mine in 1935. The only other output from Montezuma County was a small lot of bullion recovered from the Silver Leaf claim. The Hesperus Mining Co., operating the Doyle group of claims in Rush Basin, constructed a new road to the mine, two aerial jig-back tramways with terminal buildings and bins, snow sheds at two tunnels, a new mill, and other buildings needed for a new mining camp. The mill had a maximum capacity of 100 tons in 24 hours and was equipped for amalgamation and gravity and flotation concentration. On February 15, 1936, before the mill was placed in operation, it was destroyed by a snow slide which swept most of the buildings into a small canyon 150 yards away and resulted in six deaths.

MONTROSE COUNTY

La Sal district.—Sluicing on the Dolores River at the Dolores Good Bye Dan, Hardscrabble, Horseshoe, and other placers yielded many small lots of placer gold in 1935. Except for the output from the Dolores placer, shipped direct to the Denver Mint, the gold recovered was sold to dealers in lots of less than 2 ounces.

Naturita district.—Numerous small sluicing operations were worked along the San Miguel River by individuals who sold nearly all the gold recovered in small lots to dealers in Salt Lake City, Utah, and Grand Junction, Colo.

OURAY COUNTY

Red Mountain district.—A car of lead-zinc ore was shipped to the Midvale (Utah) smelter by the Blue Eagle Mining Co. in 1935.

Ridgway district.—Individual sluicing operations on the Uncompahgre River produced a little placer gold.

Sneffels district.—The King Lease, Inc., operated its amalgamation-flotation concentration mill in Imogene Basin continuously in 1935 on ores extracted from its lease on the upper workings of the Camp Bird mine. During the year the company added a 4- by 4-foot disk American filter to its mill equipment and replaced eight small flotation cells by a 4-cell No. 15 Fahrenwald flotation machine. The maximum capacity of the mill at the end of 1935 was 100 tons in 24 hours. Development work in the mine comprised 905 feet of raises, drifts, crosscuts, and winzes; 318 feet of rebuilt levels; 75 feet of spiling; and 77 feet of back stoping. The products of the mill, as in previous years, were amalgamation bullion, which was shipped direct to the Denver Mint, and concentrates, which were classed as lead-copper with the principal value in gold but which also carried 18.66 ounces of silver for each ounce of gold and considerable zinc; the zinc was not saved at the Leadville smelter. On February 24, 1936, a snow-slide crushed the mill and one bunkhouse and caused three deaths. Ore produced at the Governor and Trust Ruby mines was treated in the E. A. Alexander 5-ton amalgamation-gravity concentration mill. A small lot of lead-zinc ore was shipped to the Midvale (Utah) smelter by the Rocky Mountain Engineering Co.

Uncompahgre district (Ouray).—Dry silver ore extracted from the Pony Express and Upper Bachelor groups was concentrated in the

G. A. Franz flotation mill, and the resulting silver-lead-copper-gold-[zinc] concentrates were shipped to the Leadville smelter. The mill has a capacity of 120 tons per 24 hours and was operated continuously, but not at capacity, in 1935. Gold-silver ore was shipped to the Leadville smelter from the Wanakah-American Nettie group operated by the McCullough lease throughout the year. A small output was made from the Early Bird, Speedwell, and Woodstock mines.

PARK COUNTY

Alma Placers district.—Placer miners working individual or group leases on the Alma Placers increased their output of gold from 1,046 ounces in 1934 to 3,007.43 ounces in 1935. The largest gains were made by the operators who changed their method of mining from surface placering to drift mining and installed mechanical equipment to bring the gravels found near bedrock to sluices. Gold was deposited at the Denver Mint and small lots were sold to dealers by 90 persons leasing on this property in 1935 compared with 94 in 1934.

Buckskin district.—In 1935 the Alma Homestake Mining Co. built and equipped a 10-ton gravity- and flotation-concentration mill in Buckskin Gulch about 2 miles from Alma and treated 380 tons of oxidized quartz-gold ore from its Silver Wave mine. The Happy Five Mining Co. shipped crude gold-silver-lead ore to the A. V. smelter at Leadville from its lease on the Loveland Mountain group. Gold-silver ore from the Phillips mine was shipped to the Golden Cycle mill at Colorado Springs, and small lots of gold and gold-silver ore were produced at other properties and sold to the A. V. smelter.

Consolidated Montgomery district.—Producers of a car or more of ore in the Consolidated Montgomery district in 1935 were the Atlantic and Pacific, Columbia, and Magnolia.

Fairplay district.—A power shovel and portable trommel-screen sluicing plant was installed on the South Platte River just north of Fairplay and was operated for a short time in 1935. Lessees continued to recover placer gold from the property of the South Park Dredging Co. near Fairplay. Much churn drilling was done and many test pits were sunk in 1935 on placer ground north and west of Fairplay.

Mosquito district.—In 1935 the Mosquito district ranked second among Colorado districts in output of gold. The London Gold Mines Co. operated the 125-ton London mill on ore from the South London and London Extension groups continuously throughout the year. The company shipped high-grade gold ore containing silver, copper, and lead to the Golden Cycle mill and lead concentrates, with the principal value in gold, to the Leadville smelter. The American mine and 100-ton flotation mill were operated steadily. The mill produced gold-silver-copper-lead concentrates which were shipped to the Leadville smelter. The Fairplay Gold Mines, Inc., operated the North London mine and 100-ton flotation-gravity concentration mill continuously. A 3,000-foot aerial tramway is used to bring the ore to the mill. Concentrates were shipped to the Leadville smelter. The London-Butte Gold Mines Co. shipped crude gold-silver-lead ore from the Butte mine to the Leadville smelter. The mine is opened by a 375-foot vertical shaft and drifts. The company drove 2,519 feet of development openings in the mine in 1935 and nearly completed the building and equipping of a 100-ton flotation mill, which was placed in operation in May 1936. Other surface buildings were constructed. The mill, for which foundation work and other construction was begun in 1934 by the London Mountain Gold Mining Co. at the Oliver Twist tunnel, was completed and placed in operation in March 1935. The output of concentrates was sold to the Leadville smelter.

The Argentine Gold Mining Co. shipped several hundred tons of silver-lead-gold ore from the Hock Hocking mine to the Leadville smelter. Construction work was done on a 50-ton flotation-concentration mill to treat the ores from this mine during part of the year. Tailings from an old mill site on the Briscoe Ranch, where ore from the London mine was formerly treated, were shipped to the Golden Cycle mill at Colorado Springs. Gold-silver-lead ore was shipped to the Leadville smelter from the West London mine. Lessees shipped 174 tons of gold-silver-lead ore from the Dauser mine. Operations at this property were transferred in June 1935 to the Alma Bette Gold Mining Co., which started construction work on a 50-ton flotation mill before the end of the year. Other producers in the district, all with an output of less than 100 tons of ore, included the Champaign, Little Edith, and Susquehanna. The Silverado Mining Co. produced placer gold at the Combination placer on the east slope of Pennsylvania Mountain, and a small quantity of gold was recovered by a prospector sluicing near the North London mine.

Tarryall district.—The yield from placers in the Tarryall district was 1,122.20 ounces of gold and 93 ounces of silver. The bulk of the output was made by the Peerless Mining Co., which since 1934 has been operating a dry-land machine equipped with trommel screen, four Ainlay bowls, and stacker on the Wilson placer 7 miles southeast of Como. A power shovel is used for digging. The season's operations in 1935 lasted from April 28 to November 15. During this period 100,000 cubic yards of gravel were handled. Lessees at the Pawnee Mining Co., placering on Deadwood Creek, an upper tributary of Tarryall Creek, did small-scale sluicing from June to September, inclusive. Many individuals sluicing on Tarryall Creek during the summer recovered small lots of placer bullion. The only output from lode mines in the Tarryall district in 1935 was a small lot of gold ore shipped to the Golden Cycle mill from the Elizabeth claim and from 25 tons of eroded vein matter run through a rocker at the Black Butterfly claim on Silverheels Mountain. Ancient stream gravels on the Peabody and Foster Cline Ranches, adjoining Como, were examined by churn drilling and test pits.

PITKIN COUNTY

Lincoln Gulch district (*Aspen*).—In 1935 the owner of the Copper Blossom claim 21 miles southeast of Aspen recovered a small quantity of gold by hand methods from ore mined from an open-cut.

Roaring Fork district (*Aspen*).—The Midnight Mining Co. operated its 50-ton flotation mill continuously in 1935, but not at capacity, on highly siliceous silver ore from the Midnight mine; the sulphide minerals are silver-bearing galena, some sphalerite, and very little pyrite. The bulk of the silver recovered was in the lead concentrates sold to the Leadville smelter. Some high-grade silver-lead ore was shipped crude to the Leadville smelter. Byproduct zinc concentrates containing some silver and lead made in the zinc unit were shipped to the zinc smelter at Amarillo, Tex. The properties leased in 1934 by the Colorado-Duluth Mining Co. were operated by sublessees in 1935 and yielded 6,406 tons of silver ore containing lead and lime; the lime also was paid for at the Leadville smelter. The group includes the property of the Smuggler Leasing Co. (Durant group), Della S Consolidated Mines Co., Percy La Salle Mining & Power Co., and Spar Consolidated Mines Co., comprising in all 127 claims or parts of claims and mill sites. At the Hope property 350 tons of dry silver ore were treated in the Herron mill and yielded 35 tons of silver concentrates containing some lead. The ore was put through small rolls and a circular screen, the coarse material going to two jigs and the fines over a table.

RIO GRANDE COUNTY

Summitville district.—The Summitville Consolidated Mines, Inc., operated the Little Annie group of mines and 100-ton flotation-cyanidation mill (built in 1934) continuously in 1935. The ore is brought by trucks and tramway to the mill, where it is put through jaw crushers and ball mills in closed circuit with a Dorr classifier and then through Fahrenwald flotation machines. Tailings from the flotation machines are cyanided, and precipitation is by the Merrill-Crowe process. Concentrates produced are shipped to smelters.

ROUTT COUNTY

Hahns Peak district.—Operations at the Hahns Peak Gold Mining & Milling Co. property in 1935 comprised only development work and repairs to underground timbering. At the P. I. C.-Master Key group of the Primary Industries Corporation, Inc., opened by a 300-foot vertical shaft and 1,200 feet of adits and drifts, 600 feet of development work were done from June to December. Small sluicing operations at placers in Ways Gulch south of Grouse Mountain yielded the entire output of metals from the district in 1935.

SAGUACHE COUNTY

Blake district (Mirage).—Development work was done at the Maid of Orleans-New Deal claims on Cotton Creek in 1935 and a small quantity of gold was produced during test runs of the 3-ton gravity-concentration mill at the mine.

Crestone district.—The principal producer of gold in Saguache County in 1935 was the Luis Maria Baca Mining & Development Co., operating a group of mines in the mineral section of Baca Grant No. 4. The ore was treated in the 35-ton flotation mill built during the year on Cottonwood Creek about ½ mile from the mine. The equipment of the mill consists of a Universal jaw crusher, Marcy ball mill, classifier, and Denver Equipment four-cell flotation machine. The overflow from the classifier was passed over carpets before it reached the flotation machine, and the carpet concentrates were amalgamated. Flotation concentrates were shipped to the Leadville smelter.

Kerber Creek district (Bonanza).—The output from the Kerber Creek district in 1935 comprised chiefly several cars of silver-lead-copper ore shipped from the Rawley mine to the Leadville smelter. Small lots of ore of a similar type were shipped from the California and two other properties, and a test lot of silver ore was shipped from the Little Johnny claim.

SAN JUAN COUNTY

Animas district.—Since 1931 the Shenandoah-Dives Mining Co. has produced most of the metal from San Juan County from gold-silver ore containing copper and lead mined at its property in Arrastre Gulch 4 miles easterly from Silverton and milled in its 600-ton flotation mill on the Animas River connected with the mines by a 1½-mile aerial tram. In previous years, only company ore had been treated in the mill, but in 1935 some custom ores were concentrated. Company ore totaled 167,521 tons, yielding 5,730 tons of gold-silver-copper-lead-[zinc] concentrates which were sold to the Leadville smelter. Most of the custom ores treated comprised 4,733 tons from the Pride of the West mine, yielding 893 tons of lead-silver-gold-copper-[zinc] concentrates. In addition 755 tons from this mine were shipped crude to the Leadville smelter. The remainder of the custom ores treated at the Shenandoah-Dives mill came from the North Star-Sultan and the Little Fannie-Philadelphia group. Other producers included the Old Hundred, A. & M. Mining Co., Mystery Gold Mining Co., and San Juan Mining Co. (Mabel mine). Small-scale placer operations near Silverton yielded a little gold.

Eureka district.—Producing lode mines in the Eureka district in 1935 were the Brooklyn group and the Frederika mine of the Silver Wing group. Gold production was reported from the Blue Eagle placer.

SAN MIGUEL COUNTY

Iron Springs district (Ophir).—In 1935 the ore produced and shipped from eight mines and prospects in the Iron Springs district totaled only 157 tons, most of which was shipped to the Midvale (Utah) smelter. A little high-grade silver ore was shipped from the Montezuma mine. Among small producers were the Carribeau and Butterfly-Terrible groups, which yielded gold-silver-lead ore.

Lower San Miguel district (Sawpit, Vanadium).—The output of ore from the Lower San Miguel district in 1935 consisted of two small lots shipped to the Leadville smelter, one from the J. L. lode and tunnel site and one from the Micherado Mining Corporation property. Gold was recovered at small placers along the San Miguel River and its tributaries.

Mount Wilson district.—Producing mines in the Mount Wilson district were the Polar and Silver Pick, both of which yielded small lots of high-grade gold-silver ore which was sold to smelters.

Upper San Miguel district.—The most important producer of gold, silver, and lead in the Upper San Miguel district in 1935 was the Telluride Holding Corporation from its operations at the Smuggler-Union mine. The chief producer of copper and the second largest producer of gold, silver, and lead was the San Juan Metals Corporation, which milled old tailings 1 mile east of Telluride. These two companies produced 91.2 percent of the gold, 98.7 percent of the silver, 94.4 percent of the copper, and 99.3 percent of the lead output of the district in 1935. Ore from the Smuggler-Union mine was treated in the company amalgamation-flotation concentration mill, which had a capacity of 300 tons in 24 hours at the end of 1935. Both the mine and mill were operated continuously throughout the year. The mill of the San Juan Metals Corporation is equipped for flotation and table concentration. Its capacity at the end of 1935 was given as 400 tons per 24 hours. Each year since its erection in 1933 the plant has been operated only during the summer; it was run 156 days in 1935. Concentrates produced at both the mills mentioned above were shipped to the Leadville (Colo.) and Garfield (Utah) smelters. At the Mammoth group the Maryland Mines Corporation drove 375 feet of drifts and erected a 50-ton amalgamation-gravity concentration mill in 1935. Amalgamation bullion produced during the year was sold to the Denver Mint, and concentrates were shipped to smelters. The milling plant was damaged by a snowslide in February 1936. Other producers in the district included the Alta, Atlas, Dividend, La Junta, Lucky Strike (small milling operation on old tailings), Laura (equipped with a 15-ton amalgamation-gravity concentration mill), and Savage. Sluicing along the San Miguel River below Telluride yielded small lots of placer gold.

SUMMIT COUNTY

Breckenridge district.—Two floating dredges on Blue River yielded the bulk of the output of gold in Summit County in 1935. One was operated by the Continental Dredging Co. about 2 miles north of Breckenridge and the other by the Tiger Placers Co. dredging through the town of Breckenridge. Both are electrically driven. The dredge of the Continental Dredging Co. has a rated capacity of 4,000 cubic yards per 24 hours and is equipped with 88 buckets, each having a capacity of 7½ cubic feet; it was operated 254 partial 24-hour days in 1935 and handled approximately 650,000 cubic yards of gravel. The dredge of the Tiger Placers Co. has a rated capacity of 5,000 cubic yards per 24 hours and is equipped with 82 buckets, each having a capacity of 9½ cubic feet. It suffered the loss of the stacker early in the year and handled about 250,000 yards of gravel during the 128 partial 24-hour days it operated. Lessees operating intermittently from June 15 to August 20 produced 93.80 ounces of bullion 0.825 fine in gold and 0.172 fine in silver at the Bemrose-Bostwick placer. Steam shovels were used to dig the gravel, which was delivered by trucks to trommel screens, the coarse gravel being discarded and the fine material sluiced. A placer in French Gulch was operated for a short time with a power shovel, and lessees on the Royal Tiger property used the hydraulic method for a short period. Sluicing operations at the "86", Germania, Key West, McDaniel, and other placers in the district yield placer gold. Almost the entire metal output from lode mines in the Breckenridge district was from ore shipped crude to smelters. Gold-silver ore was produced by lessees working on a small scale at the property of the Royal Tiger Mines Co. The Carbonate and Congress mines each produced several cars of gold-silver-lead ore. Smaller quantities of ore were shipped from the Blue Flag, Fredonia, Betty Ann, and nine other mines and prospects in the district.

Montezuma district.—Two lots of silver-lead-copper smelting ore were shipped from the Bullion group, where the lessee installed a gasoline motor and compressor, repaired and retimbered the 160-foot shaft, and cleaned out 100 feet of tunnel, part of which he also retimbered. A lessee on part of the "Sts. John" mine shipped a car of silver-lead ore to the Leadville smelter. A car of gold-silver ore was shipped to the Leadville smelter by the Polartic Mining Corporation, and 8 tons of the same type of ore were shipped from another property in the district. A small lot of silver-lead ore was sold to the sampler at Idaho Springs from the Rothchild property.

Ten Mile (Kokomo, Robinson) and Wilkinson (Frisco, Dillon) districts.—Gold-silver ore was shipped from both the Delaware mine (at Kokomo) and the Excelsior (at Frisco); part of the output from each went to the Golden Cycle mill and part to the Leadville smelter. The only other mine in the district producing as much as a car of ore in 1935 was the Gold Crest (at Kokomo). Small lots of gold-silver-lead ore aggregating 27 tons were shipped from five other properties, including the Connors Bonanza and Frisco. Placer gold was recovered by hydraulicking at the Buffalo placers, near Dillon, and by small sluicing operations, principally in McNulty Gulch, above Robinson.

TELLER COUNTY

CRIPPLE CREEK DISTRICT

The Cripple Creek district produced 460,448 tons of mine and dump siliceous sulphotelluride gold ore in 1935 which yielded, in calculated recovered metals, 124,287.66 fine ounces of gold and 13,287 fine ounces of silver compared with 425,242 tons yielding 127,901.20 fine ounces of gold and 12,555 fine ounces of silver in 1934. In these calculations account is taken of mill slags, clean-ups, and stolen specimen gold. Such accounting has been made in all previous reports of this series (Mineral Resources and Minerals Yearbook) and in United States Geological Survey Professional Paper 138. The figures show an increase of 35,206 tons of ore produced and sold but a decrease of 3,613.54 ounces of recovered gold in 1935, indicating that more ore was handled but that it had a lower average grade. Another factor affecting gold production was the curtailment of mining operations on the Stratton Estate from June to December while a custom mill was being erected on the property. Small placer operations in the district produced 36.34 ounces of gold and 1 ounce of silver in 1935.

The bulk of the ore produced in the Cripple Creek district in 1935 was shipped over the Midland Terminal Railway to Colorado Springs and sold to the Golden Cycle mill (operations described under El Paso County). The mill is owned and operated by the Golden Cycle Corporation, which also operated several mines in the Cripple Creek district in 1935. The following excerpts pertaining to the mill are from the annual report of the corporation, for the calendar year ending December 31, 1935:

During the year 1935 the Golden Cycle mill treated 502,142 tons of ore, of an average value of $11.3345, which is the largest tonnage ever put through this plant. Sales of bullion and concentrates amounted to $5,562,929.54. The mill plant is now one of the largest custom plants of its kind in the country. The larger part of the tonnage treated came from the Cripple Creek district, but ores were also received from many other mining camps in Colorado and surrounding States.

Despite a noted increase in activity in many mining sections of the State, due to the increased price of gold, there is not much new ore of good commercial grade being developed, but the improvements at the Golden Cycle mill have in a large measure been able to maintain satisfactory earnings from the plant.

The treatment rates for the Cripple Creek district have not been changed since September 1, 1933, and those for miscellaneous ores from other districts were changed only slightly in 1935. These rates were continued into 1936.

The treatment schedules follow.

Cripple Creek treatment rates, Golden Cycle mill, 1935 (in effect during 1936)

Ore up to and including $4 gold per ton	$1.95 plus $0.60 freight.
Over $4 and including $5 gold per ton	1.95 plus $0.75 freight.
Over $5 and including $8 gold per ton	2.50 plus $1 freight.
Over $8 and including $10 gold per ton	4.40 (includes freight).
Over $10 and including $15 gold per ton	5.70 (includes freight).
Over $15 and including $20 gold per ton	7.00 (includes freight).
Over $20 and including $25 gold per ton	7.35 (includes freight).
Over $25 and including $30 gold per ton	7.90 (includes freight).
Over $30 and including $40 gold per ton	8.50 (includes freight).
Over $40 and including $100 gold per ton	9.60 (includes freight).
Over $100 gold per ton	6.50 plus $3.10 freight.

Freight rate on ores of value over $100 per ton is $3.10 plus 1 percent of value in excess of $100 unless consignment be released to value not to exceed $100 per ton.

An added charge of $5 will be made for sampling all lots of ore containing less than 10 tons, dry weight, and an extra charge of $2.50 per lot made for each lot, when more than one lot is shipped in a car.

An added charge of 10 cents per ton made if ore is sacked. An added charge of 10 cents per ton will be made if ore is received frozen.

An added charge of 5 cents per ton will be made for each 1 percent moisture in excess of 10 percent.

BASIS OF PAYMENTS

Gold-bearing materials received at the Golden Cycle mill, Colorado City, Colo., until further notice, will be settled for on the basis of world gold prices, according to Treasury regulations. To obtain the world price, gold must be recovered from actual deposits in the United States or any places subject to its jurisdiction and be eligible under President Roosevelt's Executive order of August 29, 1933.

Settlement will be made in the following manner until further notice:

1. Provisional advance payment will be made according to the terms of the schedule under which material is shipped, which, in respect to the gold content, is predicated on the present mill price for gold of $20.00 per troy ounce.

2. Final settlement will be made according to the terms of schedule under which the material is shipped, with the exception that an additional payment will be made for the gold content based upon the amount by which the realized price for gold shall exceed the mint price of $20.67 per troy ounce as follows:

> First 5 ounces gold per dry ton contained in product pay 90 percent of said excess price. Second 5 ounces of gold per dry ton contained in product pay 92½ percent of said excess price. All gold contained in product in excess of 10 ounces per dry ton pay 95 percent of said excess price.

In the event that in any calendar month the "realized price" shall be less than the "mill price" the price paid in respect to such gold content shall be the "realized price" less 8 percent.

The term "realized price" referred to above shall be the net average price per ounce realized by the buyer upon all sales of gold originating in mines of the United States made by it in this country or abroad during the calendar month of delivery of seller's product. The said net average price shall mean the gross average price less cost of delivery to place of sale from buyer's refinery, including cost of insurance, selling expenses paid to others, and such other direct expenses as packing costs, cables, etc.

The term "mill price" referred to above shall be understood to refer to the provisional advance payment of $20.00 per troy ounce.

The term "mint price" referred to above shall be understood to refer to the present mint price of $20.67 per troy ounce, and not to any other or different mint price at which gold may hereafter be purchased by the mint.

Treatment rates for miscellaneous ores and concentrates at the Golden Cycle mill, Colorado Springs, 1935 (in effect during 1936)

Ore up to and including $8 (calculated value) per ton	$2. 50
Over $8 and including $10 (calculated value) per ton	3. 00
Over $10 and including $15 (calculated value) per ton	4. 00
Over $15 and including $20 (calculated value) per ton	4. 50
Over $20 and including $40 (calculated value) per ton	5. 50
Over $40 (calculated value) per ton	6. 00

An added charge of $5 will be made for sampling all lots of ore containing less than 10 tons, dry weight, and an extra charge of $2.50 per lot made for each lot when more than one lot in a car.

An added charge of 10 cents per ton will be made if ore is sacked. An added charge of 10 cents per ton will be made if ore is received frozen.

An added charge of 5 cents per ton will be made for each 1 percent moisture in excess of 10 percent (minimum deduction of 1 percent).

The above rates are exclusive of freight rates.

Freight charges must either be guaranteed or prepaid by shipper.

The following ores will not be accepted for treatment at this plant:

Ore containing nonsulphide copper in excess of 0.2 percent.
Ore containing copper in excess of 3.0 percent.
Ore containing zinc in excess of 3.0 percent.

Concentrates: Accepted only at option of mill manager, and, when accepted, payment made for gold and silver contents only.

TRUCK SHIPMENTS AND SHIPMENTS LESS THAN 10 TONS

When umpiring is done, shipper must pay umpire expense.

Further: When values are less than 3.00 ounces gold per ton of ore, provisional advance payment will be made at $19.50 per ounce.

Miscellaneous ores:

Gold: No payment for gold when under 0.02 ounce per ton; $19.50 per ounce when 0.02 ounce per ton up to and including 0.50 ounce per ton; $20.00 per ounce when settlement value exceeds 0.50 ounce per ton.

Silver: No payment for silver when under 1.0 ounce per ton. Payment for silver will be made, under the existing Government regulations on the basis of 77 cents per ounce, on the following schedule, providing as required by the Treasury Department, miner's silver affidavits are promptly furnished; otherwise the following rule will be followed:

Market quotation date immediately preceding date of settlement, excluding fractions of cents, unless ore exceeds 100 ounces silver per ton, in which event 2½ cents per ounce additional will be charged for ounces in excess of 100 ounces.

Silver contents:

Pay 50 percent on ore containing 1 ounce and including 5 ounces.
Pay 65 percent on ore over 5 ounces and including 10 ounces.
Pay 75 percent on ore over 10 ounces and including 20 ounces.
Pay 85 percent on ore over 20 ounces and including 50 ounces.
Pay 90 percent on ore over 50 ounces and including 100 ounces.
Pay 95 percent on ore over 100 ounces.

Sulphide lead: No payment when sulphide lead content is under 3.0 percent.

Wet assay less 1.0 percent; pay for 80 percent of remainder at New York quotation less 2½ cents per pound. Market-quotation date immediately preceding date of settlement used as basis of payment.

No payment for nonsulphide lead content.

Sulphide copper: In crude ores only.

Wet assay less 1.0 percent; pay for 80 percent of remainder at New York quotation less 9 cents per pound. When copper is quoted over 15 cents per pound, deduct 25 percent of excess. Market-quotation date immediately preceding date of settlement used as basis of payment.

No payment for nonsulphide copper content.

Concentrates: Payment for gold and silver values only.

GOLD PREMIUM PAYMENTS

[Apply to both miscellaneous ores and concentrates]

Payment for the first 5 ounces gold per dry ton contained in product shall be 90 percent of the net "realized" price after basing on the former standard price of gold at $20.67 per fine ounce.

Payment for the second 5 ounces gold per dry ton contained in product shall be 92½ percent of the net "realized" price after basing on the former standard price of gold at $20.67 per fine ounce.

Payment for all gold contained in product in excess of 10 ounces per dry ton shall be 95 percent of the net "realized" price after basing on the former standard price of gold at $20.67 per fine ounce.

In 1935 a new 500-ton flotation-roast-amalgamation custom mill was completed on the Stratton Estate on the west slope of Globe Hill. The mill was built under contract from June 17 to November 19 for the Cripple Creek Milling Co., which had previously entered into an agreement with the Stratton-Cripple Creek Mining & Development Co. to purchase the ores produced from mines owned by that company. Ores from other mines in the district were also to be purchased as offered. Operations from completion of the mill to the end of 1935 comprised chiefly runs on low-grade ore to test the equipment. Bullion produced from ores treated in 1935 was not shipped to the mint until January 1936. Water for milling was piped from dams on West Beaver Creek. Trucks were used to transport the ore to the mill where it was weighed and dumped by lots into bins. Part of the ore was roasted direct after being crushed and sampled, and part was concentrated in the two-unit flotation section; the concentrates were mixed with the crude ore going through the roaster, which is an 80-spindle Edwards duplex type heated by two pulverized coal units. The product from the roaster was ground and treated by the cyanidation process.

The treatment rates of the Cripple Creek Milling Co., effective February 10, 1936, follow:

Treatment rates of Cripple Creek Milling Co.

[Effective Feb. 10, 1936]

Up to and including $5 per ton	$2.50	$20.01 and including $25 per ton	$5.50
$5.01 and including $8 per ton	3.00	$25.01 and including $30 per ton	6.00
$8.01 and including $10 per ton	3.50	$30.01 and including $35 per ton	6.50
$10.01 and including $12 per ton	4.00	$35.01 and including $40 per ton	7.00
$12.01 and including $15 per ton	4.50	$40.01 and including $50 per ton	7.50
$15.01 and including $20 per ton	5.00	$50.01 and over	8.00

Gold will be paid for on the basis of $32.76 per ounce, based on present Government price of $35.00 per ounce, subject to change should Government price be increased or decreased.

Fifty percent of silver will be paid for after 1 ounce has been deducted from assay settlement of Government price on date of assay.

Additional charges will be made as follows: Ten cents per ton on sacked ore. Ten cents per ton for each 1 percent of moisture in excess of 10 percent. Five dollars sampling charge on lots of less than 10 tons.

MINES REVIEW

The total number of producing mines, dumps, and prospects in the Cripple Creek district in 1935 was 122, including each of several separately operated mines under one general management. Production was made from mined ore at 83 mines and prospects. The three largest producing companies, in order of output, were the United Gold Mines Co., an operating and holding company for property scattered throughout the Cripple Creek district; the Cresson Consolidated Gold Mining & Milling Co.; and the Ajax operation of the Golden Cycle Corporation (formerly the Granite group).

The annual report of the United Gold Mines Co. for the 12 months ended December 31, 1935 (dated February 29, 1936) contains the following report of the mine superintendent:

Axtel.—The Robush brothers are running a drift from the bottom level of the Solomon shaft to intersect the vein system, at a depth of 350 feet, under the Midway workings. They also expect to cut the downward extension of an ore chute they have been working in a winze on the upper levels. The Fairview was operated about 6 months during 1935, and about 250 feet of development work was accomplished by the R. & W. Leasing Co., without finding any values of importance. Neither the Fairview nor the Londonderry made very much production during the year. The Patti Rosa was operated about 7 months by the Tennessee Mines, Inc., with very little production. The shaft was sunk an additional 100 feet, but very little work was done on the lower levels. About 10 men, including lessees, were given employment on this group of properties during the year 1935.

Bonanza.—Five sets of lessees are operating on the Bonanza, New Market, and Big Theatre. At the present time the most important development is being done by Wade & Co. They have done about 1,000 feet of drifting and crosscutting on the 700 level of Gold Coin and have opened some good ore on New Market vein. Wade & Co. have made a very good production during the past year, and from all indications 1936 will also be a good year. Dick Wright has had a very profitable lease on the New Market vein between the 1,800- and 1,600-foot levels. This chute is now apparently worked out, and they are beginning to pull the ore, which averages about 1.25 ounces gold per ton. Joe Thomas & Co., leasing between 1,600 and 1,400, have shipped a few cars of good ore from a pillar left in this vicinity. Hutchins & Pollhill have been taking up a stope about 60 feet long between 1,600 and 1,400, which at this time seems to be pitching into Ajax ground. The ore in this stope has been assaying about 0.80 ounce per ton. Mr. Clayton Kissell, who is supervising the work on the Bonanza, reports that he believes 1936 will be as good a year as 1935.

Coriolanous.—Very little work was done on this property during the year. Akin & Kay made a small production of low-grade ore from a surface lease, and two or three other sets of lessees accomplished a small amount of development work without much production.

Deadwood.—The Gold Bullion Mines, Inc., is operating on the upper Deadwood and Trachyte and has produced some very good ore during the past year. They have three sets of lessees working in better than average grade ore, and the outlook for 1936 is very good. At the present time this company is making arrangements to install machinery on the old Trachyte shaft. They report that they have made an examination of the underground workings in this mine and have found a large amount of low-grade ore in sight. The lower Deadwood is under lease to Blackwood and associates, who have constructed a headframe and ore bins and have repaired the shaft down to the 700-foot level. They have also produced some low-grade ore.

Empire Lee, under lease to United Gold Mines.—The Isabella Mines Co. is driving a crosscut into virgin ground on 700. No values of importance have been encountered to date. They also have three sets of sublessees. Sharp & Edwards have produced some high-grade ore from a small streak between 800 and 1,000 of the Isabella shaft. E. D. Scott is operating a surface lease on the old Maloney vein and has some very good ore. There is some production of low-grade ore coming from the Gallagher and Kneece lease north of the Smuggler shaft. Altogether about 20 men are employed on this property.

Findley.—A part of the Findley and Shurtloff claims have been leased to C. K. Woods and associates, who say that they are well financed and will be ready to start installing hoisting machinery early this spring.

Hardwood.—Dobbins & Stocklacy have a surface lease on the north end of the Hardwood around the old Dewark workings. They have made some shipments of very good ore. The Jerry Johnson Gold, Inc., has a lease on the W. P. H. and has shipped a small quantity of low-grade ore.

Hull City.—The Hull City, under lease to the Hidalgo Gold Mines, Inc., made a small production of low-grade ore during the year.

Mountain Beauty.—Ed Sprague, who has 200 feet of the surface leased, is doing some surface prospecting on this claim. The ground from 200 feet down is leased to Hamilton & Muir, who have been working it through the Orpha May, which has been closed down for the last 4 months. They expect to resume operations immediately, at which time they have promised to continue the development on the 1,300-foot level of the Mountain Beauty.

May B.—The May B. shaft was sunk an additional 50 feet during the year, and 98 feet of drifting was done on the 10th level. Very little values were found in either the shaft or drift. A drift on the May B. vein was extended north for 250 feet to reach an intersection of the May B. and M. K. & T. veins. This drift is now within about 100 feet of its objective. A small tonnage of low-grade ore was produced from various parts of the mine during the year.

Pauper.—E. E. Quentin and associates of Denver have accomplished about 350 feet of crosscutting east from the 4th level of the Shurtloff shaft, and they are within a very few feet of their objective.

Portland.—During the year the following shafts were operated by the company under the split-check system: Last Dollar, Portland No. 1, Portland No. 2, and Independence. An average of 16 sets of lessees were employed at Portland No. 1, 8 sets at Portland No. 2, 15 sets at the Last Dollar, and 3 sets at the Independence, until the last named was shut down in September. The most interesting developments of the year in company-operated shafts were those on the Hawkeye vein through the Last Dollar 600 level on the cyanite veins on the same level, in the Captain area through Portland No. 2 on the Mahurin breccia vein on 800, and on the Wisconsin vein on 1,700 through the same shaft. All these leases are now producing ore, notably the Hawkeye vein which is producing ore running as high as 4 ounces gold per ton, and the cyanite veins which furnish a large tonnage of low-grade ore that makes a profitable operation. Company development was limited to 75 feet of drifting on 1,000 Last Dollar, which developed some low-grade ore which could not be profitably extracted, and 200 feet of crosscutting and drifting on 400 Independence, to develop the eastern granite-breccia contact which was not productive. Portland No. 1 and the Last Dollar were operated profitably during the year, while Portland No. 2 showed a loss; however, considerable worthwhile development was accomplished through the last named, and it is hoped that the money expended will soon be repaid. These leases are just coming into production. The Independence showed a loss throughout the year, and as we had an offer from an independent lessee to take it over, it was turned over to him. In addition to company-operated shafts, the following shafts were operated by other lessees: Colorado City, Modoc, Portland No. 3, Ocean Wave, and Independence (after September 10). These were all small operations but provided considerable tonnage and were a source of revenue for the United Gold Mines Co. The Colorado City and Ocean Wave produced the most ore, the lessees on the other properties having been engaged for the most part in opening up old workings and development. Perhaps the most interesting of the developments on the outlying properties is the work on the 100-foot shaft of the Ocean Wave and the drift on the 200-foot level of Portland No. 3. A small stope was found and mined in the Ocean Wave, which produced several cars of $30.00 screenings and a large tonnage of low-grade coarse ore, and has encouraged the lessees to undertake more development in a very favorable area. On Portland No. 3 a drift is being driven into hitherto undeveloped ground to cut the possible downward extension of ore chutes mined above. Some ore has already been encountered, and it is possible for this area to produce a considerable tonnage. The lessees working on the surface on the overflow and outcrops of the large Portland stopes continue to produce an excellent tonnage of ore which averages about $7.00 per ton, although a few shipments of ore running up to $40.00 per ton have been made. Insofar as conditions justify it, efforts have been made to improve the surface plants of the various shafts. This includes installing a sprinkler system to cut down fire hazards, elimination of all heating stoves where they might be dangerous, opening the No. 1 shaft from 1,100 to 1,600, and the establishment of various manways to enable the men to get out of the shafts in case of break-downs or other emergency. The end of the year finds the properties in fair condition with the prospect that the development carried on during the past year may be productive of excellent results. Altogether the different properties employ a total of 114 men—15 company men and the balance lessees.

Rose Nicol.—The company is operating on three levels of this mine, 1,200, 1,600, and 1,700. On 1,200 they are running a drifting machine and also working a small low-grade stope. A stope about 100 feet long with average values of about 1 ounce is being worked by the company on 1,600. On 1,700 they are doing development work, with good but spotted values. This property has about 25 company employees and six sets of lessees. Eden & Co. on the 9th level have discovered what they believe will be a good ore chute after having done a considerable amount of development work. A small tonnage of low-grade ore has been produced by Saunders & Co. on the 1,000 level. E. J. Williams, lessee on the Trail, has during the past year been developing a large body of low-grade ore. This ore has been settling at about 0.30 ounce. The Last Effort, under lease to the Colorado Gold, Inc., has been the source of a large production of medium-grade ore. The Bradley Leasing Co., lessees on the 1,600 intermediate, have a good prospect which will require more development to determine its worth. Harding & Co. are doing some surface prospecting but have not encountered any values of importance.

Vindicator and Theresa.—The Vindicator has 23 sets of lessees, of this number 5 sets are on dead work. The others are producing some kind of ore. Quite a large tonnage of medium grade is being hoisted on company account from the 20th level, which was recovered during the past year. Three separate ore chutes are being developed on 2,000, the La Bella, Carr, and Ready Money, and from all indications, very good values extend below the level. The company is now preparing to unwater and develop the 21st level, and arrangements have already been made for power lines, pumps, etc. About 1,200 feet of crosscutting will be required to open the La Bella, Carr, and Ready Money ore chutes on 2,100. The La Bella will be opened first at a distance of about 350 feet from the shaft. Early in the year of 1935 the reconstruction of the Theresa head frame and ore house was completed. These buildings were constructed entirely of steel and concrete and are absolutely fireproof. There are four company employees on this property and 15 sets of lessees, and they produce about 35 carloads of low- and medium-grade ore each month. Two sets of lessees, Norgren & Co. on 800 and Beckman & Co. on 1,200, have been doing dead work for the last 3 months and are just now reaching their objectives. These leases should come into production during the coming year. On 800 good ore has been opened. There are about 40 company employees on the Vindicator and Theresa, and about 80 men are employed as lessees.

Wild Horse.—Blackwood and associates have a lease on the old Wild Horse shaft and have worked continuously during the year and have produced a large tonnage of low-grade ore.

Total production of property—United Gold Mines Co.

	Net tons	Gross value
Ore mined before consolidation	26,310	$456,806.19
Production under operation of the United Gold Mines Co	1,309,673	14,617,532.05
Total to Dec. 31, 1935	1,335,983	15,074,338.24

Production of the United Gold Mines Co.—Company ore in 1935

Mine	Net tons	Gross value	Company ore cash receipts	Average gross value per ton	Number of cars shipped
Vindicator	9,597	$51,114.23	$22,318.34	$5.33	290
Rose Nicol	5,845	126,375.41	86,748.23	21.62	144
Portland	129	430.82	116.64	3.28	3
Last Dollar	231	1,135.63	478.44	4.93	7
Theresa	29	94.15	18.94	3.28	1
	15,831	179,150.24	109,680.59	11.32	445

Production of the United Gold Mines Co.—Lessee ore in 1935

Group	Net tons	Gross value	Royalties received	Lessees' receipts	Average gross value per ton	Number of cars
Vindicator	18,999	$284,093.42	$96,995.67	$95,717.39	$14.95	580
Theresa	15,784	152,136.43	37,328.11	48,409.46	9.65	481
Rose Nicol	5,657	52,405.92	8,602.83	19,799.86	9.26	165
Portland	18,482	223,790.16	58,048.84	79,385.17	12.11	621
Last Dollar	18,043	147,004.90	40,463.05	38,026.97	8.15	522
Independence	1,508	10,213.03	1,843.40	2,686.01	6.77	52
W. P. H. group	1,051	6,077.24	392.27	1,901.87	5.78	27
Deadwood group	9,828	78,751.93	8,140.80	31,720.91	8.01	307
Bonanza group	6,773	180,547.49	26,531.25	97,244.31	26.66	206
Londonderry group	3,286	36,144.23	3,964.73	15,921.05	11.00	106
Hardwood group	1,269	10,288.70	1,130.72	4,160.96	8.11	35
Empire group	1,304	10,174.61	235.01	4,579.13	7.80	43
	101,984	1,191,628.06	283,676.68	439,553.09	11.68	3,145

The annual report of the Cresson Consolidated Gold Mining & Milling Co. for the 12 months ended December 31, 1935 (dated Feb. 15, 1936) states:

During the 12 months 73,000 dry tons of ore were shipped on company account of a gross value of $537,959.27, averaging $7.37 per ton; the returns, less transportation and treatment of $261,536.04, were $276,423.23, giving the ore a net value of $3.78 per ton. The company received as additional income the sum of $2,722.64, interest on bank deposits and notes, and $196,083.05, net royalty on 58,389 tons lessee ore, making a total of $475,228.92, with total expenses of $340,579.25, resulting in a net gain from operations of $134,649.67.

Owing to increased price of gold, development work has been done in territory adjoining the Cresson by lessees; while this has resulted in low-grade ore being developed, the large altered mass of breccia and basalt in your property remains the most promising condition for ore.

The development below the Roosevelt Tunnel level in the Ajax mine, a short distance from your property, is being done as rapidly as possible, and this will be of value as to continuation of Cripple Creek ore at greater depths.

Development

	Feet	Feet
Drifts and crosscuts:		
Company	5, 841	
Lessees	3, 044	
		8, 885
Raises and winzes:		
Company	1, 533	
Lessees	2, 027	
		3, 560
Total		12, 445

Development work during the year has been pushed with all possible speed. This work has resulted in the opening of a number of small bodies of ore.

Ore bodies are now being mined on the 11th, 12th, 13th, 14th, and 15th levels. The grade of the ore is somewhat lower than a year ago. While the tonnage of broken ore ready to be pulled is greater than a year ago.

Total tons shipped from the property is the largest in its history. Mining costs, per ton shipped, is the lowest, notwithstanding a general increase of nearly all supplies.

Twenty-five sets of split-check lessees are working through the Cresson shaft. The Dante and Gold Sovereign shafts are also being operated by lessees, on a royalty basis.

The average cost, per ton shipped by company and lessees, was $2.59 on total of 131,389 tons.

	Per ton
Federal taxes	$0. 163
Taxes	. 063
Insurance	. 07
Salary of officers	. 026
Colorado Springs office	. 039
Mining operations	2. 22
General	. 009
	$2. 59

Production of the Cresson Consolidated Gold Mining & Milling Co., Colorado, 1903 to Dec. 31, 1935

Period	Dry short tons	Gross value	Freight and treatment	Net value
1903 to Dec. 31, 1934	2, 219, 590	$36, 585, 720. 21	$11, 291, 609. 85	$25, 294, 110. 36
1935:				
Company ore	73, 000	537, 959. 27	261, 536. 04	276, 423. 23
Lessee ore	58, 389	652, 479. 33	258, 026. 41	394, 452. 92
1903 to Dec. 31, 1935	2, 350, 979	37, 776, 158. 81	11, 811, 172. 30	25, 952, 895. 85

Production of the Cresson Consolidated Gold Mining & Milling Co., Colorado, 1903 to Dec. 31, 1935—Continued

Period	Royalties received by company	Amount paid lessees	Average gross value per ton	Average net value per ton	Dividends
1903 to Dec. 31, 1934			$16.48	$11.40	$12,613,072.50
1935:					
Company ore			7.37	3.78	
Lessee ore	$196,083.05	$198,369.87	11.17	6.75	244,000.00
1903 to Dec. 31, 1935			16.06	11.04	[1] 12,857,072.50

[1] Represents 34.03 percent of the gross value and 49.54 percent of the net value.

The annual report of the Golden Cycle Corporation dated March 10, 1936, for the calendar year ending December 31, 1935, contains the following paragraphs regarding the corporation's mining operations in the Cripple Creek district:

During the year your company acquired for $80,000 cash the International Gold Mining Co.'s Cripple Creek holdings, which were the Granite, Ajax, and Gold Coin properties of over 250 acres on Battle Mountain and adjoining the Portland and Strong mines; also the Sunshine Sedan group near Cameron.

The shaft on the Ajax has been extended 240 feet deeper and since acquisition has shipped 15,000 tons of ore to mill in 1935. The property was operated at a loss, but during the year 1936 we expect a substantial profit. The Sunshine Sedan is a prospect and has only been operated by lessee since our purchase.

Your company also acquired for 100,000 shares of stock of the United Gold Mines Co. and $18,514.95 cash the Anchoria Leland group on Gold Hill. This property has produced a large amount of high-grade ore. There is a large amount of undeveloped territory in the 60 acres. The property has been operated at a loss, and our work has not developed any profitable ore to date.

Data for the following table were taken from annual reports for 1935 issued by the three companies named.

Production in 1935

Company	Net tons	Gross value	Royalty	Lessees	Average gross value per ton
Dr. Jack Pot Mining Co.	7,731	$25,818.65	$1,537.80	$7,618.33	$5.46
New Gold Dollar Mining Co.	4,779	41,739.28	3,248.43	16,944.36	8.73
The Elkton Co.	18,612	114,630.79	7,349.15	44,871.99	6.16

Most of the output from mines owned by the Stratton-Cripple Creek Mining & Development Co. (Stratton Estate) was made during the first part of 1935, before arrangements were completed for the construction of the new custom mill on Globe Hill and shipments to the Golden Cycle mill were discontinued. After work was started on the mill in June, a number of the lessees closed their mines and worked for wages for the mill contractor. Others continued development work and stored any ore produced in bins to await completion of the mill. Producing properties of the Stratton Estate included the Abe Lincoln, American Eagles group, Colorado King, Los Angeles, John A. Logan, Orpha May, and Specimen. The New Zealand Gold Mines, Inc., shipped 10,111 tons of ore containing 3,093 ounces of gold from its lease on the three upper levels of the Joe Dandy mine.

The Cameron Gold Mines, Inc., operating the Cameron Townsite and Pinnacle group, sank the main Cameron shaft 214 feet to a depth of 854 feet at the sixth level and drove 2,010 feet of drifts and crosscuts. The company shipped 4,200 tons of ore from the two properties in 1935. At the Queen group, 393 feet were developed and 7,586 tons of ore produced. The Hidalgo Gold Mines, Inc., shipped ore continuously from the El Paso group in which it has the controlling interest. About 4,000 feet of drifts, crosscuts, and raises were driven in the mine during the year. The company produced additional ore from the Hull City (United Gold Mines Co.) and Victor (Smith-Moffat Mines Co.) mine, operated under lease. The Jerry Johnson produced ore steadily throughout the year. The cyanide leaching plant at the Iron Clad mine was operated continuously. W. D. Wade & Co. shipped a substantial output of dump ore from the Empire Lee property. The output from School Section 16 was made by sublessees from the Kyner Leasing Co. Ore shipped from the mine was produced by the Reba-Lee Mining Co. from its lease on part of Block 8, where the company drove 1,250 feet of drifts during the year. This company also produced ore from the Mohawk mine. The K. & C. Leasing Co. shipped dump material, using a tractor and dragline to load the ore into railroad cars spotted on a spur tract at the mine.

Other important producers in Teller County in 1935 were the Acacia Gold Mining Co. (Morning Star and North and South Burns), Ada Belle, Atlas Gold Mines Co. (Midget-Bonanza King), Buckeye Mines & Milling Co., Commonwealth Gold, Inc., Delmonico, Dexter (dump), Economic mill dump, Forest Queen, Free Coinage Gold Mining Co., Gold Bond Consolidated Mines Co., Sangre de Cristo Tunnel, Hiawatha, Index group, Katinka, LeClair Consolidated Mines Co. (Mary McKinney), Pharmacist, Prince Albert, Ramona, Raven & Beacon Hill Gold Mining Co., Requa Savage group, Rubie, Santa Rita Mines Co., and Strong Mining Co. Lessees continued to ship tailings from the old Standard and Philadelphia dumps near Colorado Springs to the Golden Cycle mill. The tailings were made from ores originating in Teller County prior to 1919.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE EASTERN AND CENTRAL STATES [1]

(MINE REPORT)

By J. P. Dunlop and H. M. Meyer

SUMMARY OUTLINE

The mines in the Eastern and Central States as a whole increased their output of gold, silver, copper, lead, and zinc in 1935. The value of the copper, lead, and zinc greatly exceeded that of gold, although the quantity of gold produced in the Eastern States increased 2,844.21 ounces. More gold mines were active in 1935, but at many development work only was done. Much of the gold output was derived from small lode or placer mines.

There were no new producers of copper, lead, or zinc, but the old mines had an increased output.

The production figures given in this report are final for gold, silver, and copper, and those for lead and zinc are final except for mines in Kansas, Missouri, and Oklahoma for which data are preliminary.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold in 1931–32 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1835, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95 per ounce, the average weighted yearly United States Government prices [2]; and in 1935 at $35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1931–33 is the average New York price for bar silver; in 1934 the Treasury

[1] The figures for lead and zinc in the Tri-State region—Kansas, Missouri, and Oklahoma—are preliminary; detailed data, with final revisions, will be released later.

[2] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold from 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

buying price for newly mined silver, $0.64646464+ per ounce; and in 1935 the average weighted Treasury buying price for newly mined silver, $0.71875 per ounce. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of gold, silver, copper, lead, and zinc, 1931–35

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1931	[1] $20.67+	$0.290	$0.091	$0.037	$0.038
1932	[1] 20.67+	.282	.063	.030	.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044

[1] $20.671835. [2] $0.64646464.

Salient statistics of mine production of gold, silver, copper, lead, and zinc in the Eastern and Central States in 1935, by States, in terms of recovered metals

State	Ore, old tailings, etc., sold or treated	Gold (lode and placer)		Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Short tons	*Fine ounces*		*Fine ounces*	*Pounds*	*Short tons*	*Short tons*	
Eastern States:								
Alabama	15,067	2,227.24	$77,953	401	10,061			$79,076
Georgia	1,200	993.78	34,782	74				34,835
New Jersey	476,608						85,708	[1] 9,404,881
New York	295,179			21,750		(2)	23,720	[3] 2,102,993
North Carolina	37,487	2,175.57	76,145	7,584	(4)			[5] 81,596
Pennsylvania	936,421	745.00	26,075	5,843	(4)			[5] 30,275
South Carolina	17,467	2,273.51	79,573	1,117	240			80,396
Tennessee	1,390,240	423.00	14,805	47,151	[4] 20,802,110	[2] 4,982	[6] 48,832	[7] 6,471,046
Virginia	318,721	652.56	22,840	55	700	(2)	(6)	[8] 22,938
	3,488,390	9,490.66	332,173	83,975	20,813,111	4,982	158,260	18,308,036
Total, 1934	3,041,133	6,646.45	232,293	104,493	20,334,600	3,625	147,453	17,064,462
Central States:								
Arkansas	(9)					38	153	16,504
Illinois	(9)			3,147		436		37,142
Kansas	(11)					[10] 11,000	[10] 50,000	[10] 5,280,000
Kentucky	(9)					132	127	21,736
Michigan	1,376,803			4,219	64,108,689			5,324,053
Missouri	(11)			110,551	67,660	[10] 97,580	[10] 7,500	[10] 8,551,475
Oklahoma	(11)					[10] 23,500	[10] 134,000	[10] 13,672,000
Wisconsin	263,000					286	8,923	808,104
	(11)			117,917	64,176,349	[10] 132,972	[10] 200,703	[10] 33,711,014
Total, 1934	12,447,755	58.63	2,049	63,905	48,262,135	114,463	163,092	26,400,506

[1] Estimated smelting value of recoverable zinc content of ore after freight, haulage, smelting, and manufacturing charges are added.
[2] New York and Virginia included under Tennessee; Bureau of Mines not at liberty to publish separate figures.
[3] Excludes value of lead, which is included under Tennessee.
[4] North Carolina and Pennsylvania included under Tennessee; Bureau of Mines not at liberty to publish separate figures.
[5] Excludes value of copper, which is included under Tennessee.
[6] Virginia included under Tennessee; Bureau of Mines not at liberty to publish separate figures.
[7] Includes also value of copper from North Carolina and Pennsylvania, lead from New York and Virginia, and zinc from Virginia.
[8] Excludes value of lead and zinc, which is included under Tennessee.
[9] No estimates available for small quantity of ore treated in Arkansas, Illinois, or Kentucky.
[10] Subject to revision.
[11] Data not yet available.

Gold and silver (placer and lode) produced in the Eastern States and number of producing mines in 1935

State	Number of mines		Gold (fine ounces)		Silver (fine ounces)	
	Placer	Lode	Placer	Lode [1]	Placer	Lode [1]
Alabama	2	3	5.09	2,222.15		401
Georgia	30	6	332.50	661.28	10	64
New Jersey		1				
New York		2				21,750
North Carolina	17	15	90.84	2,084.73	6	7,578
Pennsylvania		1		745.00		5,845
South Carolina	12	8	143.00	2,130.51	8	1,107
Tennessee		5		423.00		47,151
Virginia	2	3	153.82	498.74	3	52
	63	44	725.25	[1] 8,765.41	27	[1] 83,948

[1] Dry and siliceous ores (47,735 tons) yielded 7,417.41 ounces of gold and 2,244 ounces of silver; copper ore (763,309 tons) yielded 603 ounces of gold and 54,057 ounces of silver; lead-zinc ore yielded 21,804 ounces of silver; pyritiferous magnetite ore (936,421 tons) yielded 745 ounces of gold and 5,843 ounces of silver; and zinc ores (1,197,139 tons) yielded no gold or silver.

Gold.—The output of gold in the Eastern States was 9,490.66 fine ounces in 1935, or 2,844.21 ounces more than in 1934. The yield from placer mines decreased from 874.34 fine ounces in 1934 to 725.25 in 1935; gold derived from siliceous ore increased from 4,494.11 to 7,417.41 ounces and that from the refining of copper bullion from 1,278 to 1,350 ounces. Yields of gold in 1935 were reported from 63 placers and 37 lode mines. One mine in Alabama, one in North Carolina, and two in South Carolina produced more than half the gold recovered in the Eastern States; few of the new mines or of the old mines reopened made any large output, as most of the work was experimental. The estimated output of gold in the Southern Appalachian States from 1799 to 1935, inclusive, is recorded as 2,495,449 fine ounces valued at $51,796,836. In 1934, 41,232 tons of siliceous ore were treated, of which 6,319 tons were amalgamated or cyanided and 302 tons shipped crude to smelters; in 1935, 48,275 tons of siliceous ore (from mines in Alabama, Georgia, North Carolina, South Carolina, and Virginia) were treated, of which 19,987 tons were treated at gold and silver mills (by amalgamation), 2,831 tons (mostly from North Carolina and South Carolina) were shipped crude to smelters, and 25,457 tons were sent to all-flotation mills and yielded 1,334 tons of gold concentrates which were shipped to smelters. These gold concentrates yielded 3,432.93 ounces of gold, whereas bullion from gold milling plants yielded only 1,522.87 ounces (about two-thirds as much as was derived from flotation copper concentrates smeltered) and crude siliceous ore smeltered yielded 2,351.61 ounces.

No mines in the Central States yielded any gold in 1935.

Silver.—Of the silver (83,975 ounces) produced in the Eastern States in 1935 all except 27 ounces from placer bullion and 2,244 ounces from lode-gold mines was derived from copper bullion recovered from copper ore and copper concentrates from mines in North Carolina, Pennsylvania, and Tennessee and from lead bullion from a mine in New York. The decrease (20,518 ounces) in the silver output of the Eastern States was due largely to the smaller output of Tennessee mines.

Production of silver in the Central States in 1935 totaled 117,917 ounces. The small output in Illinois (3,147 ounces) came from galena concentrates recovered in milling fluorspar; that in Michigan was from copper ore; and that in Missouri (110,551 ounces) was from bullion from lead ore. No copper ore or zinc concentrates containing silver were shipped in 1935.

Copper.—The mine production of copper in the Eastern States was 20,813,111 pounds valued at $1,727,488 in 1935 compared with 20,334,600 pounds valued at $1,626,768 in 1934. Each of the large producing States—North Carolina, Pennsylvania, and Tennessee—showed an increase in value of output, but the Bureau of Mines is not at liberty to show their production separately. The copper was derived from copper ore mined in North Carolina and Tennessee; from gold concentrates shipped to smelters from Alabama, South Carolina, North Carolina, and Virginia; and from copper concentrates recovered from Pennsylvania pyritiferous magnetite ore mined for its iron content. The output of copper from the gold concentrates was 36,221 pounds. The copper ore yielded about 0.001 ounce of gold and 0.07 ounce of silver to the ton of crude ore. The copper concentrates from the magnetite ore contained about 22.2 percent copper and about 0.10 ounce of gold and 1 ounce of silver to the ton.

The copper output of the Central States in 1935 came from copper ore from Michigan and lead ore from Missouri; no copper ore was shipped from Missouri. The output of refined copper in Michigan increased from 48,215,859 pounds in 1934 to 64,108,689 in 1935, while the average recovery per ton of rock treated dropped from 68.9 to 46.6 pounds.

Lead.—The lead produced from mines in the Eastern States in 1935 came from lead-zinc ores from the Austinville mine in Virginia, the Balmat mine in New York, and the Embree mine in Tennessee. Shipments of galena concentrates totaled 7,559 tons and yielded 4,982 tons of lead—1,357 tons more than in 1934.

Final figures for lead recovered from shipments of lead ore and concentrates from the Central States are available for all districts except the Tri-State region, for which preliminary data are given.

The lead recovered from shipments of lead ore and concentrates from mines in the Central States increased from 114,463 tons in 1934 to 133,000 in 1935, due mainly to shipments from mines in Oklahoma, Kansas, and southeastern Missouri. Missouri shipments yielded about 97,580 tons of lead in 1935 compared with 90,493 in 1934, of which 96,941 tons in 1935 and 84,980 in 1934 were from mines in the southeastern Missouri district.

Recovered lead in shipments from Oklahoma mines totaled about 23,500 tons in 1935 and 16,747 in 1934, and shipments of lead concentrates from Kansas mines yielded about 11,000 tons of lead compared with 6,805 in 1934. Wisconsin mines produced ore yielding 286 tons of lead in 1935 compared with 234 in 1934. Lead concentrates from Illinois mines yielded 436 tons of lead in 1935, lead concentrates and lead-zinc ore from Kentucky 132 tons, and lead concentrates from Arkansas 38 tons. Mines in the Tri-State or Joplin region shipped about 48,000 dry tons of lead concentrates yielding 36,100 tons of lead, or about 50 percent more than the lead yield in 1934.

Zinc.—The recoverable zinc in ore and concentrates shipped from mines in the Eastern States was 158,260 tons valued at $15,789,500 in 1935 compared with 147,453 tons valued at $14,869,600 in 1934.

Mines in New Jersey yielded more than 85,700 tons, as metal or in oxide, valued at $9,404,881 in 1935.

[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.]

Mines in New York shipped concentrates in 1935, partly from zinc ore and partly from lead-zinc ore, from which 23,720 tons of zinc were recovered. Zinc sulphide ores yielded nearly all the zinc from Tennessee, and all the ore was concentrated except a small quantity of zinc carbonate. The recovered zinc output and the shipment of zinc concentrates from mines in Virginia may not be disclosed, but the recoverable zinc content of concentrates shipped from Tennessee and Virginia was 48,832 tons. All zinc concentrates shipped were sphalerite except 1,897 tons of zinc carbonate from Tennessee.

Shipments of zinc concentrates from mines in the Central States had a recovered zinc content of about 201,000 tons in 1935 compared with 163,092 tons in 1934. Mines in the Tri-State region shipped ore and concentrates yielding about 191,500 tons of zinc in 1935 (153,092 tons in 1934), of which Oklahoma contributed 67 and Kansas 25 percent. Stocks of sphalerite were comparatively small at the end of 1935. The zinc recovered from Wisconsin mine shipments totaled 9,807 tons in 1934 and 8,923 in 1935 and that from mines in Missouri 7,059 tons in 1934 and 7,500 in 1935. No Illinois mines shipped any zinc in 1935, and shipments from Arkansas contained only 153 tons of recoverable zinc. Kentucky mines shipped zinc carbonate concentrates and lead-zinc ore containing 127 tons of recoverable zinc.

MINE PRODUCTION IN THE EASTERN STATES

Alabama.—The quantity of gold produced in Alabama from 1830 to 1935, inclusive, is recorded as 42,223.37 fine ounces. The yield in 1935 was 2,227.24 ounces, from two placer and three lode mines. There was a small placer production, but the gold output of the State was mainly that of the Hog Mountain Gold Mining & Milling Co. in Tallapoosa County about 15 miles from Alexander City, which mined and milled nearly one-third of the gold ore mined and treated in the Appalachian States in 1935. The Hog Mountain mine was discovered in 1839; its total production of gold is not known, but its yield from 1893 to 1915, inclusive, is estimated at about $250,000. It was operated throughout 1935. The mine is opened by a 215-foot shaft; about 2,000 feet of drifts were run in 1935. The sulphide ore is treated at the 150-ton all-flotation mill first operated in February 1934. The crude ore contains about 0.179 ounce of gold to the ton and traces of silver, copper, and zinc; the concentrates, which were shipped to the Nichols Copper Co., yielded about 2.65 ounces to the ton. The flotation concentrates turn to a hard, red clinker after being dried.

Georgia.—The quantity of gold produced in Georgia from 1830 to 1935, inclusive, is recorded as 866,472.43 fine ounces. In 1935, 30 placers and 6 lode mines yielded a total of 993.78 ounces of gold and 74 ounces of silver. Of the 332.50 ounces of placer gold produced, 66.53 ounces came from the placers near Dahlonega and Auraria in Lumpkin County, 204.17 ounces from mines in White County, and the remainder from small mines operating in Cherokee, Dawson, Carroll, Wilkes, and Paulding Counties. The largest placer producers were T. J. Stevenson at Sautee, White County; the Dixie Gravel at Helen, White County; and the Boston at Villa Rica, Carroll County.

Gold recovered from siliceous ore (1,200 tons) amounted to 661.28 fine ounces in 1935, nearly all of which was recovered from ore from the Battle Branch mine at Dahlonega, which was operated by the Southern Mineral Development Co. The bullion was recovered at the 10-stamp amalgamation-concentration mill. The concentrates were not treated in 1935. The incline shaft is 438 feet deep, and 1,860 feet of development was done in 1935.

Other lode properties with small yields of gold in 1935 were the 301 Mining Co. in Cherokee County, the Georgia Development Co. in White County, and the Barlow mine in Lumpkin County. Some properties at Dahlonega had no output but were under development. One of these was the Findley, optioned to Cornelius O'Kane. Other properties controlled by Dr. Craig R. Arnold were being developed late in 1935.

Maryland.—The total gold production of Maryland to the end of 1934 is estimated as 3,467.71 fine ounces. No gold or silver was produced in 1934 or 1935. The old Maryland mine near Rockville, Montgomery County, was reopened by the Maryland Mining Co. in October 1935. The 200-foot shaft was retimbered, and samples of ore were taken to determine what process to use in the proposed mill on the property.

New Jersey (see also note on p. 285).—The production of zinc ore in New Jersey in 1935 was 476,608 tons, containing 85,708 tons of recoverable zinc. The only producing properties were the Mine Hill and Sterling Hill mines.

New York.—The quantity of zinc ore (80,731 tons) and of lead-zinc ore (214,448 tons) milled in New York in 1935 was slightly larger than in 1934. The concentrates shipped yielded 23,720 tons of zinc and some lead; the lead concentrates also yielded considerable silver. The old Edwards mine yields sulphide zinc ore and is equipped with a 500-ton all-flotation plant, and the Balmat mine near Sylvan Lake produces lead-zinc ore and is equipped with a 700-ton all-flotation plant. The shaft at the Edwards mine is about 1,500 feet deep and that at the Balmat 500 feet deep.

North Carolina.—The quantity of gold produced in North Carolina from 1799 to 1935, inclusive, is recorded as 1,149,813.10 fine ounces. The yield in 1935 was 2,175.57 ounces, of which 90.84 ounces came from 17 placers and 2,084.73 from 15 lode mines. The output of silver was 7,584 ounces. The Fontana copper mine was the second largest producer of gold in the State, although its crude ore assays only 0.009 ounce of gold to the ton. Placer gold was recovered in Burke, Catawba, Cherokee, Cabarrus, Guilford, Halifax, McDowell, Montgomery, Randolph, Rutherford, and Union Counties; the larger producing placers were the Biggerstaff in Rutherford County and the Gardner Hill in Guilford County. The largest producers of lode gold were the Rudisil mine in Cabarrus County, the Long Creek mine in Gaston County, the Parker and Thompson mines in Stanly County, and the Liberty in Davidson County. Other producers of lode gold were the Snyder, Allen Furr, Long Creek, and Alred mines.

The North Carolina Exploration Co. shipped crude sulphide copper ore from the Fontana mine in Swain County to the Tennessee Copper Co. smelter at Copperhill, Tenn.; this ore is said to average

0.009 ounce of gold and 0.068 ounce of silver to the ton. Some crude ore was shipped from the Snyder prospect in Cabarrus County before the option held by Shorey C. Guess was terminated.

The gold output of the Rudisil Gold Mines, Inc., operating a mine and mill near Charlotte, in Mecklenburg County, was only exceeded by that of the Hog Mountain mine in Alabama in 1935. The mine has a 172-foot vertical shaft, and 950 feet of drifts were run in 1935. The sulphide ore containing gold, silver, and a little copper was treated at a 50-ton flotation mill. The concentrates were shipped to a smelter. The Allen Furr mine in Cabarrus County was operated by the Midas Mines, Inc., and the ore hoisted was treated at a custom mill. About 15 tons of gold ore were mined and shipped to a smelter by E. T. Garsed, of Charlotte. A clean-up at an old mill of the Long Creek mine, Lincoln County, yielded considerable gold. The Keystone mine at Union Mills, Rutherford County, was under development, and about 50 tons of ore were treated at a small ball mill. The Parker mine near Albemarle, Stanly County, was operated most of 1935 by the North Carolina Mining Corporation. Most of the work was prospecting and development, but considerable gold was panned, as no mill has been built. The Thompson mine, also near Albemarle, was operated the last half of 1935, and the 10-stamp mill produced some bullion. The concentrates were not shipped or treated. C. W. Wheelock, the former operator of the Thompson mine, sold some bullion in 1935 which was obtained from operations in 1934. The Liberty Mining Corporation operated a property near Lexington, Davidson County, which yielded a fair output of bullion from ore treated at a small amalgamation plant. The Alred mine near Franklinville in Randolph County was operated part of the year by A. J. Bowers, and some ore was treated at an experimental plant. The mine is now under option to the State Center Mining Co. Mines that produced no gold in 1935 but were being extensively developed included the Capps Hill in Mecklenburg County, now owned by the Stark Manufacturing Co.; the Whitney and the Gold Hill in Rowan County, operated by the lessees; the Clericy Consolidated Mines, Ltd., Ottawa, Canada, and the Howie mine in Union County, being developed by the Candor Consolidated mines.

Pennsylvania.—The Cornwall mines in Lebanon County were operated at a greatly increased rate in 1935, and more than 8,700 tons of copper concentrates were shipped. The ore mined is pyritiferous magnetite, and the tailings from the iron concentrates go to the flotation plant. The copper concentrates, which contain about 23 percent copper and about 0.10 ounce gold and 1 ounce silver to the ton, were shipped to the Nichols Copper Co.

South Carolina.—From 1829 to 1935, inclusive, mines in South Carolina yielded 253,962.53 fine ounces of gold. The output in 1935 from 12 placers and 8 lode mines was 2,273.51 ounces, of which 2,130.31 ounces came from the lode mines. Gold milling plants recovered 541.66 ounces of gold, and crude ore shipped to smelters yielded 1,588.85 ounces. The lode mines also yielded 1,109 ounces of silver and 240 pounds of copper. The placer output of silver was only 8 ounces. The only large placer operated was the Brewer, in Chesterfield County near Jefferson. Eight lode mines milled or shipped 17,467 tons of gold ore in 1935. The Notts Hill mine in Union

County was operated by B. Baldwin and produced a small quantity of bullion in a 10-stamp mill. The Dickey mine, near Smyrna, in Cherokee County, was operated by C. W. Hamilton, and several cars of sulphide ore were shipped to smelters; most of the ore came from open pits. The Terry mine, also near Smyrna, was operated for about 9 months by Shorey C. Guess; considerable development was done, and crude ore was shipped to smelters in Tennessee and New Jersey. This property yielded more gold than any other in South Carolina in 1935. The old Haile mine at Kershaw, Lancaster County, which has had an estimated output of gold valued at more than $3,200,000 since 1828, was the second largest producer in 1935. The mine is worked in an open-cut 80 feet deep, and the ore was treated at a 50-ton amalgamation plant. About 780 tons of crude siliceous ore were shipped to the Tennessee Copper Co. in 1935 from several properties near Hickory Grove, York County, by W. C. Sowell, W. M. Fulton, and the Thirty-Five Mining Co. About 500 feet of development work were done by the Southern Gold Mining Co. at the Landrum mine in Edgefield County, but no ore was treated or shipped.

Tennessee.—Mines in Tennessee produced 18,565.88 fine ounces of gold from 1831 to 1935, inclusive; almost the entire output since 1906 has been from copper ore. No placer gold was marketed from Coker Creek in 1935, and the entire gold yield of the State came from copper bullion refined. There were decreases in the output of gold, silver, copper, lead, and zinc from Tennessee mines in 1935 compared with 1934. Production of gold decreased from 455.00 ounces to 423.00 ounces and that of silver from 61,148 to 47,151 ounces. Tennessee produces little lead, and the output was less than in 1934.

The total copper produced from mines in Tennessee, North Carolina, and Pennsylvania was 20,802,110 pounds in 1935, an increase of 479,310 pounds over 1934; most of the increase in value of copper produced was confined to mines in Pennsylvania. The total lead recovered from mines in Tennessee, New York, and Virginia was 4,982 tons in 1935. The total zinc recovered from mines in Tennessee and Virginia was 48,832 tons. The Bureau of Mines is not at liberty to publish figures for the foregoing States separately.

The Tennessee Copper Co. ran its flotation plant and smelter on ore from its Burra-Burra mine in Tennessee and on sulphide ore from the Fontana mine in Swain County, N. C. The Burra-Burra mine was operated 261 days and the 1,200-ton flotation plant 312 days. The zinc concentrates were shipped to the American Steel & Wire Co., Donora, Pa., and the copper bullion was shipped to the Nichols Copper Co. Development work done in 1935 totaled 8,425 feet. Shipments of siliceous ore and copper ore from several mines in North Carolina and South Carolina were smelted in 1935. The Ducktown Chemical & Iron Co. operated its Isabella mine and 700-ton flotaton plant, and as its smelter has been dismantled the copper concentrates were shipped to the Nichols Copper Co. for smelting.

The Mascot mine and mill of the American Zinc Co. of Tennessee were operated in 1935 at a slightly lower rate than in 1934, and little development was done other than some prospect drilling. The Universal Exploration Co. kept its 800-ton all-flotation plant running on zinc sulphide ore at a little higher percentage of capacity than in

1934; the blende concentrates shipped had an average zinc content of 64.5 percent. The Embree Iron Co., Washington County, shipped high-grade zinc carbonate and lead carbonate concentrates direct to smelters.

Virginia.—The quantity of gold produced by Virginia mines from 1828 to 1935, inclusive, is recorded as 160,944.53 fine ounces, of which only about 1,858 ounces were produced during the last 24 years. In 1935 Virginia produced 652.56 ounces of gold and 55 ounces of silver from three placers and three lode mines.

Shipments of zinc and lead concentrates increased substantially in 1935, but the Bureau of Mines is not at liberty to publish the figures for zinc or lead output as the Austinville mine of the Bertha Mineral Co. is the only producer of lead-zinc ore in Virginia. The Austinville mine and 1,200-ton concentration flotation mill were operated 220 days.

A large part of the gold output in 1935 was made by the Virginia Mining Corporation of Fredericksburg, which operated the Melville and Vancluse mines near Wilderness in Orange County. The mines were operated about 200 days in 1935, and 825 feet of development work were done. The concentrates from the 60-ton all-flotation plant, which were shipped to smelters, contain gold and a little silver and copper. A small car of crude ore obtained from sorting surface material was shipped to a smelter by H. S. Marean of Culpeper County. The Whitehall and Franklin mines in Culpeper County, under option to Paul G. Benedum, were being prospected and sampled. No ore was treated or shipped, and the options will probably be dropped.

Most of the placer gold reported from Virginia in 1935 was produced by the Powhatan Mining Corporation from the Ruth mine in Goochland County. The mine was operated by a dragline and portable washing plant steadily all year and was one of the larger placers in the Appalachian States. A small quantity of placer gold was recovered by sluicing by William B. Crawford at Quantico, Prince William County. The small output was obtained from panning test samples.

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.

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. The production of lead and zinc by regions is not available for 1935.

REVIEW BY STATES

Arkansas.—In 1935, 435 tons of zinc carbonate concentrates and mixed sphalerite and carbonate were shipped from Arkansas mines; the shippers were J. A. Goodall, J. C. Durst, and R. Hicks in the Rush Creek district; Ray Dardene, in the Jimmie Creek district; Mischer & Mays in the St. Joe district; Urschel Mining Co. in the Ponca district; and Koeter & Frank in the Water Creek district. About 50 tons of galena concentrates were shipped from the Brewer land at Ponca by the Urschel Mining Co. The total shipments of concentrates yielded 38 tons of lead and 153 tons of zinc. The demand for zinc carbonate has been good, and some of the old mines at Rush Creek are being reopened.

Illinois.—No lead or zinc mines in northern Illinois were operated in 1935. Shipments from fluorspar mines in southern Illinois were 612 tons of galena concentrates having an average lead content of 72.8 percent; 436 tons of lead and 3,147 ounces of silver were recovered from these shipments compared with 58 tons of lead and 310 ounces of silver recovered in 1934. The Hillside Fluorspar Mines was the largest shipper in 1935.

Kansas.—The 1935 data for lead and zinc mines in Kansas have not yet been compiled owing to the slow return of the Bureau's questionnaires, which are more intricate and comprehensive in 1935 than in former years, making it difficult for the smaller operators to give the information desired. The estimated recoverable lead from concentrates shipped in 1935 is 11,000 tons compared with 6,085 tons in 1934. The estimate for recoverable zinc in sphalerite concentrates shipped in 1935 is 50,000 tons compared with 40,947 tons in 1934. Few shipments of concentrates were made from the Galena or Crestline districts in 1935, but there were large increases in the Waco district and in the Baxter Springs-Blue Mound area. Numerous new tailings mills were built, but little development was done on new properties and the producing area was not extended. A number of mines in Kansas shipped crude ore to mills in Oklahoma instead of operating the mills at the mines in Kansas. The new tailings mills are of large capacity, and several old mines have resumed operations so that the output for 1936 will be greatly increased. Custom mills treated some ore from the old Lawton camp which has been idle many years. Two new tailings mills in the Waco district made several thousand tons of zinc concentrates. The principal shippers in the Baxter Springs area in 1935 were the Baxter Chat Co. (Hartley tailings), Beck Mining Co., Iron Mountain Lead & Zinc Co., Peru Mining Co., Robob Mining Co. (ore milled at the Central mill in Oklahoma), St. Louis Smelting & Refining Co. (No. 8 mine) and Kansas & Oklahoma Mining Co. The larger shippers in the Blue

Mound area were the Black Eagle Mining Co., Eagle-Picher Mining & Smelting Co., Mid-Continent Lead & Zinc Corporation, Vinegar Hill Zinc Co. (Barr mine), Cortez-King Brand Mining Co. (tailings), Commerce Mining & Royalty Co. (Webber and Chubb tailings), Ace High Mining Co. (Fox mine) and J. P. Dines (Blue Mound mine).

Kentucky.—In 1935, mines in Kentucky shipped 259 tons of zinc carbonate concentrates, 118 tons of lead-zinc ore, 60 tons of galena concentrates, and 125 tons of lead-carbonate ore, yielding in all 132 tons of lead and 127 tons of zinc; the shippers of zinc were Avery H. Reed and Roberts & Frazier. The zinc was shipped to the Grasselli Chemical Co. and the Ozark Smelting & Mining Co.

Michigan.—No gold or silver was produced by the two properties at Ishpeming, Mich. At the Michigan mine an average of five men was employed for about 100 days in 1935. The shaft was sunk 180 feet, some development was done, and surface buildings were erected. The Ishpeming Gold Mining Co. actively prospected, sampled, and developed the old Ropes mine and adjoining lands. They employed about 20 men nearly the entire year.

The output of copper in Michigan since 1932 has been made by two companies—Calumet & Hecla Consolidated Copper Co. and Copper Range Co. In 1935 these companies produced 1,376,803 tons of rock, which yielded 95,509,256 pounds of mineral containing 64,108,689 pounds of recoverable copper—almost twice the quantity of rock produced in 1934 and 33 percent more copper. Owing to the resumption of treatment of sands at the Lake Linden reclamation plant in 1935 the average grade of ore produced fell from 3.44 percent in 1934 to 2.33 copper. Except for sands, the grade of rock produced in 1935 improved, averaging 3.65 percent compared with 3.44 in 1934; this improvement marked a continuation of the upward trend in average grade that began in 1928 and has been brought about by selective mining and concentration of mining operations by Calumet & Hecla to shaft pillars and old backs.

Mine production of gold, silver, and copper in Michigan, 1930–35 [1]

Year	Gold (fine ounces)	Silver (fine ounces)	Copper			Concentrate ("mineral")		Ore ("rock") (short tons)
			Pounds	Yield				
				Pounds per ton of ore ("rock")	Percent	Pounds	Yield (percent copper)	
1930		7,820	[2] 169,381,413	[2] 25.4	[2] 1.27	[3] 258,005,986	[3] 65.7	[4] 6,659,036
1931		1,437	118,059,491	33.1	1.65	172,431,815	68.5	3,570,748
1932		71,408	54,396,108	47.6	2.38	79,753,030	68.2	1,142,775
1933	9.67	[5] 125,926	46,853,130	67.2	3.36	68,999,174	67.9	[6] 697,158
1934	58.63	[5] 529	48,215,859	68.9	3.44	70,102,754	68.8	[7] 700,055
1935		4,219	[2] 64,108,689	[2] 46.6	[2] 2.33	[3] 95,509,256	[3] 67.1	[4] 1,376,803

[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] Excludes 200 tons of old tailings cyanided for recovery of gold and silver.
[7] Excludes 800 tons of ore amalgamated for recovery of gold and silver.

Value of silver and copper produced in Michigan mines, 1930–35

Year	Silver	Copper		Total	Year	Silver	Copper		Total
		Total	Per ton of ore ("rock")				Total	Per ton of ore ("rock")	
1930	$3,011	$22,019,584	$3.31	$22,022,595	1933	[1]$44,074	$2,998,600	$4.30	$3,042,674
1931	417	10,743,414	3.01	10,743,831	1934	[1]342	3,857,269	5.51	3,857,611
1932	20,137	3,426,955	3.00	3,447,092	1935	3,032	5,321,021	3.86	5,324,053

[1] According to Bureau of the Mint.

The following data are abstracted from reports by the companies to their stockholders:

Mining operations of the Calumet & Hecla Consolidated Copper Co. were continued on a restricted scale in 1935 and, as in 1933 and 1934, mining was confined to the shaft pillars and old backs. Production from the Conglomerate mine amounted to 36,330,800 pounds of copper at an average cost sold (not including depreciation and depletion) of 6.07 cents per pound. Operations of the reclamation plant at Lake Linden were started up again in 1935, and a production of 9,118,000 pounds of copper at an average cost sold of 4.80 cents per pound was made. Production in 1934 amounted to 32,846,594 pounds of copper and 1,789,608 pounds of oxide. The average selling price for 1935 was 8.89 cents a pound compared with 8.56 cents a pound in 1934. At the Calumet mill at Lake Linden 473,303 tons of conglomerate rock was stamped. The Ahmeek mill was idle during the year but was made ready for commission in December and began stamping rock early in January 1936. After having been shut down for about 4½ years the Lake Linden reclamation plant began the treatment of sands in July. The sands treated were richer than the average grade of sands remaining to be treated. The operations of the reclamation plant for 1935 and for the entire period of its operation are shown in the following table.

Operations at the Calumet & Hecla reclamation plant at Lake Linden in 1935 and for the entire period of its operation

	1935	Since starting
Quantity treated ... short tons	623,000	20,575,000
Assay headings ... percent	0.818	0.714
Assay tailings ... do	.099	.148
Refined copper produced ... pounds	9,118,000	233,681,000
Refined copper produced per ton treated ... do	14.64	11.36

Of the total for 1935, 2,445,000 pounds was from table treatment following grinding, 5,519,500 pounds from leaching, and 1,153,500 pounds from flotation. Concentrates totaling 41,298 tons from current production and stock were treated at the smelter with the recovery of 56,559,562 pounds of copper.

Calumet & Hecla converted a net loss, before depreciation and depletion, of $65,504 for 1934 into a net gain of $1,691,583 for 1935.

The output of the Copper Range Co. was approximately 20 percent greater than in 1934 and totaled 16,759,889 pounds compared with 13,929,859 pounds in 1934. All production in 1935, as in 1934, was from the Champion mine. The average cost of producing copper was reduced from 8.69 cents in 1934 to 8.26 in 1935, while the average selling price increased from 8.55 to 8.68 cents a pound. During the year 280,500 tons of rock, which averaged 57.562 pounds of copper

per ton, were treated at the Champion mill. A total of 14,906 tons of concentrates was treated at the smelter. This tonnage represents only a fraction of the capacity of the smelter. Operations of the Copper Range Co. for the past 6 years are shown in the following table:

Copper produced by the Champion mine of the Copper Range Co., 1930–35

Year	Rock stamped	Copper produced	Yield per ton	Cost per pound [1]	Price received
	Short tons	*Pounds*	*Pounds*	*Cents*	*Cents*
1930	(2)	19,999,564	44.57	11.60	11.43
1931	[3] 404,830	[3] 17,721,270	[3] 43.77	[3] 9.754	[3] 8.2
1932	291,265	12,188,578	41.847	8.646	6.0
1933	203,940	12,167,130	59.66	7.51	7.46
1934	241,175	13,929,859	57.76	8.69	8.55
1935	280,500	16,759,889	57.56	8.26	8.68

[1] Excludes depreciation and depletion.
[2] Figures not given
[3] Includes Baltic mine.

Missouri.—The estimated value of the silver, copper, lead, and zinc shipped from Missouri mines was $8,551,475 in 1935 compared with $7,348,028 in lead and zinc in 1934. No silver was recovered from lead or copper ores in 1934 or 1935, but silver skimmings from lead refining yielded 110,551 ounces of silver in 1935; in addition, lead ores yielded 67,660 pounds of copper. The quantity of recovered lead increased from 90,493 tons in 1934 to 97,580 in 1935, and that of recovered zinc increased from 7,059 to 7,500 tons.

Shipments of lead concentrates (of which only 345 tons were lead carbonate) were about 132,200 tons in 1935 compared with 123,055 in 1934. Of the total in 1935, 131,405 tons were shipped from mines in Southeastern Missouri and averaged 75.3 percent lead; the recovered lead content was 96,941 tons in 1935 compared with 89,580 in 1934.

No zinc concentrates were recovered in or shipped from southeastern Missouri in 1935.

Shipments of lead concentrates from mines in southwestern Missouri comprised about 600 tons of galena and 345 tons of lead carbonate. In 1935, as in 1934, the quoted price for galena concentrates was that paid for medium-size lots, and sellers of larger than carload lots were paid $1 to $3 above the quoted prices.

The total value of concentrates sold is based on actual receipts by the sellers and not on quoted prices.

The average weekly quoted price for galena concentrates marketed in the Tri-State or Joplin Region was $36 for the first 4 weeks of January. The price slumped to a low of $32 in February but increased to $35 in March. In May it again advanced to $36. In June the price increased first to $38, then to $40. In July it was $42. The last week in August it increased to $45, where it remained four weeks. Early in October the price was quoted at $47, where it remained until the end of 1935.

The price of zinc blende concentrates opened at $26 a ton in January 1935 and remained at that price for 23 weeks. Late in May the price increased to $28 a ton, where it remained for 7 weeks. In August the quoted price advanced to $30. This price prevailed for 7 weeks, or until the middle of September, when the quoted price was $31. Early in October the price advanced to $32, where it remained until the end of December 1935.

No price was quoted for zinc carbonate or silicate.

A flat rate which averaged about $16 to $17 was paid for 40-percent zinc concentrates.

All the zinc concentrates shipped from Missouri mines in 1935 were from properties in southwestern Missouri. The total quantity of blende concentrates shipped was about 13,300 tons, an increase of 600 tons over 1934; their average zinc content was about 59 percent.

Shipments of zinc silicate in 1935 were about 1,400 tons (200 tons more than in 1934) and averaged about 38 percent zinc. All the silicate was purchased at a flat price as there were no quoted prices, and demand was limited to three purchasers.

Flotation zinc concentrates made in Missouri in 1935 totaled about 4,520 tons of sphalerite and 53,500 tons of galena.

There was no special demand in 1935 for lead-free sphalerite concentrates, and such concentrates brought no premium. During most of the year flotation blende concentrates were quoted at $1 a ton less than jig and table concentrates. Some lead concentrates were shipped under contract and not sold to smelters; these concentrates were valued at the current weekly base price of galena on the date of shipment.

About 31 mines and 10 mills were active in southwestern Missouri in 1935; only a few operated steadily, and more than 75 percent of the zinc was produced by three operators.

Of about 361,000 tons of sphalerite zinc concentrates shipped from the Tri-State or Joplin region in 1935, it is estimated that 159,000 tons were a flotation product. The zinc concentrates produced at tailing mills are mainly a flotation product, and very few low-grade galena concentrates are derived from tailings. Except in the southeastern Missouri district, where 53,488 tons of flotation lead concentrates were made from 131,005 tons of galena, the quantity of galena concentrates recovered by flotation is comparatively small.

The largest shippers of blende concentrates were the Missouri Mining Co., which operated a 600-ton tailing plant at Chitwood; the American Zinc, Lead & Smelting Co., which operated a 250-ton plant at Diamond; the D. & C. Mining Co., at Carthage; and the Webb City Lead & Zinc Co. at Oronogo. Other large shippers of zinc concentrates were the Playter Mining Co. and other operators who used the Playter mill at Waco; the Zig Zag Mining Co. at Joplin; the Roadside Mining Co. at Fidelity; and the Mineral Recoveries Co. at Webb City, which treated old slimes. Most of the zinc silicate shipped in 1935 was from small mines at Granby, Joplin, and Westplains; small quantities were shipped from Aurora, Wentworth, and Diamond. The lead concentrates shipped were mainly small lots produced near Joplin, Oronogo, Granby, and Waco.

Some surface work was done on creek bottoms and low lands by labor paid for by State relief funds preparatory to unwatering the mining area near Oronogo and Webb City. The unwatering is being done by private interests. Old shafts were cleaned out, new shafts were sunk, and some drilling was done in the Oronogo and Webb City districts. Two mines, the Unity and the Oronogo Mutual, commenced shipping to the Central mill of the Eagle-Picher Mining & Smelting Co. at Picher, Okla. The ore is loaded on 60-ton railroad cars and transported at a rate said to be less than 13 cents a ton.

Experiments are being made to determine the feasibility of screening the fines from crude ore derived from the sheet-ground mines south of Oronogo. Operators know that much waste rock was milled there in former days when prices for concentrates were high and recoveries were as low as 2 to 3 percent. It is believed that by screening and using a picking belt to sort the ore from the coarse rock the grade of the crude material shipped can be raised to 8 or 10 percent of the tonnage.

The lead ore (3,082,300 tons) mined in the southeastern Missouri disseminated-lead district yielded 4.25 percent in galena concentrates averaging 75.3 percent lead. The low price of lead had the effect of eliminating small producers. The mines and mills of the St. Joseph Lead Co., which have a daily capacity of about 17,000 tons, were operated at about 60 percent capacity.

Oklahoma.—About 45 mills (large and small), 15 less than in 1934, were operated in Oklahoma in 1935 but none continuously, as nearly all were shut down in May for several weeks and many others were operated only intermittently. Stocks of zinc concentrates in bins at mines at the end of 1935 were only about 17,000 tons, of which nearly all were held by one or two operators. The stocks of galena concentrates in the Oklahoma and Kansas part of the Tri-State district were about 10,500 tons at the end of the year, a decrease of about 6,000 tons. A strike at the mines, mills, and smelters closed the mines for about 6 weeks, which materially reduced stocks. The strike was a fiasco, and the men returned to work at the same wages and conditions prevailing at the time of the strike. The wages have been and are governed by the selling price of concentrates, and most operators were paying more than the scale. Prices for concentrates advanced considerably, wages were increased, and a few operators of mines having high-grade ore made some money, but profits were negligible at most mines. Two large central mills are handling ore from many mines, so that although the number of active mines increased the number of concentrating plants continued to decrease. The milling of old tailings increased, and most of the higher-grade tailing piles are leased. Company operation of mines is on the down grade, and clean-up and small operations are gradually being transferred to partnership lessees, the crude ore being mined and shipped to central milling plants on a sharing basis.

Estimated (exact figures are not available) shipments from Oklahoma mines in 1935 were 31,350 tons of galena concentrates averaging 79 percent lead and 252,800 tons of blende concentrates averaging 60 to 60.3 percent zinc. The estimated recoverable content of the galena shipped in 1935 is 23,500 tons of lead and that of the blende shipped 134,000 tons of zinc.

There was no output from the Peoria camp in 1935, and the production at the old camp at Commerce was very small.

The producers in the Quapaw-Sunnyside area were the Kansas & Oklahoma Mining Co., Atlas Milling Co., Old Mission Mining & Royalty Co., St. Nicholas Mining Co., Century Zinc Co. (Scott mine), Tulsa Quapaw Mining Co., and Prairie Chicken Mining Co.

The larger producers in the western part of the district in Oklahoma were the Cardin Milling Co. (2 mills), Beaver Mine Co., Commerce Mining & Royalty Co. (3 mills), Brett Milling Co., F. B. Milling Co., Rialto Mining Corporation, Evans-Wallower Lead Co. (2 mills), Tri-State, Inc. (2 mills), Interstate Zinc & Lead Co., Mary M. Mining Co., Velie Mines Corporation (2 mills), Dines Mining Co., A. J. Hutts Mining Co., Youngman Milling Co., Eagle-Picher Mining & Smelting Co. (5,500-ton mill), Peru-Laclede Syndicate, Inc., Cortez-King Brand Mining Co., Canadian Mining & Milling Co., C. Y.

Semple, W. H. Aul Milling Co., Guaranty Mining & Royalty Co., St. Louis Smelting & Refining Co., United Zinc Smelting Corporation, Black Mining Co., Lavrion, Skelton Lead & Zinc Co., and Lawyers Lead & Zinc Co.

The Central mill of the Eagle Picher Mining & Smelting Co., in addition to treating company-mined ore from mines in Oklahoma and Kansas, milled crude ores for other operators of mines in Kansas and Oklahoma.

Shipments of crude ore from Kansas included those from the Robob, Mid-Continent, Foley, Fox, and Northern mines.

Noncompany crude ore was shipped from the following properties in Oklahoma: Davis Big Chief (Nos. 2 and 3 and the Goodwin), Crystal, Waxahachie, Kitty, Mudd, Foch, Black Hawk, Consolidated No. 3, Netta, Dorothy Bill, Swift, McBee, Montreal, Whitebird, Niangua, Slim Jim, and Buckeye.

Wisconsin.—The increase in shipments of zinc concentrates from Wisconsin mines in 1935 was due mainly to the operations of the Vinegar Hill Zinc Co. Few mines and mills of the State were in operation, and little development work was done. Nearly all the raw zinc concentrates were shipped to the National roasting plant of the Vinegar Hill Zinc Co. at Cuba City. The company worked the Blockhouse mines 300 days and the Crawford mine 129 days in 1935. The Crawford ore body was worked on the Thomas land, and an electric shovel was used underground. The Badger Zinc Co. all-flotation plant was idle throughout 1935. The Thomas Mining Co. lease on the Crawford land and the 500-ton mill were operated 181 days. The ore treated was from the 230-foot level. The Meloy & Baker Mining Co. developed a mine on the De Rocher land at Shullsburg. The shaft was sunk to 114 feet, and a 200-ton mill was built. This mill was put in operation late in 1935 and was run 69 days.

Mine production of lead and zinc in Wisconsin, 1934 and 1935

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

[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 of 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 concentrates produced in Wisconsin, 1932–35

	1932	1933	1934	1935
Total ore ... short tons	310,300	256,400	308,600	236,000
Total concentrates in ore:				
Lead ... percent	0.42	0.30	0.11	0.17
Zinc ... do	9.07	10.01	10.20	14.0
Metal content of ore:				
Lead ... do	.30	.22	.08	.12
Zinc ... do	2.98	3.60	3.61	4.85
Average lead content of galena concentrates ... do	70.7	72.5	70.3	73.3
Average zinc content of sphalerite concentrates ... do	32.9	35.7	35.4	34.6
Average value per ton:				
Galena concentrates	$29.34	$40.86	$37.02	$42.62
Sphalerite concentrates	6.34	12.85	11.62	11.48

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEVADA [1]

(MINE REPORT)

By Charles White Merrill and H. M. Gaylord

SUMMARY OUTLINE

The output of gold, silver, copper, lead, and zinc from Nevada ores, gravels, and re-treated tailings in 1935, in terms of recovered metals, is estimated to be 184,940 fine ounces of gold valued at $6,472,900, 4,359,300 fine ounces of silver valued at $3,133,247, 76,243,000 pounds of copper valued at $6,328,169, 25,304,000 pounds of lead valued at $1,012,160, and 31,321,000 pounds of zinc valued at $1,378,124, a total value of $18,324,600 for the five metals. In 1934 Nevada mines yielded 144,275 fine ounces of gold valued at $5,042,411, 3,057,114 fine ounces of silver valued at $1,976,316, 41,611,119 pounds of copper valued at $3,328,890, 21,981,874 pounds of lead valued at $813,329, and 27,880,790 pounds of zinc valued at $1,198,874, a total value of $12,359,820 for the five metals.

The quantity and value of the output of all five metals increased substantially; gold increased 28 percent in both quantity and value, silver 43 percent in quantity and 59 percent in value, copper 83 percent in quantity and 90 percent in value, lead 15 percent in quantity and 24 percent in value, and zinc 12 percent in quantity and 15 percent in value. The estimated value of the metal output in 1935 exceeded that for 1934 by $5,964,780 (48 percent) and was the largest for any year since 1930. Of the estimated total value of the five metals, 35 percent was contributed by gold, 17 percent by silver, 34 percent by copper, 6 percent by lead, and 8 percent by zinc.

During 1935 White Pine County was the largest contributor to nonferrous-metal mineral wealth of Nevada, and it appeared that this county would forge even farther into the lead with the reviving copper output of the Robinson district around Ely. The high price for gold and silver proved stimulating to such districts as Tonopah, Manhattan, and Round Mountain in Nye County. The mines in the Pioche and the Tybo districts were largely responsible for Lincoln

[1] Figures for 1935 are preliminary; detailed data with final revisions will be released later.

and Nye Counties leading the State in lead and zinc production. Throughout Nevada increased activities were reported not only from properties that carry gold and silver but also from those that derive substantial revenue from the base metals. Outputs by lessees, as well as by company-operated mines, enlarged the total production of the State in 1935.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold in 1931–32 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1835, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95, the average weighted yearly United States Government prices;[2] and in 1935 at $35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1931–33 is the average New York price for bar silver; in 1934 the Treasury buying price for newly mined silver, $0.64646464+; and in 1935 the average weighted Treasury buying price for newly mined silver, $0.71875 per ounce. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Price of gold, silver, copper, lead, and zinc, 1931–35

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1931	[1] $20.67+	$0.290	$0.091	$0.037	$0.038
1932	[1] 20.67+	.282	.063	.030	.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044

[1] $20.671835. [2] $0.64646464.

Mine production of gold, silver, copper, lead, and zinc in Nevada, 1931–35, in terms of recovered metals

Year	Gold (lode and placer)		Silver (lode and placer)		Copper	
	Fine ounces	Value	Fine ounces	Value	Pounds	Value
1931	142,293.76	$2,941,473	2,562,071	$743,001	72,634,497	$6,609,739
1932	129,719.83	2,681,547	1,304,365	367,831	31,487,606	1,983,719
1933 [1]	98,590.28	2,519,968	1,148,621	402,017	28,489,610	1,823,335
1934	144,275.17	5,042,417	3,057,114	1,976,316	41,611,119	3,328,890
1935 [2]	184,940.00	6,472,900	4,359,300	3,133,247	76,243,000	6,328,169

Year	Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	
1931	15,860,634	$586,843	20,861,348	$792,731	$11,673,787
1032	880,896	26,430	254,795	7,644	5,067,171
1933 [1]	4,606,732	170,449	12,774,550	536,531	5,452,300
1934	21,981,874	813,329	27,880,790	1,198,874	12,359,826
1935 [2]	25,304,000	1,012,160	31,321,000	1,378,124	18,324,600

[1] Includes copper recovered from copper concentrates produced in 1930 but not marketed until 1933.
[2] Subject to revision.

[2] The Treasury from February 1, 1934, through December 1934 has calculated all gold, old and new, at $35 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

Gold.—The production of recoverable gold in Nevada in 1935 is estimated to be 184,940 fine ounces valued at $6,472,900, an increase of 28 percent in both quantity and value over 1934. Exact figures are not available on proportionate contributions of lode and placer mines, but the data at hand indicate that almost all of the gold was derived from lode mines, as in 1934. In 1934, 76 percent of all the gold produced in Nevada came from dry gold ore. Reviving activity in the base-metal mines, however, probably decreased the percentage derived from this type of ore. The higher price for silver was another factor in the production of gold, as many of the reopened silver mines in the State yielded a substantial quantity of byproduct gold. Among the leading gold districts in Nevada were the Robinson district, White Pine County; Comstock district, Storey County; Manhattan district, Nye County; Silver Peak and Goldfield districts, Esmeralda County; and Silver City district, Lyon County. The first of these is the outstanding copper district of the State. The second is more famous for its silver production than its gold. At present prices, however, its ores are more valuable in gold than in silver.

The following is a list of companies (or mines) operating lode gold properties, approximately in order of their importance as producers: Nevada Consolidated Copper Corporation (White Pine County), Dayton Consolidated Mines Co. (Lyon County), Nevada Porphyry Gold Mines, Inc. (Nye County), White Caps Gold Mining Co. (Nye County), Bradshaw Syndicate, Inc. (Esmeralda County), Nevada State Gold Mines Co. (Pershing County), Lucky Boy Divide Mining Co. (Esmeralda County), Tonopah Mining Co. of Nevada (Nye County), and Nevada Lucky Tiger Mining Co. (Humboldt County). In addition to the larger mines listed above there were many smaller producers of gold in the State.

Silver.—Recoverable silver production in Nevada is estimated at 4,359,300 fine ounces valued at $3,133,247 in 1935 compared with 3,057,114 fine ounces valued at $1,976,316 in 1934. This represents an increase of 43 percent in quantity and 59 percent in value over 1934. The higher price of silver, established by the United States Treasury during the year, proved a great boon to Nevada miners. In 1934 Nye County was the leading producer of silver, followed in order by Lincoln County, White Pine County, and Storey County. Preliminary figures for 1935 indicated that Nye County would continue to be the principal silver producer by a wide margin, but reviving copper mining in White Pine County seemed likely to raise that county's production to a par with Lincoln County. Increased activity on the Comstock Lode should result in Storey County having a considerably larger output than it had in 1934. A few of the major silver producers derived their silver from straight argentiferous ores, but most of the silver output of Nevada came as a byproduct of gold, copper, lead, and zinc mining.

The companies having the largest outputs of silver, listed approximately in order of importance, were as follows: Treadwell Yukon Co., Ltd. (Nye County), Combined Metals Reduction Co. (Lincoln County), Tonopah Mining Co. of Nevada (Nye County), Arizona Comstock Corporation (Storey County), General Metals Recovery Corporation (Esmeralda County), Tonopah Belmont Development Co. (Nye County), Bristol Silver Mines Co. (Lincoln County), Piermont, Inc. (White Pine County), and Nevada Consolidated

Copper Corporation (White Pine County). Many smaller properties accounted for the remainder of the silver output of Nevada.

Copper.—The output of recoverable copper in Nevada was estimated to be 76,243,000 pounds valued at $6,328,169 in 1935, compared with 41,611,119 pounds valued at $3,328,890 in 1934. This is an increase of 83 percent in quantity and 90 percent in value. The Nevada Consolidated Copper Corporation in White Pine County produced far more copper than all other mines in the State together, but a substantial output was reported in Elko County from the Mountain City Copper Co., a subsidiary of the Anaconda Mining Co. Much smaller outputs of copper were reported by various properties throughout the State, notably in the Jack Rabbit and Battle Mountain districts; the Bristol Silver Mines Co. was the most prominent of these.

Lead.—The production of recoverable lead in Nevada is estimated at 25,304,000 pounds valued at $1,012,160, in 1935, compared with 21,981,874 pounds of lead valued at $813,329 in 1934; this was an increase of 15 percent in quantity and 24 percent in value. Lincoln and Nye Counties were the leading producers of lead in 1934 and 1935. Most of the production came from two companies—the Treadwell Yukon Co., Ltd., at Tybo, Nye County, and the Combined Metals Reduction Co. at Pioche, Lincoln County. Smaller outputs were reported for the Bristol Silver Mines Co., Lincoln County, and a number of other companies. The two leading producers of lead in the State mined lead-zinc ore that also contained substantial quantities of silver and gold. Considerable lead was derived from argentiferous and auriferous lead ores shipped by small producers to smelters.

Zinc.—The production of recoverable zinc in Nevada is estimated at 31,321,000 pounds valued at $1,378,124 in 1935 compared with 27,880,790 pounds valued at $1,198,874 in 1934. Thus, the output of zinc in Nevada increased 12 percent in quantity and 15 percent in value over 1934. The bulk of the zinc production, like that of lead, came from the Combined Metals Reduction Co., in the Pioche district, Lincoln County, and the Treadwell Yukon Co., Ltd., in the Tybo district, Nye County.

MINING INDUSTRY

Nonferrous metal production in Nevada is divided rather unevenly among gold, silver, copper, lead, and zinc. In 1935 the gold output comprised 35 percent of the total value of the five metals, silver 17 percent, copper 34 percent, lead 6 percent, and zinc 8 percent. The mining industry of the State in 1935 was as much affected by the market for the base metals as it was by the price-raising legislation recently applied to the precious metals. Since the onset of the depression most of the encouragement to the mining industry of Nevada has come from legislation. Base-metal producers in Nevada, however, have shared in the benefits from higher-priced precious metals, as most of the copper, lead, and zinc is produced from ores carrying substantial values in either gold or silver or both.

Probably no State depends as much as Nevada on the mining industry for the livelihood of its citizens. Increased production of each of the five metals under discussion has been particularly welcome. Not only have mine owners and businesses depending on mining activity benefited, but also employment has increased markedly.

The outlook for 1936 appears to be very bright, if the number of properties being prospected, developed, and equipped can be taken as a reliable index and if prices for the metals continue at present or better level.

METALLURGIC INDUSTRY

Data now available do not include much information on the Nevada metallurgic industry during 1935. It appears, however, that all mills operating in 1934 continued in 1935 and that substantial additions were made to the State milling capacity during the year. The new capacity reported included expansion at old mills and building of new ones. The increased production of copper ore in the Robinson district considerably augmented the output of the only smelter in the State, the copper smelter at McGill. This plant depended chiefly on ores produced by its owner, the Nevada Consolidated Copper Corporation. In addition, however, it did a substantial custom business on purchased ores used for fluxing. Custom mills were operated in various parts of the State; the most important were at Silver City, Lyon County; at Midas, Elko County; Seven Troughs, Pershing County; and Searchlight, Clark County. Large quantities of ore were shipped out of the State, principally to the lead and copper smelters in the Great Salt Lake Basin. The Bauer plant in Utah of the Combined Metals Reduction Co. treated all the company lead-zinc ore mined at Pioche.

REVIEW BY COUNTIES AND DISTRICTS

CHURCHILL COUNTY

The output of metals from mines in Churchill County in 1935 came largely from ore shipped from miscellaneous districts.

Bernice district.—The Bernice mine yielded 50 tons of silver-lead ore by drifting; it was shipped to a smelter.

Eastgate district.—One car lot of ore yielding 8 ounces of gold and 473 ounces of silver was shipped to a smelter from the Eastgate district in 1935.

Fairview district.—The Road Runner mine was the largest producer; 33 tons of ore shipped to a smelter yielded $1,380 in gold and silver. A lessee on the Chalk Mountain Silver Lead property shipped 5 tons of ore recovered from prospecting.

Holy Cross district.—Holy Cross was the principal producing district in the county; 126 tons of ore were shipped to smelters in California and Utah from the Last Hope and other properties. Some prospecting was done in the area.

Jessup district.—A few tons of milling ore were produced in the Jessup district, principally from the Cyclops prospect.

Wonder district.—A lessee on the Jack Pot mine 60 miles from Fallon shipped 80 tons of sulphide ore assaying 90 ounces of silver and 0.2 ounce of gold to the ton. The Wonder mine, which was operated in 1934, was idle in 1935.

CLARK COUNTY

Clark County in 1935 was the scene of a general revival in mining activity. The Crescent, Eldorado Canyon, and Searchlight districts were particularly active. The Yellow Pine district, which contains the oldest lode mine in the State, also showed increased activity.

Crescent district.—In the Crescent district bullion was shipped from the Nippeno mine; 200 tons of tailings from this property averaged approximately $7 a ton, chiefly in gold. A test lot of ore was also shipped from the Elsinor mine to a Utah smelter.

Eldorado Canyon district.—The Wall Street mine, operated by the Eldorado Canyon Development Co., was the largest producer in the Eldorado Canyon district; 265 feet of drifting and raising were done. The property is equipped with a 40-ton flotation mill; most of the ore treated in 1935 came from the dumps. The second largest producer was the Techatticup mine, also equipped with a flotation mill.

Searchlight district.—This district was the outstanding producer in the county, and its old mines were being actively developed. The custom mills in the area treated many small lots of ore from nearby properties. Numerous lessees and sublessees worked the Blossom mine. The Quartette mine, operated by the Mollin Investment Co., was the principal producer in the district; more than 500 tons of concentrates carrying values in gold, silver, copper, and lead were shipped to a smelter. The Duplex Mining Co. mined 133 tons of ore, which were treated in the Quartette mill. The Chiquita mine was a small producer, and the M. & M. was being developed by the Western Consolidated Gold Mines, Inc., which is equipped with a 10-stamp mill. The Good Hope, LaEstrella, LaAquila, and Pompeii also produced ore.

Yellow Pine district.—Four mines in the Yellow Pine district, the Golden Chariot, Keystone-Barefoot, Lavina, and Utah, yielded approximately 1,300 ounces of gold. The old Boss mine was a small producer.

DOUGLAS COUNTY

The small output of gold and silver reported from mines in Douglas County was largely from the Red Canyon district.

ELKO COUNTY

The production of metals from mines in Elko County came chiefly from the Cope (Mountain City), Jarbidge, and Spruce Mountain districts. The output of the county in 1935 exceeded that in 1934 because of the production of the International Mining & Smelting Co. at its Mountain City copper mine, active development of which started in 1931.

Centennial district.—Both milling and shipping ore was mined at the Echo Canyon mine in the Centennial district.

Cope (Mountain City) district.—At the Rio Tinto mine of the Mountain City Copper Co., a subsidiary of the International Mining & Smelting Co., 4,017 feet of development work were done. The mine is developed by both inclined and vertical shafts in addition to drifts and crosscuts. The ore was trucked from Mountain City to Elko, where it was shipped to the smelter at Tooele, Utah. More than 50 men a day were employed on construction and development work, particularly during the latter months of the year. The company was one of the leading producers of copper in the State with an annual output not far short of 10,000,000 pounds.

Delano district.—The Cleveland, Net, and Panther mines were the principal producers in the Delano district. Nearly 1,000 tons of ore obtained from drifting were shipped from the Cleveland property.

More than 500 tons of old tailings from the Panther mine were milled or shipped; operations were not profitable, owing to low lead prices and high milling and freight rates; the 50-ton mill was dismantled in August. The Net mine, which changed hands earlier in the year, shipped over 1,200 tons of lead-silver ore.

Gold Circle district.—Production and development work were active in the Gold Circle district, and several lessees mined and shipped ore from the Gold Circle property, controlled by the Gold & Silver Circle Mines, Inc.; this company also operated a property in the Battle Mountain district, Lander County. The Buena Gold Mines, Inc., mined and treated ore from its Esmeralda and Coots mining claims and shipped a small tonnage of concentrates to a smelter. The property is equipped with a 15-ton Ellis ball mill, plates, and two flotation cells; five to eight men were employed underground and at the mill throughout the year. A third important producer in the district was the Sleeping Beauty mine operated by the East Standard Mining Co.; it is equipped with an amalgamation, flotation, and concentration mill. Development work throughout the year amounted to 1,300 feet.

Island Mountain district.—This district was one of the important producers in the county in 1935. Lessees operated the Alpha mine and treated 130 tons of ore in the five-stamp concentration mill on the property; 400 tons of old tailings were cyanided. At the O. K. property a 10-ton amalgamation mill was built in 1935, and 3,000 feet of drifts were driven; 360 tons of ore were mined and treated, yielding high values in gold. A tailing pond was worked on the July mining claims, and 200 tons of tailings were treated by flotation. A small tonnage of concentrates was shipped from the Elkoro property, a large producer of gold ore in former years. No production was reported from the Bluster mine.

Mardis district.—Some lode and placer gold was produced in this district in 1935.

Spruce Mountain district.—Nearly 1,500 tons of ore were mined and shipped from the Spruce Mountain district in 1935. The Black Forest mine of the Missouri Monarch Consolidated Mines Co. was under development throughout the year, and 867 tons of oxidized lead ore were shipped to smelters in Utah. In 1935, 2,018 feet of drifting and 1,114 feet of raises were driven. Lessees worked the property of the Index Mining Co. 17 miles south of Jasper and shipped 600 tons of lead-silver ore to Utah smelters. Shaft sinking and drifting were done at the Humbug mine, and 20 tons of lead ore assaying 7.05 ounces of silver and 0.03 ounce of gold to the ton were shipped.

Tuscarora district.—Prospecting was carried on in this district, and small quantities of placer and lode gold were produced. From the Eira patented claim of the Milner Corporation 22 tons of ore assaying from 0.55 ounce to 1.59 ounces of gold and from 4.6 to 32.7 ounces of silver to the ton were shipped to the Garfield smelter. The long-tom method was used extensively at the placer mines.

ESMERALDA COUNTY

Activity in Esmeralda County centered in the Goldfield, Silver Peak, and Divide districts.

Desert district.—The Gilbert Mammoth Gold Mines Co. shipped a small quantity of ore in 1935 and treated some ore in its 15-ton mill.

Divide district.—The property of the Tonopah Divide Mining Co. was operated by various lessees during 1935. Considerable ore was produced that yielded about equal values in gold and silver. The property of the Brougher Divide Mining Co. was also in the hands of lessees during the year.

Goldfield district.—The Bradshaw Syndicate, Inc., worked 348,000 tons of old tailings on the property of the Goldfield Consolidated Mines Co.; 5,306 ounces of gold and 2,859 ounces of silver were extracted. The work was done in a 1,400-ton cyanide plant, and an average of about 25 men worked from March to the end of the year. A production of 940 ounces of gold was reported from 313 tons of ore shipped from the Florence claim of the Goldfield Deep Mines Co. of Nevada. An average of 10 men worked underground on the property of the Goldfield Consolidated Mines Co.; over 700 tons of gold ore was shipped to smelters. Lessees did the mining, and 825 feet of development work were reported. Lessees also worked on the Jumbo Extension property.

Hornsilver district.—The Ohio Mines Corporation was the principal operator in this district.

Lone Mountain district.—The Weepah Nevada Mining Co. built a 250-ton flotation and amalgamation mill at its property 40 miles south of Tonopah during the latter half of 1935. The company also produced over 8,000 tons of gold ore.

Silver Peak district.—The Mary Gold Mines Co. succeeded the Lucky Boy Divide Mining Co. and produced more than 500 tons of shipping ore containing gold and silver. The Calumet Gold Mines Co. shipped some ore to the mill of the Black Mammoth Consolidated Gold Mining Co. for treatment. The Black Mammoth Consolidated Mining Co. treated a substantial quantity of company ore in its 50-ton concentration plant; some custom ore was also treated. This company built a new 100-ton cyanide plant. Considerable prospecting was reported in this district.

Tonopah district.—A part of the Tonopah district extends from Nye County into Esmeralda County. In this area the General Metals Recovery Corporation treated 178,994 tons of old tailings, which yielded 2,820 ounces of gold and 203,260 ounces of silver. The tailings from the old mill of the Tonopah Mining Co. at Millers were moved to bins by electric shovels and belt conveyors, and after they were reground the pulp was cyanided by agitation followed by countercurrent decantation. An average of 22 men worked throughout the year.

EUREKA COUNTY

Cortez district.—A little mining and development were done at the Consolidated Cortez silver mine by a lessee.

Eureka district.—Small lots of ore were shipped from the Cyanide property, worked by the owner and lessees. Lessees on the property of the Eureka Smelting Co. produced more than 1,000 tons of ore, which were shipped to a smelter and yielded gold, silver, copper, and lead. The entire production of the Richmond Eureka mine was made by lessees, who shipped most of their ore to lead smelters but a small quantity to a copper smelter.

Lynn district.—Several placer operations were reported in the Lynn district, where stream and bench gravel yielded considerable gold. Most of the miners used sluices and long toms in their work.

HUMBOLDT COUNTY

Amos district.—The Alabama Mining Co., Inc., installed a 40-ton amalgamation mill on its property during 1935; about 100 tons of gold ore were treated during the last half of the year.

Buckskin district.—The Nevada Lucky Tiger Mining Co. operated the Buckskin mine during 1935 and did a large amount of development work, including the installation of a 10-ton flotation and special washing plant. Considerable gold ore containing some silver was produced. The company maintained a large pay roll, an average of about 50 men working underground and on the surface.

National district.—Some gold-silver ore was produced at the National mine. The 35-ton concentration mill on the property was shut down after a short run.

Paradise Valley district.—The Silver Butte Mining Co. shipped a little ore containing high values in gold and silver during 1935. The 75-ton flotation mill was rebuilt.

Sawtooth district.—The Austin Bros. Gold Mining Co. produced 100 tons of gold ore at the Jumbo mine; approximately 500 feet of development tunnels were driven during the year.

Warm Springs district.—The Ashdown property produced some ore which was treated in a 15-ton amalgamation plant at the mine.

LANDER COUNTY

Battle Mountain district.—Numerous properties reported an output of ore in the Battle Mountain district in 1935. The Buzzard mine of the Gold Deposit Mining Co. was worked by lessees throughout the year; 171 tons of ore were shipped from the mine. The Copper Canyon Mining Co. shipped 3,102 tons of sorted ore which contained 1,895 fine ounces of gold, 6,785 fine ounces of silver, and about 46,500 pounds of copper. Fifteen men were employed throughout the year, and 800 feet of development headings were driven. The Lucky Chance, Peggy group, and Honeycomb were important contributors to the total output of the district. The Bluebird mine produced a little gold-silver ore; 250 feet of development work were done during the year. A small lot of crude ore was shipped from the Treasure Vault property. Several other properties were also reported as shippers. The Dahl placer was worked from September 1 until the end of the year with a dry-land dredge equipped with Ainlay bowls.

Bullion district.—More than 2,000 yards of bench gravel on the Triplett group yielded 59 ounces of gold by dry washing. At the Gold Acres property 4,000 tons or more of gold ore were mined and treated in the 50-ton leaching plant constructed on the property during the year.

Hilltop district.—Leasers on the Blue Dick vein shipped 584 tons of ore to a smelter and recovered 22,553 ounces of silver and 26 ounces of gold. An average of three men worked the mine throughout the year, and 310 feet of development work were done.

Reese River (Austin) district.—Many lessees were reported to be working on old mines in this district. Approximately 150 tons of high-grade silver ore were shipped from the Amador group which lessees operated until August 1. The mine was idle the balance of the year.

LINCOLN COUNTY

Caliente district.—The Caliente-Cobalt Mining Co. produced 189 tons of gold ore from the Cobalt mine; 250 feet of development work were done during the year, and an average of three men was employed underground.

Comet district.—Lessees on the property of the Prince Consolidated Mining Co. in the Comet district produced lead ore carrying considerable values in silver and gold. Some development work was carried on by the Comet Coalition Mines Co.

Ferguson district.—The Delamar Exploration Co. shipped a considerable quantity of gold ore to a smelter; several lessees were working on the property. About 300 tons of ore were shipped from the Jumbo and Salvator claims. Ore was shipped from the Easter mine and from the Mountain Lion property. The Caliente Cyaniding Co. worked tailings on the Delamar property in a 150-ton cyanide mill remodeled during the year.

Jack Rabbit district.—The Bristol Silver Mines Co. shipped almost 15,000 tons of silver-lead ore from its property in this district. The ore contained substantial values in silver, lead, and copper. During the year 124 feet of development headings were driven; the company employed an average of 59 men throughout the year.

Pioche district.—The Andesite Mining Co. shipped some crude gold ore during the year. More than 1,700 tons of silver ore carrying some gold were shipped from the No. 3 mine of the Pioche Mines Consolidated, Inc. The Combined Metals Reduction Co. produced over 92,000 tons of ore at the No. 1 Pioche mine, from which were recovered large quantities of zinc, silver, lead, and gold. An average of more than 200 men was employed at the property throughout the year. A lessee on the Half Moon mine of the Manhattan Copper & Gold Co. produced 272 tons of lead ore valuable principally for its precious-metal content. At the Sterling property 1,214 tons of silver ore were produced and shipped. An average of five men worked at the mine during the latter half of the year.

LYON COUNTY

Palmyra district.—The Como Mines Co. produced more than 36,000 tons of ore in 1935 from its property 9 miles from Dayton; the ore was treated in the company 300-ton flotation mill built during the year. The values extracted from the ore were gold and silver, mostly gold.

Silver City district.—Many small operations in the Silver City district yielded ore throughout the year. About 250 tons of ore were shipped from the Arrowhead mine to the Trimble custom mill. The Dayton Douglas Cyanidation Co. treated old Comstock tailings in its 100-ton leaching plant built during the year 4 miles east of Dayton. The Dayton Wedge mine shipped gold ore to the Trimble amalgamation mill; the tailings were re-treated at the Donovan custom mill. The Esher Mines Co. treated about 3,000 tons of ore in its plant, which was changed from flotation to amalgamation and concentration during the year. Mining was reported at the Esther and the Spring Valley mines. The Santiago property was operated by Hardwick and Trimble, and 500 feet of development work was done. More than 700 tons of gold ore were produced at the Vivian and US–103 properties. The South Comstock Gold Mines, Inc., worked its property in the Devil's Gate section of the Silver City district; company and custom ore from miscellaneous properties was treated in the company 60-ton amalgamation-flotation mill. Other properties were worked intermittently by their owners and lessees.

MINERAL COUNTY

East Walker district.—A dragline and portable flume outfit were used to work approximately 16,000 cubic yards of stream gravel that yielded 146 ounces of gold from May 1 to October 25. Inadequacy of water made the operation irregular. Three men worked the Lone Pine and Golden Star claims 17 miles northwest of Thorne and shipped 4 tons of ore averaging 5 ounces of gold to the ton.

Garfield district.—The West End Consolidated Mines Corporation produced 238 tons of gold-silver ore from the Mable property. The ore was shipped to the Salt Lake City area for smelting.

Hawthorne district.—The Ashby Gold Mines, Inc., shipped some rich gold ore to a smelter. Ore was also shipped from the Sunnyside property.

Pilot Mountain district.—The Belleville mine produced 159 tons of gold ore during the latter months of the year.

Pine Grove district.—The Rockland Mining Co. produced 668 tons of gold ore which were treated in a 100-ton cyanide plant at the mine. The property operated from September to the end of the year and employed a number of men.

NYE COUNTY

Mine development and operations were reported from many localities in Nye County. Tonopah continued to be the most important district, although there was considerable activity at the mines in the Manhattan and Round Mountain districts.

Bruner district.—The Penelas Mining Co. shipped a little gold ore from its property 75 miles southwest of Fallon. This company did 2,000 feet of underground development work and erected a 40-ton all-slime countercurrent cyanide plant. An assay office, boarding house, 13 residences, warehouse building, office, pumping plant, and 200-horsepower Diesel power plant were built.

Johnnie district.—The Johnnie mine produced a little ore which was treated by amalgamation.

Manhattan district.—The Manhattan Consolidated Mines Development Co. produced considerable ore from its property which was treated in the 35-ton company flotation plant. Lessees did most of the work at the property. Lessees operated the property of the Nevada Coalition Gold Mines Co. during the year. The Verden property was operated by the Reliance Mining Co., which produced almost 5,000 tons of gold ore during the year. The ore was treated at the company 20-stamp mill with a small tonnage of custom material early in the year. The White Caps Gold Mining Co. operated the White Caps mine on a leasing system; 4,120 tons of gold ore were produced and treated in the company 100-ton cyanide mill. Some placer mining was done on bench gravel in this district. The Cole & Kirchen placer ground was operated by lessees as a drift mine and yielded almost 200 ounces of gold.

Round Mountain district.—The Sixty Mile Mining & Milling Co. produced 500 tons of gold ore which was treated in a 25-ton amalgamation mill. The Monte Cristo mine produced 300 tons of ore yielding 132 ounces of gold; 100 feet of development work were driven during the year. The Gold Hill Mines, Inc., successor to the Gold Hill Development Co., operated its property on a leasing system during the year and produced 889 tons of crude shipping ore; 39 tons of mill clean-up were collected. An average of about five men was employed. Considerable gold was produced at the Round Mountain, Sunnyside, and Fair View mines of the Nevada Porphyry Mines, Inc.

Tonopah district.—The Tonopah-Belmont property was worked by lessees and sublessees during 1935. An average of about 50 men a day worked underground; 4,287 tons of ore carrying silver and gold were produced. Approximately 1,000 feet of development work were done. The Jim Butler mine was idle throughout the year, but a small quantity of ore was shipped by lessees from surface workings. The mine of the Tonopah Extension Mines, Inc., was in the hands of miscellaneous lessees who mined and shipped 1,140 tons of ore; 132 tons of tailings were also shipped. The material contained silver and gold, the former having a total value of approximately twice the latter. An average of 15 men worked throughout the year. The property of the Tonopah Mining Co. of Nevada was worked by sundry sets of lessees who extracted 11,821 tons of silver-gold ore which were shipped to a smelter. Five men were employed by the company throughout the year, and about 60 sets of lessees worked underground.

Tybo district.—The Treadwell Yukon Co., Ltd., was the only producer in the district. According to the printed annual company report for the year ended December 31, 1935, the largest tonnage for any year since the mill was completed in 1929 (106,086 tons) was milled. The ore had an average assay of 0.027 ounce of gold and 11.51 ounces of silver per ton, 6.69 percent lead, and 5.04 percent zinc. The mill produced 10,097 dry tons of lead concentrate containing 0.111 ounce of gold and 82.82 ounces of silver per ton, 55.86 percent lead, and 5.10 percent zinc and 7,612 dry tons of zinc concentrate assaying 0.035 ounce of gold and 13.18 ounces of silver per ton, 48.80 percent zinc, and 1.62 percent lead.

Union district.—A small production of shipping ore was reported from the Richmond, Marquis, and Oliver Twist property; an average of two men worked at the latter from the first of the year through August.

PERSHING COUNTY

Imlay district.—Numerous operations were reported in the district, including the cyanide leaching of old tailings of the Star Peak mine. Some placer gold was recovered during the year.

Placerites district.—Gold was produced from dry placers in this district.

Rochester district.—The Rochester Plymouth Mines Co. opened its mine on April 1 and started its 50-ton flotation mill on April 20; concentrates were shipped to a smelter during the latter part of the year. Small shipments were reported from the Luckie Joe mine.

Rosebud district.—The Janke group of placer claims was worked by hauling ancient lake-bed gravels by truck to water 2 miles away. About 1,500 yards of material were treated and approximately

20 ounces of gold recovered. At the Red Gulch mine 600 cubic yards of bench gravel were dry-washed during the year. Miscellaneous dry-washing operations yielded many small lots of gold.

Scossa district.—The Dawes Gold Mines, Inc., produced 175 tons of gold ore at its North Star group of claims. About 350 feet of development work were done, and a 10-ton amalgamation-concentration mill was built during the year. An average of five men worked the Hawkeye property and produced 210 tons of ore.

Seven Troughs district.—The Nevada State Gold Mines Co. operated its 100-ton cyanide mill on ore from lessees on its own property and properties in the Rosebud, Vernon, Scossa, Farrell, and Seven Troughs districts. Considerable tailings were also milled. The Annie property produced a little rich gold ore during the year.

Sierra district.—The Black Hole mine of the White Bear Mining Co. completed a 30-ton amalgamation-concentration mill in March. The company did some development work and produced 400 tons of ore. The five claims in the Gold Top group yielded 400 tons of gold ore, from which 4 tons of concentrate were shipped to a smelter. The 15-ton amalgamation-concentration mill on the property was rebuilt during the year, and almost 300 feet of development headings were driven.

STOREY COUNTY

The only productive area in Storey County in 1935 was the Comstock district, which embraces the Flowery, Gold Hill, Silver Star, and Virginia City sections. Many lessees were developing and producing at old mines in the district. In addition, company operations were reported at some of the properties. Much of the ore was treated in the custom mills of Silver City. At the Brunswick Chollar mine, 590 tons of gold ore were treated by flotation and considerable ore was shipped crude to smelters; 500 feet of development drifts and raises were driven. Leasing was reported on the Consolidated Virginia property. This mine includes the "Big Bonanza", the most productive ore chute ever found in the district and probably the largest single body of high-grade ore yet mined in the State. A small tonnage was reported shipped from the Cosmopolitan mine to the Trimble custom mill at Silver City. A number of shipments were made from the Keystone and Justice mines to the Trimble and Donovan custom mills. A 100-ton flotation mill was operated by Bradley & Holmes. The Arizona Comstock Corporation worked the Chollar, Potosi, Hale and Norcross, and Savage claims throughout the year. The company produced 7,035 ounces of gold and 200,025 ounces of silver from 116,000 tons of ore. An average of approximately 60 men was employed at the mine, mill, and elsewhere. About half of the employees worked underground. Development work during the year totaled 1,330 feet, and additions were made to the 350-ton flotation mill built in 1932. More than 10,000 tons of gold-silver ore were produced by the Nevada Securities Co., lessee of the Overland group of claims; this ore was treated by amalgamation and flotation. A lessee produced a small quantity of gold-silver ore during the year from the Imperial mine. The Sutro Tunnel Coalition, Inc., built a 100-ton cyanide mill to treat ore from the Crown Point mine. A number of lessees worked on the St. Louis property. The Silver Hill mine produced almost 10,000 tons of ore which, with more than 16,000 tons of tailings and the small amount of custom work mentioned above, were treated at the Donovan mill. An average of 20 men was employed at the mine and mill. The Sierre Nevada, Ltd., treated approximately 10,000 tons of ore by flotation.

WASHOE COUNTY

The principal activities in Washoe County were reported in the White Horse district, where a number of small mines were operated. The Olinghouse mine produced a little ore, and lessees mined ore at the Texas No. 2 property.

WHITE PINE COUNTY

Aurum district.—The Siegel mines produced 1,304 tons of silver ore which was sent to smelters. During the year 200 feet of development drifts were driven; an average of about 10 men was employed at the property.

Cherry Creek district.—A number of the operators in the Cherry Creek district shipped silver-gold ore to the McGill smelter. Tailings from a dump about 7 miles north of Cherry Creek were shipped to the McGill smelter for their silver and gold content and fluxing properties. The Egan Mines, Inc., which worked the Gilligan vein system, produced 3,476 tons of shipping ore containing high values in gold and silver. The company employed an average of 10 men throughout the year and drove 1,000 feet of development headings.

Osceola district.—Numerous lode mines and placers were reported in this district. The Osceola Gold Mining Corporation spent a large amount of money for construction work, including the installation of a power shovel on its placer ground; however, no ore was produced in 1935.

Piermont district.—The Piermont, Inc., which operated the Piermont mine, produced almost 10,000 tons of silver ore carrying some gold. An average of 32 men was employed throughout the year. The ore was treated at a small flotation plant with a capacity of 50 tons in 24 hours.

Robinson district.—The Robinson district, by far the most important in the county, is the most productive copper camp in Nevada and contains one of the richest ore deposits in the State. The largest producer in the district was the Nevada Consolidated Copper Corporation, a subsidiary of the Kennecott Copper Corporation. A huge tonnage of copper ore was produced and treated at the company smelter at McGill, White Pine County. The bulk of the production came from its great open pit at Copper Flat, which the company operated, but some underground stoping was done at the Ruth mine. Another large producer of gold and silver was the Consolidated Coppermines Corporation, whose mine was operated mainly by lessees during 1935. The ore was shipped to the nearby McGill smelter. Fluxing ores shipped to the McGill smelter from various nearby mines yielded large quantities of gold and silver.

White Pine district.—Six hundred tons of old tailings were cyanided at the Smokey mill property in a 5-ton cyanide plant.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEW MEXICO

(MINE REPORT)

By Chas. W. Henderson and A. J. Martin

SUMMARY OUTLINE

The total production of gold, silver, copper, lead, and zinc from New Mexico ores and gravels in 1935, in terms of recovered and estimated recoverable metals, was 33,435.00 fine ounces of gold, 1,061,902 fine ounces of silver, 4,505,000 pounds of copper, 14,578,000 pounds of lead, and 44,252,000 pounds of zinc. This output compares with a production in 1934 of 27,307.01 ounces of gold, 1,061,775 ounces of silver, 23,630,000 pounds of copper, 18,729,000 pounds of lead, and 53,043,000 pounds of zinc and shows increases of 6,127.99 ounces in gold and 127 ounces in silver and decreases of 19,125,000 pounds in copper, 4,151,000 pounds in lead, and 8,791,000 pounds in zinc. There were 150 lode mines and 234 placers producing in 1935, a decrease of 3 lode mines and 94 placers from 1934.

The total recorded production of gold, silver, copper, lead, and zinc (in terms of recovered metals) in New Mexico from 1848 to 1935, inclusive, compiled by F. C. Blocksom under direction of Chas. W. Henderson, has been 1,930,755 fine ounces of gold, 57,502,661 fine ounces of silver, 1,544,635,473 pounds of copper, 425,429,385 pounds of lead, and 887,433,394 pounds of zinc.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the figures given in the table that follows: Gold in 1931–32 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1835, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95, the average weighted yearly United States Government prices; [1] and in 1935 at $35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1931–33 is the average New York price for bar silver; in 1934 the Treasury buying price for newly mined silver, $0.64646464+; and in 1935 the average weighted

[1] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

Treasury buying price for newly mined silver, $0.71875 per ounce. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of gold, silver, copper, lead, and zinc, 1931–35

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1931	[1] $20.67+	$0.290	$0.091	$0.037	$0.038
1932	[1] 20.67+	.282	.063	.030	.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	[3] .718+	.083	.040	.044

[1] $20.671835. [2] $0.64646464. [3] $0.71875.

Mine production of gold, silver, copper, lead, and zinc in New Mexico, 1931–35, in terms of recovered metals

Year	Mines producing			Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Total		Fine ounces	Value	Fine ounces	Value
1931	59	109	168	3,003,941	31,161.24	$644,160	1,041,859	$302,139
1932	87	378	465	1,464,718	23,208.05	479,753	1,142,351	322,143
1933	92	302	394	1,475,839	26,474.09	676,678	1,181,580	413,553
1934	153	328	481	1,397,709	27,307.01	954,380	1,061,775	686,400
1935	150	234	384	440,799	33,435.00	1,170,225	1,061,902	763,242

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1931	61,503,100	$5,596,782	22,537,000	$833,869	55,732,000	$2,117,816	$9,494,766
1932	28,419,000	1,790,397	20,227,000	606,810	51,186,000	1,535,580	4,734,683
1933	26,947,000	1,724,608	22,086,000	817,182	61,848,000	2,597,616	6,229,637
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

Gold and silver produced at placer mines in New Mexico, 1931–35, 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	
1931	406.59	$8,405	59	$17	$8,422	1934	2,587.64	$90,438	212	$137	$90,575
1932	1,270.28	26,259	181	51	26,310	1935	3,554.40	124,404	302	217	124,621
1933	1,399.15	35,762	160	56	35,818						

Gold.—The mine production of recoverable gold in New Mexico was 33,435.00 fine ounces valued at $1,170,225 in 1935 compared with 27,307.01 ounces valued at $954,380 in 1934. San Miguel County (Pecos mine) produced 44.31 percent of the total in 1935, Catron 20.78 percent, Sierra 10.70 percent, Grant 8.48 percent, and

Colfax 6.93 percent. The largest increases over 1934 were 3,747.60 ounces in Catron County, 1,684.01 ounces in Sierra County, and 1,170.27 ounces in Colfax County, Mount Baldy district; the largest decrease was 815.73 ounces in San Miguel County. Lead-zinc ore yielded 44.65 percent of the total gold; dry and siliceous ore 42.95 percent; copper, copper-lead, and lead ores 1.77 percent; and placers 10.63 percent. The bulk of the placer gold was produced in the Hillsboro and Pittsburg districts, Sierra County, by operators using power shovels and centrifugal separators or specially constructed washing plants.

Silver.—The mine production of recoverable silver in New Mexico amounted to 1,061,902 fine ounces valued at $763,242 in 1935 compared with 1,061,775 ounces valued at $686,400 in 1934. San Miguel County produced 40.74 percent of the total in 1935, all from lead-zinc ore of the Pecos mine in the Willow Creek district; Grant County 30.61 percent, chiefly from the Central, Steeple Rock, and Pinos Altos districts; and Catron County 25.82 percent, all from the Mogollon district. Lead-zinc ore from Grant and San Miguel Counties yielded 61.52 percent of the total silver; dry and siliceous ore, chiefly from Catron and Grant Counties, 36.31 percent; and copper, copper-lead, and lead ore 2.17 percent. The quantity recovered from placers was negligible.

Copper.—The mine production of recoverable copper in New Mexico totaled 4,505,000 pounds valued at $373,915 in 1935 compared with 23,630,000 pounds valued at $1,890,400 in 1934. The Chino Mines of the Nevada Consolidated Copper Co. in the Central district, Grant County, which produced 82.40 percent of the State total in 1934 until closed in October 1934, remained idle in 1935. The result was a very large decrease in production of copper during the year. The only important producers of copper in New Mexico were the Ground Hog and San Jose mines, Grant County, and the Pecos mine, San Miguel County. Lead-zinc ore yielded 85.95 percent of the total copper and copper and copper-lead ore 12.03 percent; only a small percentage was recovered from other types of ore.

Lead.—The mine production of recoverable lead in New Mexico was 14,578,000 pounds valued at $583,120 in 1935 compared with 18,729,000 pounds valued at $692,973 in 1934. The chief lead-producing districts in both years were the Willow Creek, San Miguel County; Central, Grant County; and Magdalena, Socorro County. Lead-zinc ore yielded 96.43 percent of the total lead.

Zinc.—The mine production of recoverable zinc in New Mexico amounted to 44,252,000 pounds valued at $1,947,088 in 1935 compared with 53,043,000 pounds valued at $2,280,849 in 1934. The zinc-producing districts in 1935 were the Willow Creek in San Miguel County, the Central in Grant County, and the Magdalena in Socorro County. Zinc concentrates were shipped to the American Smelting & Refining Co. natural-gas retort plant at Amarillo, Tex.; to the Illinois Zinc Co. retort plant at Peru, Ill.; to the American Metal Co. producer-gas retort plant at Langeloth, Pa.; and to the American Metal Co. natural-gas retort plant at Blackwell, Okla. Zinc sulphide ore was shipped to the Ozark Smelting & Mining Co. zinc-lead pigment plant at Coffeyville, Kans.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1935, by counties, in terms of recovered metals

County	Mines producing			Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Total		Fine ounces	Value	Fine ounces	Value
Catron	6		6	59,637	6,946.17	$243,116	274,172	$197,061
Colfax	5	8	13	5,323	2,316.88	81,091	292	210
Dona Ana	1		1	13			736	529
Grant	41	52	93	178,635	2,836.43	99,275	325,003	233,596
Hidalgo	46		46	3,075	992.86	34,750	16,178	11,628
Lincoln	6	71	77	963	893.40	31,269	455	327
Luna	2		2	54	6.20	217	380	273
Otero		8	8		258.69	9,054	18	13
Rio Arriba	1	4	5	8	9.91	347	7	5
Sandoval	2		2	159	20.20	707	1,575	1,132
San Miguel	1		1	185,380	14,816.66	518,583	432,622	310,947
Santa Fe	5	56	61	144	201.00	7,035	182	131
Sierra	24	31	55	732	3,578.63	125,252	4,341	3,120
Socorro	10		10	6,676	550.89	19,281	5,938	4,268
Taos		4	4		7.08	248	3	2
	150	234	384	440,799	33,435.00	1,170,225	1,061,902	763,242
Total, 1934	153	328	481	1,397,709	27,307.01	954,380	1,061,775	686,400

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Catron	1,000	$83	1,000	$40			$440,300
Colfax	4,000	332					81,633
Dona Ana			200	8			537
Grant	3,148,000	261,284	3,876,700	155,068	16,807,000	$739,508	1,488,731
Hidalgo	89,000	7,387	47,500	1,900			55,665
Lincoln	2,000	166	17,900	716			32,478
Luna			7,400	296			786
Otero							9,067
Rio Arriba			100	4			356
Sandoval			7,800	312			2,151
San Miguel	1,227,000	101,841	10,323,000	412,920	26,744,000	1,176,736	2,521,027
Santa Fe	11,000	913	100	4			8,083
Sierra	22,000	1,826	19,100	764			130,962
Socorro	1,000	83	277,200	11,088	701,000	30,844	65,564
Taos							250
	4,505,000	373,915	14,578,000	583,120	44,252,000	1,947,088	4,837,590
Total, 1934	23,630,000	1,890,400	18,729,000	692,973	53,043,000	2,280,849	6,505,002

Gold and silver produced at lode mines in New Mexico in 1935, by counties, in terms of recovered metals

County	Ore sold or treated	Gold	Silver
	Short tons	*Fine ounces*	*Fine ounces*
Catron	59,637	6,946.17	274,172
Colfax	5,323	2,143.77	267
Dona Ana	13		736
Grant	178,635	2,650.94	324,914
Hidalgo	3,075	992.86	16,178
Lincoln	963	559.71	427
Luna	54	6.20	380
Rio Arriba	8	3.40	7
Sandoval	159	20.20	1,575
San Miguel	185,380	14,816.66	432,622
Santa Fe	144	90.60	178
Sierra	732	1,099.20	4,206
Socorro	6,676	550.89	5,938
	440,799	29,880.60	1,061,600

Gold and silver produced at placer mines in New Mexico in 1935, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Dry-land dredges [1]		Total	
	Gold	Silver	Gold	Silver	Gold	Silver
Colfax	146.01	20	27.10	5	173.11	25
Grant	137.03	81	48.46	8	185.49	89
Lincoln	327.97	28	5.72	----------	333.69	28
Otero	48.53	3	210.16	15	258.69	18
Rio Arriba	6.51	----------	----------	----------	6.51	----------
Santa Fe	110.40	4	----------	----------	110.40	4
Sierra	116.37	12	2,363.06	123	2,479.43	135
Taos	7.08	3	----------	----------	7.08	3
	899.90	151	2,654.50	151	3,554.40	302
Total, 1934	1,070.41	107	1,517.23	105	2,587.64	212

[1] Includes dragline and power-shovel excavators with sluices or special amalgamators.

REVIEW BY COUNTIES AND DISTRICTS

CATRON COUNTY

Mogollon district.—In 1935 the Mogollon district ranked second among the districts of the State in output of gold and third in output of silver. The largest producer was the Black Hawk Consolidated Mines Co., operating a group of mines locally known as the Little Fanney and Johnson groups. The property is equipped with a 150-ton cyanide mill, which was run continuously throughout the year on ore extracted from the Little Fanney, Champion, Consolidated, Johnson, and Clifton claims. The Mogollon Consolidated Mines Co. reopened the Deadwood-Last Chance group and erected a mill to treat the ores from that property by flotation. The concentrates produced were shipped to the El Paso smelter. At the Queen group the Cooney Mining Co., Inc., did development work in the mine and made experimental runs of its new mill for a few weeks at intervals during the year. Small lots of ore were shipped from the Ann Arbor property and the Horseshoe group, and a clean-up of an old mill in the district yielded a little gold and silver.

COLFAX COUNTY

Mount Baldy district (Baldy, Elizabethtown, Eagle Nest).—In 1935 the Aztec Mines, lessee of the Aztec Mines property of the Maxwell Land Grant Co. at the head of Ute Creek, continued to treat ore by amalgamation and gravity concentration until October, when the company changed the method of treatment to flotation concentration. The capacity of the new flotation equipment is 36 tons per 24 hours. At the Montezuma mine, also owned by the Maxwell Land Grant Co., the lessee treated most of the ore mined during the year in the small amalgamation-concentration mill at the mine. The concentrates produced and some crude ore were sold to the Golden Cycle mill at Colorado Springs, Colo. Bullion produced was shipped to the Denver Mint. The Ajax Mines, Inc., shipped 200 tons of ore containing 207.63 ounces of gold from the Golden Ajax mine on Willow Creek to the Golden Cycle mill at Colorado Springs, Colo. Gold bullion was produced by the lessee of the Rebel Chief group, who washed the fines in a rocker and caught the gold in riffles, ground pieces of the high-grade ore in a hand mortar, and panned to save the gold. The owner of the Red Bandana mine produced amalgamation bullion from ore treated in a Huntington mill with copper plates. The New Mexico Gold Producers Corporation operated a dragline and floating washing plant at its lease on the property of the Maxwell Land Grant Co. in Mills Canyon from May 15 to June 20, 1935, as a development and testing project. About 14,600 cubic yards of gravel were handled, from which were recovered 675 pounds of black sand containing gold. The company reported that the experiment was unsuccessful. Drift mining and hydraulicking at the Ute Creek placers and sluicing operations on South Ponil, Ute, and Willow Creeks yielded the remainder of the output from the district.

DONA ANA COUNTY

Organ district.—In 1935 the operator of the Silver Coinage claim shipped 13 tons of ore containing 738 ounces of silver, 104 pounds of copper, and 249 pounds of lead to the El Paso smelter.

GRANT COUNTY

Burro Mountain district (*Tyrone*).—In 1935 shipments of gold-silver-copper ore were made to the El Paso smelter from the Burro Mountain group of the Phelps Dodge Corporation, Contact group, and Shamrock group. A small lot of bullion was produced at the Shamrock group which was equipped with a 5-ton ball mill and amalgamation plates and tables.

Central district (*Bayard, Fierro, Georgetown, Hanover, Santa Rita*).—In 1935 the Black Hawk Consolidated Mines Co. 250-ton concentrator 1 mile south of Hanover operated as a custom mill, treating zinc-lead-copper-silver sulphide ore from the Ground Hog and San Jose properties of the Asarco Mining Co. near Cobre and company ore of somewhat similar type. The mill feed averaged 4.11 ounces of silver per ton, 2.54 percent copper (wet assay), 3.31 percent lead (wet assay), and 6.27 percent zinc. The mill was operated 335 days at a daily average of 224 tons. Part of the ore mined at the Ground Hog and San Jose properties was of direct-smelting grade and was shipped crude to the El Paso smelter. The Peru Mining Co. produced zinc sulphide ore from its Pewabic mine at Hanover. The ore is shipped 60 miles by railroad to the company 500-ton flotation mill (mentioned under Luna County) at Deming for treatment. A lessee at the property of the Hanover-Bessemer Iron & Copper Co. shipped 7 cars of copper-gold-silver ore to the El Paso smelter. A few lots of smelting ore obtained from various other mines and dumps were shipped from the district. The Chino Mines of the Nevada Consolidated Copper Corporation at Santa Rita and the 15,000-ton flotation mill at Hurley, which were closed in October 1934, remained idle during 1935. One lot of placer gold recovered at a property 6 miles southeast of Silver City was sold to the Denver Mint in 1935.

Chloride Flat district (*Silver City*).—A car of dry silver ore was shipped to the El Paso smelter by an operator in the Chloride Flat district in 1935.

Gold Hill district (*see also Hidalgo County*).—The Indian Springs Mining Co. shipped 43 tons of gold ore from its property, and 12 tons of ore were shipped to an ore buyer at Douglas, Ariz., from small-scale operations at another property in the district.

Pinos Altos district.—Nearly the entire output of metals from the Pinos Altos district in 1935 was crude ore shipped to the El Paso smelter. Producing mines and dumps included the Golden Giant, Golden Rule, Hazard, Kept Woman, Langston, Savannah Copper Co. property, Silver King, and Wild Bill. The New Mexico Mining Corporation, a subsidiary of the International Mining Corporation of New York City, which early in the year did extensive development work on about 50 claims, including the property of the Savannah Copper Co., ceased operations and relinquished the properties before the end of the year. Placer gold was produced by individuals engaged in panning, rocking, and sluicing near Pinos Altos.

Steeple Rock district (22 miles northeast of Duncan, Ariz., by road).—Shipments of dry, oxidized, siliceous gold-silver ore from the East Camp group in 1935 totaled 908 tons containing 269.19 ounces of gold, 14,801 ounces of silver, and 1,285 pounds of copper. The ore came from the McDonald and Davenport claims. Smaller tonnages of gold-silver ore were shipped to smelters from the Billali, Norman King, and Rival mines. A small lot of gold-silver-copper ore was shipped from the Thanksgiving group.

White Signal district.—The equipment installed in 1933–34 by the Sunset Gold Fields, Inc., at a placer 23 miles northeast of Lordsburg in Gold Gulch, Burro Mountains, was operated for a short period in 1935.

HIDALGO COUNTY

Eureka district (Hachita).—All the ore produced in the Hachita district and sold in 1935 was shipped crude to the El Paso smelter. The chief producer was the Barney group, but some ore was produced from five other properties, including the Lead Queen.

Gold Hill district (see also Grant County).—Small lots of smelting ore were shipped from the Oro Grande, Lost Prospector, and two other properties, presumably prospects, in the Gold Hill district in 1935.

Lordsburg district (including Pyramid and Virginia or Shakespeare districts).—The output of the Lordsburg district in 1935, from many small-scale operations, was shipped direct to smelters or sold in small lots to buyers of ore. Lessees at an open-cut on the Morningstar and Augustine property shipped 67 tons of silver-gold-copper ore to the El Paso smelter. At the Belle-Last Chance-Dakota Pearl (three claims), also developed by open-cuts, lessees produced and shipped several cars of gold-silver-lead-copper ore. Other producing properties, mostly operated by lessees, included the Alberta, Battle Ship, Jarosite, Misers Chest, Sherman, and Wheeling Lordsburg Copper Co. property.

San Simon district (Steins).—Producing mines in the San Simon district in 1935 were the Bob Montgomery, Hattie Lee, and "66". Except for 9 tons sold to an ore buyer at Douglas, Ariz., all the ore was shipped crude to the El Paso smelter.

LINCOLN COUNTY

Gallinas Mountains or Red Cloud district.—Two cars of ore produced during exploration by a lessee at the Deadwood-Red Cloud mine were shipped to the El Paso smelter in 1935.

Jicarilla district.—The metal output of the Jicarilla district in 1935, as in 1934, comprised chiefly small lots of placer gold produced in the Jicarilla Mountains southeast of Ancho by individuals and prospectors who sold most of the gold to merchants at Ancho and Carrizozo. A power shovel and other equipment for large-scale operations were moved to the Ancho placer during the year but were operated for only a short period.

Nogal district.—In 1935 the Helen Rae mine was operated on a small scale. It is equipped with a small Huntington mill; the output of amalgamation bullion was sold to the Denver Mint. A small lot of lead ore, presumably from a prospect in the district, was sold to the El Paso smelter, and a small quantity of gold was recovered from placers during the year.

White Oaks district.—The El Aviador Gold Mining Co. shipped 612 tons of gold-silver ore from the Little Nell and Smuggler mines to the El Paso smelter and had 117 tons treated by amalgamation in the mill at the Little Mack mine. The smelting ore contained 279.10 ounces of gold and 153 ounces of silver; the output of bullion weighed 93.03 ounces and had a fineness of 0.853 in gold and 0.119 in silver. A small quantity of amalgamation bullion was produced from the Little Mack and one other property in the district.

LUNA COUNTY

Deming.—In 1935 the selective flotation mill of the Peru Mining Co. at Wemple, near Deming, was operated 290 days at an average daily rate of 327 tons, chiefly on lead-free zinc sulphide ore from the company's Pewabic mine at Hanover, Grant County. The mill was used for about 1 month to treat custom ore received from the Hazel mine, in the Van Horn district, Culberson County, Tex. Improvements made in 1935 increased the capacity of the mill from 300 to 500 tons per 24 hours.

The only output from mines in Luna County in 1935 was two cars of lead-silver ore, one from Columbus and the other from Gage, shipped to the El Paso smelter.

OTERO COUNTY

Orogrande district.—The Oro Grande Placer Syndicate operated a special placer machine at the Little Joe and Cotton Top placers and made regular shipments of bullion to the Denver Mint in 1935. Gold was recovered at the Center placer 2½ miles northeast of Orogrande by a two-way dry washer run by a small gasoline engine, which was operated intermittently during the year. Small sluicing operations were carried on at several other placers in the Orogrande district.

RIO ARRIBA COUNTY

Headstone district.—Two test lots of ore totaling 8 tons were shipped from the Buckhorn-Little Eureka group in 1935. The ore contained 3.58 ounces of gold, 7 ounces of silver, and 111 pounds of lead. Small sluicing operations on Hopewell Creek yielded a little gold.

SANDOVAL COUNTY

Cochiti (Bland) district.—A lessee who has been operating the Crown Point group since 1932 continued shipments of gold-silver ore to the El Paso smelter in 1935. The ore was extracted from the Crown Point and Iron King claims. Another operator shipped 54 tons of lead-silver-gold ore from Domingo to the El Paso smelter.

SAN MIGUEL COUNTY

Willow Creek district (Terrero).—Operations were continuous at the Pecos mine of the American Metal Co. on Willow Creek—the only producing mine in San Miguel County in 1935—in its ninth year of production. The mill is in Alamitos Canyon 6 miles by road from Glorieta Station and 4 miles by railroad spur from Fox Station on the Atchison, Topeka & Santa Fe Railway and is connected with the mine by a 12-mile aerial tram; it treated an average of 508 tons daily during 1935.

The heads of ore into the mill in 1935 averaged 0.107 ounce of gold and 3.37 ounces of silver per ton, 0.67 percent copper (wet assay), 3.88 percent lead (wet assay), 10.71 percent zinc, and 13.22 percent iron. The yield from 185,380 dry tons of ore treated in 1935 was 29,519 tons of zinc concentrates—averaging 0.049 ounce of gold and 3.44 ounces of silver per ton, 1.04 percent copper (wet assay), 1.10 percent lead (wet assay), 54.64 percent zinc, and 8.13 percent iron—and 14,789 tons of lead-copper concentrates—averaging 0.93 ounce of gold and 25.26 ounces of silver per ton, 3.66 percent copper (wet assay), 38.78 percent lead (wet assay), 10.64 percent zinc, and 12.70 percent iron.

SANTA FE COUNTY

Los Cerrillos district.—The only output from lode mines in the Los Cerrillos district in 1935 was 9 tons of gold-silver ore containing a small percentage of copper shipped by the Granito Mining Co. to the El Paso smelter. Merchants at Cerrillos purchased small lots of gold produced by panning, sluicing, and dry washing in the district.

San Pedro or New Placers district.—Lessees at the La Santa Fe mine extracted 15 tons of gold ore from small quartz veins and had it milled in 1935 as custom ore in the 6-foot Huntington mill operated by Joe Stewart on his ranch; amalgamation bullion recovered yielded 13 ounces of gold. Several cars of gold-silver-copper ore produced from small-scale operations and testing of properties in the district were shipped to the El Paso smelter. Small sluicing and dry-washing operations yielded placer gold which was marketed through mercantile establishments or sent direct to the Denver Mint.

SIERRA COUNTY

Apache, Cuchillo Negro district (Chloride).—In 1935 prospectors shipped four 1-ton lots of ore from properties near Chloride to the El Paso smelter.

Kingston district.—A lessee at the Kingston-Templer group shipped 6 tons of silver ore to the El Paso smelter in 1935.

Lake Valley district.—The only output from the Lake Valley district in 1935 was two cars of silver ore containing a small percentage of lead and copper, shipped to the El Paso smelter from the Lake Valley mine.

Las Animas district (Hillsboro).—In 1935, as in 1934, the John I. Hallett Construction Co., operating the Animas Consolidated and Slease leases (a consolidation of the old Gold Dust and other placers, totaling 1,200 acres), was the largest producer of placer gold in the Hillsboro district and in the State. The equipment used in 1935 comprised two Northwest dragline excavators, each with a capacity of 1,000 cubic yards per 24 hours, and a portable Coulter-Ainlay recovery plant with four Ainlay 36-inch bowls using gasoline engines for power. Operations were continuous in 1935, and the company handled 70,000 yards of material. At the Wakely placer in Gold Run Gulch 6 miles east of Hillsboro, William Little completed the installation of machinery begun in 1934 and started production in April 1935, continuing until November 1. His equipment consisted of one ¾-yard dragline, one 1¼-yard shovel, and a mobile recovery plant with six Ainlay bowls, with which he handled 70,000 cubic yards of gravel. The Hoot Owl placer was equipped with a dragline excavator having a capacity of 1,000 cubic yards per 24 hours, a portable screening plant with screens and scrubber, and a 30-foot sluice box. The plant was operated part of the year. Scattered, small sluicing operations contributed to the output from placers.

Production from lode mines in the Las Animas district in 1935 consisted chiefly of shipments of crude ore to the El Paso smelter or to an ore buyer at Douglas, Ariz., by lessees at the Biglow-Empire-Bonanza, Portland-Sherman-Caballero, and Snake-Opportunity groups and at the Wicks and Yankee King mines.

Pittsburg district.—From February 1 to December 31, 1935, the Consolidated Mines, Inc., operated the property of the Pittsburg Placer Mining Co. lying between the Rio Grande River and the Caballo Mountains 3 miles northeast of Arrey. Ore was produced from the Caballo, Experanzo, Oro Grande, Pan do Oro, Pulido, and Union Jack claims. The company equipment comprised one gasoline-powered dragline excavator having a capacity of 960 cubic yards per 24 hours, two hydraulic giants, one 4-stage Dean Hill centrifugal pump, and one sluice box. The company changed from portable-plant to central-plant operations about October 1. Recovery of bullion totaled 669.01 crude ounces averaging approximately 0.970 fine in gold and 0.027 fine in silver. Small sluicing operations in the Pittsburg district yielded 68.58 fine ounces of gold and 6 fine ounces of silver.

SOCORRO COUNTY

Magdalena district.—The Kelly mine group of the Empire Zinc Co. was operated continuously in 1935 under lease to Kenneth Hughes. The mine produces zinc-lead sulphide ore. The entire output in 1935 was shipped to the Ozark Smelting & Mining Co. at Coffeyville, Kans. The ore produced at other mines in the Magdalena district (all shipped crude to the El Paso smelter) included 71 tons of gold ore from the Morning Star and 17 tons of lead-silver ore from the Queen mine.

Rosedale district.—In 1935 the Rosedale Gold Mines, Ltd., completed the reconditioning of the milling plant at the Rosedale mine and treated 2,972 tons of ore during the last few weeks of the year. The mine is opened by a 700-foot shaft and approximately 1 mile of drifts. The ore is crushed in a jaw crusher and ground in a Hardinge ball mill in closed circuit with a Dorr classifier; the overflow from the classifier goes to a Diester table, from which the heads go to the smelter and the tails to cyanide tanks. Precipitation is accomplished in zinc boxes. The products of the mill in 1935 were 31 tons of concentrates containing 118.18 ounces of gold and 23 ounces of silver and precipitates yielding 39.96 fine ounces of gold and 124 fine ounces of silver.

Salinas Peak district.—At the Smith group 270 feet of development work were done in the mine and 19 tons of ore containing 15,422 pounds of lead and 25 ounces of silver were shipped to the El Paso smelter.

San Mateo Mountains district.—At the Panky mine the Springtime Mining Co. produced 1,295 tons (wet weight) of gold-silver ore which were treated by flotation in the new 40-ton mill completed at the mine during 1935. The concentrates produced contained 280 ounces of gold and 4,800 ounces of silver. The mine is opened by a main-level adit 600 feet long, a main shaft 100 feet deep, a secondary shaft 50 feet deep, and 50 to 150 feet of drifts at the 50- and 100-foot levels. Operators at another property in the San Mateo Mountains district shipped 35 tons of gold-silver ore to the El Paso smelter.

Silver Hills district.—In 1935 the Open Cut Mines continued test runs of the 25-ton flotation mill built in 1935; 240 tons of ore were treated. The ore is ground and passed over a table and blanket-lined launder. The gross content of 2 tons of table and blanket concentrates produced and sold was 21.62 ounces of gold and 17 ounces of silver.

TAOS COUNTY

Red River district.—In 1935 the Molybdenum Corporation of America continued operations at 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.

Rio Grande River district.—Small sluicing operations on Rio Grande River west of Questa, one of which was in T. 28 N., R. 12 E., New Mexico principal meridian, yielded 7.08 fine ounces of gold and 3 fine ounces of silver in 1935.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN OREGON[1]

(MINE REPORT)

By CHARLES WHITE MERRILL AND H. M. GAYLORD

SUMMARY OUTLINE

The output of gold, silver, copper, and lead from Oregon ores, gravels, and re-treated tailings in 1935, in terms of recovered metals, is estimated as 52,920 fine ounces of gold valued at $1,852,200, 110,100 fine ounces of silver valued at $79,134, 397,000 pounds of copper valued at $32,951, and 60,000 pounds of lead valued at $2,400, or a total value of $1,966,685 for the four metals. No output of zinc was reported. In 1934 Oregon mines yielded 33,712 ounces of gold valued at $1,178,220, 46,560 ounces of silver valued at $30,099, 38,375 pounds of copper valued at $3,070, 41,603 pounds of lead valued at $1,539, and 73,184 pounds of zinc valued at $3,147—a total value of $1,216,075 for the five metals.

The quantity and value of all the metals except zinc increased substantially. Gold increased 57 percent in both quantity and value; silver increased 136 percent in quantity and 163 percent in value; copper increased 935 percent in quantity and 973 percent in value; and lead increased 44 percent in quantity and 56 percent in value. The value of the output of the four metals in 1935 increased 62 percent over that of the five metals in 1934. Moreover, the estimated value of the output in 1935 exceeded that for any year since 1918. Gold provided the principal revenue of the metal miners of Oregon; it accounted for 94 percent of the total value of the five metals in 1935. Baker County continued to be the leading metal producer of the State, but substantial outputs were also reported from Grant, Jackson, Josephine, and Lane Counties, and small yields of gold were reported from almost every other county in the State.

Placer mines in Oregon yielded approximately twice as much gold as lode mines in 1934, and early estimates indicate that approximately the same ratio continued into 1935. There were numerous placer operators, many of whom mined for only a few weeks or months because of the scarcity of water. On the other hand, large quantities of gold were produced by several dredging companies. Conventional

[1] Figures for 1935 are preliminary; detailed data with final revisions will be released later.

bucket dredges and several types of dragline outfits were used in 1935. The largest producers among the dredging companies were the Pioneer Gold Dredging Co. and the Sumpter Valley Dredging Co. in Baker County; Ferris & Marchbank, the Monarch Gold Dredging Co., and the Timms Gold Dredging Co. in Grant County; and the Rogue River Gold Co., which operated in Jackson County early in the year and in Josephine County later in the year. Hydraulic mining also accounted for an appreciable gold output during the year. The itinerant miner played an important part in the production of placer gold as in 1934. Most of this production was bought by the various mercantile organizations and banks of the State and found its way to the United States Mint through them. The leading placer-gold-producing counties were Baker, Grant, Jackson, and Josephine.

Mine production of gold, silver, copper, lead, and zinc in Oregon, 1931–35, in terms of recovered metals

Year	Gold (lode and placer)		Silver (lode and placer)		Copper		Lead		Zinc		Total value
	Fine ounces	Value	Fine ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
1931	15,350.10	$317,315	7,254	$2,104	1,700	$155	3,497	$129			$319,703
1932	19,861.21	410,568	8,616	2,430	32,199	2,029	7,917	238	12,061	$362	415,627
1933	20,239.66	517,326	20,760	7,266	11,453	733	9,379	347	12,290	516	526,188
1934	33,711.59	1,178,220	46,560	30,099	38,373	3,070	41,603	1,539	73,184	3,147	1,216,075
1935 [1]	52,920.00	1,852,200	110,100	79,134	397,000	32,951	60,000	2,400			1,966,685

[1] Figures subject to revision.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the figures given in the table that follows: Gold in 1931–32 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1835, to January 31, 1934;[2] in 1933 at $25.56 and in 1934 at $34.95, the average weighted yearly United States Government prices; and in 1935 at $35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1931–33 is the average New York price for bar silver; in 1934 the Treasury buying price for newly mined silver, $0.64646464+; and in 1935 the average weighted Treasury buying price for newly mined silver, $0.71875 per ounce. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of gold, silver, copper, lead, and zinc, 1931–35

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1931	[1] $20.67+	$0.290	$0.091	$0.037	$0.038
1932	[1] 20.67+	.282	.063	.030	.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044

[1] $20.671835. [2] $0.64646464.

[2] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

Gold.—The production of gold in Oregon in 1935 was estimated as 52,920 fine ounces valued at $1,852,200, an increase of 57 percent in quantity over 1934. Exact figures are not available as to the proportionate contributions of lode and placer mines, but sufficient data have been collected to indicate important increases during the year from both sources. In 1934 placer mines accounted for 66 percent of Oregon's gold output and lode mines 34 percent. Baker County continued to be the largest producer of lode gold in 1935, but important outputs were reported in Jackson, Josephine, Lane, and Grant Counties. In 1934 these five counties produced 95 percent of the lode gold in the State, and preliminary figures indicate that they will continue to account for an overwhelming proportion of the output in 1935. Most of the gold was derived from dry gold ore or from old tailings from the same type of ore, but a small amount was extracted from gold-silver and base-metal ores. Accurate information is not available as to the proportion of ore and old tailings treated by various metallurgical processes, but preliminary reports indicate the continued importance of smelting flotation concentrates, as well as amalgamation and direct smelting of crude ore.

Silver.—Silver production in Oregon is estimated as 110,100 fine ounces valued at $79,134 in 1935, compared with a production of 46,560 ounces valued at $30,099 in 1934. This represents an increase of 136 percent in quantity and 163 percent in value. The larger part of the production came from Baker County, where the Cornucopia Gold Mines, Inc., produced 78,142 fine ounces of silver, or 71 percent of the estimated total output for the State. Other important silver-producing counties were Grant, Jackson, and Lane. Most of the silver was derived from dry gold ores, but dry gold-silver and base-metal ores also made a substantial contribution; appreciable amounts of silver were recovered by the dredges.

Copper.—In 1935, 397,000 pounds of copper valued at $32,951 were produced in Oregon compared with 38,375 pounds valued at $3,070 in 1934; this is an increase of 935 percent in quantity and 973 percent in value. Most of the copper came from two mines in Baker County, the Balm Creek Gold Mining Co. and the Cornucopia Gold Mines, Inc., where it was derived from ores treated principally for their precious-metal content.

Lead.—The production of lead in Oregon in 1935 is estimated as 60,000 pounds valued at $2,400 compared with an output of 41,603 pounds valued at $1,539 in 1934, an increase of 44 percent in quantity and 56 percent in value. Over half of the lead came from two mines in Lane County, the Helena of the Helena Mines, Inc., and the Musick of the Minerals Exploration Co.

Zinc.—No zinc was reported as having been produced in Oregon in 1935, but 73,184 pounds valued at $3,147 were produced in the State during 1934. The entire 1934 output came from lead-zinc ore mines in Marion County.

MINING INDUSTRY

The production of gold comes so near to comprising the entire nonferrous metal-mining industry in Oregon that the higher price for gold has stimulated mining operations tremendously. A few large lode mines, operated almost exclusively for gold, and a few large dredges accounted for the larger part of Oregon's metal output. This small group of companies has also been an important factor in the purchase of supplies and the employment of labor. In proportion to their production, however, the small operations of itinerant miners employ many more men. Although precise figures are not yet available, it is obvious that the amount of labor per ounce of gold produced by such miners is very high. It is also true that virtually all their income is available for labor because their supplies are negligible aside from food.

Other important factors in employment in the mining industry have been prospecting, development, and preparation for operations of many properties idle before the price of gold was raised. It appears that the majority of such operations were at abandoned mines, but prospects and new discoveries also received the attention of practical mining men. There was little production and development for metals other than gold in Oregon in 1935.

METALLURGIC INDUSTRY

Data now available do not include much information on the metallurgic industry in Oregon during 1935. It appears, however, that virtually all the mills that were operating in 1934 continued to operate in 1935 and that several new mills were added. Some old mills were expanded and at some equipment was added so that new methods of treatment could be applied. Flotation seems to be the process most favored by operators building new plants or rehabilitating old ones. Lane and Baker Counties contained the principal milling operations.

EASTERN OREGON

Baker County.—Baker County continued to be the most important mining county in the State; it produced large quantities of gold from lode and placer mines and some silver and copper. In the Baker district production of placer gold was reported from the Washington Gulch property; the Highland mine was reopened and its mill rebuilt. In the Burnt River district the Record mill, using amalgamation and flotation, was started in June and continued for the rest of the year. An average of 20 men was reported as being employed, and over a thousand ounces of gold were recovered.

The principal operation in the Cornucopia district was that of the Cornucopia Gold Mines, Inc., which employed over 100 men a day throughout the year. This company treated ore and old tailings and produced concentrates in its flotation plant containing 8,897 ounces of gold and 78,142 ounces of silver. During the year about 5,000 feet of development work were done, including the driving of the new Coulter tunnel designed to tap the veins below the present workings and furnish drainage and improved underground transportation to the mine. Several other lode mines were operating and developing in the district, and considerable placer mining was done, particularly along Pine Creek. The Victory Mining Co. was reported to have shipped some placer gold. In the Eagle Creek district the Balm Creek Gold Mining Co. completed a 100-ton flotation plant and operated it during the latter half of the year. The Balm Creek mine, which was formerly known as the Oregon Copper Co., mined 13,526 tons of ore, 12,749 tons of which were treated in the company mill; the remainder was shipped as crude ore to a copper smelter. The mine yielded 2,120 ounces of gold, 1,065 ounces of silver, and concentrates containing 195,179 pounds of copper. No men were used underground prior to June, but at the end of the year 30 miners were employed, as well as an average of 20 men in the mill and at other points on the surface.

Development work was reported at the Basin mine where approximately 500 feet were driven, and camp and mine portal buildings were erected. Seventeen hundred tons of tailings were treated at the Sanger property. Some activity, both in production and re-equipping, was reported in the Greenhorn, Mormon Basin, and Sparta districts. The beginning of operations by the Sumpter Valley Gold Dredging Co. in the middle of the year marked the first large-scale dredging in the Sumpter district since 1922. Other activities in the district included a test run by a dragline and traction-dredge outfit, which reported satisfactory values but poor performance. In the Virtue district considerable work was done to reopen the old White Swan mine owned by the White Swan Gold, Inc. A new vertical shaft with two 4½- by 5-foot compartments was sunk, and a depth of 200 feet was reached at the end of the year. Drifts and crosscuts totaling 710 feet were also driven. Six miles of electric-power transmission line were built, and the property's machinery was electrified. All work was of a development nature, and no output of metals was recorded. Numerous small properties were developing and producing in the Weatherby district.

Grant County.—Grant County was one of the principal producers of placer gold in 1935; it also yielded considerable lode gold. Some gold was produced in the Canyon district, mostly from placer mines. On the John Day River, the Monarch Gold Dredging Co. operated a dredge throughout the year. The Ferris and Marchbank property had two Diesel-powered dragline outfits operating on stream gravel from May 31 until the close of the year. A large output of gold was reported. The John Day Placers working on the Marysville property recovered 108 ounces of gold by hydraulicking. There were many small operators in the district, particularly on the North Fork of the John Day River.

A large number of operators were reported as producing and doing development work in the Granite district. The Granite Gold Mining Co. operated a flotation plant in this area and shipped a number of tons of ore and concentrates having their principal value in gold. Small operations and development projects were carried on in the part of the Greenhorn district, which extends from Baker County.

Mining and development work were reported in the Oriental and Quartzburg districts. A number of operations were carried on in the Susanville district, the largest of which was that of the Timms Gold Dredging Co. on the Middle Fork of the John Day River. This company operated an electric dredge with a capacity of 2,000 cubic yards per 24 hours; an average of 20 men was reported employed throughout the year.

Malheur County.—No large operators were reported in Malheur County in 1935, but many small placer mines were worked. In addition, itinerant miners continued to be active in the Malheur and Mormon Basin districts.

Other counties.—Activity in the gold mines of Harney, Lake, Morrow, Umatilla, and Wheeler Counties continued in 1935. Most of the output was from placer properties; the total for these counties was very small.

WESTERN OREGON

Coos County.—The operations in Coos County were small in 1935. A number of active placer claims were reported along Johnson Creek. In the Rock Creek district a few men did development work, and 100 feet of tunnel were driven at the Independence mine. The Iron Dike property was sold to the Sound Gold Mining Co. near the end of the year.

Curry County.—The Patience mine produced 10 tons of ore from which over 300 ounces of gold were recovered by amalgamation and concentration. The concentrates were shipped to the Selby smelter. A small output of gold was reported in the Gold Beach district. The Sixes and the Cape Blanco beach areas had small operations. At the Higgins or Heustis mine in the Chetco district 4,600 tons of material were sluiced, using a hydraulic giant with a 150-foot head of water. The work was done largely for development purposes.

Douglas County.—The Chieftain mine in the Nugget district shipped 9 tons of concentrates containing 58 ounces of gold to the smelter at Tacoma. Output at the Huckleberry group in the Riddle district comprised 450 tons of ore, which was crushed and amalgamated in a small stamp mill; the concentrates produced were shipped to a smelter. Small placer outputs were reported along Coffee, Drew, Myrtle, Riddle, and Cow Creeks.

Jackson County.—Both placer and lode mines made Jackson County one of the principal gold producers of the State. The Ashland mine in the Ashland district produced a substantial quantity of lode gold. In the Gold Hill district the Black Channel property was operated until the middle of May; it yielded 118 fine ounces of gold with three giants. The El Sarena Mines, Inc., acquired the property formerly owned by the Pearl Mining Co. and built a 50-ton flotation mill during the summer. Production was small and of an experimental nature.

The Rogue River Gold Co. exhausted its gravel reserves on Foots Creek early in the year and moved and rebuilt its dredge on Grave Creek in time to start operations by fall. The Pacific States Mines, Inc., operating the Opp mine in the Jacksonville district, was one of the large producers of the county. Much work other than production was carried on at the mine, including the driving of 803 feet of headings and the installation of additional flotation equipment. The Jacksonville Gold Mining Co., Ltd., produced a small quantity of gold ore; the company treated 121 tons of custom material in addition to its own ore. Most of the work done at the Great I Am mine in the Upper Applegate district was of a development nature, but the mine also produced a small quantity of gold. A dragline dredge outfit was operated by the Rogue River Dredgers, Inc., in the Upper Applegate district. The Sterling Mines, Inc., hydraulicked on the Sterling mine early in the year, but installed a centrifugal concentrator with a Diesel-powered dragline excavator for mining, which was operated for 3 months in the fall.

Josephine County.—Josephine County continued to be among the leading producers of gold in 1935. Although substantial outputs were recorded from its lode properties, the bulk of the gold came from placer operations. Several small placer workings along the tributaries of the Illinois and the Rogue Rivers in the Althouse, Galice, Grants Pass, Greenback, Lower Applegate, and Waldo districts did much toward swelling the total. The Dean and Dean property in the Galice district reported a production of 75 ounces of gold during 60 to 70 days when water was available. The J. C. L. mine in the same district produced 3 tons of gold-bearing concentrates from less than 100 tons of ore. Twelve hundred feet of development workings were driven at this mine during the year. At the Last Chance mine 10,000 cubic yards of auriferous gravel were hydraulicked. Considerable rehabilitation and reconstruction were done on the Old Channel mine to bring it into larger production as a hydraulic operation during 1936. The Pacific Coast Gold, Inc., reported a small output of gold from the Forest Queen placer mine in the Grants Pass district. A small output was reported from the Blue Channel property in the Greenback district. Considerable mill construction was reported at the Greenback gold mine.

The Humdinger mine in the Lower Applegate district treated 212 tons of ore by amalgamation and concentration; 261 feet of development work was done. At the Hidden Treasure, Mount Lyon, and Mount Lyon Extension 390 tons of old tailings were cyanided for their gold and silver content. A small gasoline shovel was operated on stream gravel at the Leonard mine in the Waldo district. Considerable ancient conglomerate was treated by hydraulic mining in this district by the Waldo Placer Mining Co.

Lane County.—The Bohemia district was the principal producer in Lane County in 1935. The Evening Star Mines Co. operated a lode mine in the district. The Bohemia Gold Mines, Inc., built a 5-stamp mill during 1935 but did not treat any ore. The mill has a rated capacity of approximately 15 tons a 24-hour day and will use amalgamation and concentration; the builders are contemplating the addition of flotation. The Helena Mines, Inc., treated the output of the Helena property in its new 35-ton flotation mill that was built during the year. The Noonday property treated a little ore during the early months of 1935. A 10-stamp mill was built on the Musick property of the Minerals Exploration Co. during 1935. It is understood that the concentration tables were not used. The mine yielded a small tonnage of ore containing gold, silver, copper, lead, and zinc; a crew averaging 25 men was employed during the latter months of the year. The only other producing area was the Blue River district, where a number of small placer mines was operated. The Lucky Boy lode mine treated 234 tons of ore yielding 12½ tons of concentrates. A little development work was done.

Other counties.—Lincoln, Linn, and Marion Counties were productive in 1934, and reports indicated that mining activities continued into 1935.

GOLD, SILVER, COPPER, AND LEAD IN SOUTH DAKOTA

(MINE REPORT)

By Chas. W. Henderson and A. J. Martin

SUMMARY OUTLINE

Metal-mining history in South Dakota began with the discovery of placer gold in 1875 in the gravels of French Creek near the present site of Custer. Through 1935 metal mining has been confined to the three southwestern counties—Custer, Lawrence, and Pennington—in what is known as the Black Hills. In 1935 the metal mines of the State produced 567,230.20 fine ounces of gold, 151,047 fine ounces of silver, and 7,000 pounds of lead compared with an output in 1934 of 486,118.97 fine ounces of gold and 99,741 fine ounces of silver. The yield of gold in 1935 was the highest in any year on record; as usual, the bulk came from the Homestake mine at Lead, Lawrence County. This mine has been producing almost continously since 1876 and is the largest producer of gold in the United States. Of the 14 other producing lode mines in South Dakota in 1935, the Decorah-Portland-Two Johns-Ajax group of mines at Trojan and the Maitland in the Maitland district, both in Lawrence County, were the principal producers. Placer operations yielded 936.86 ounces of gold in 1935, compared with 1,080.20 ounces in 1934. The total production of gold, silver, copper, and lead (in terms of recovered metals) in South Dakota from the beginning of production in 1875 to the end of 1935, as compiled by Chas. W. Henderson, has been 16,469,364 ounces of gold, 8,386,026 ounces of silver, 195,691 pounds of copper, and 575,313 pounds of lead.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold in 1931–32 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1835, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95, the average weighted yearly United States Government prices;[1] and in 1935 at $35.00 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1931–33 is the average New York price for bar silver; in 1934 the Treasury buying price for newly

[1] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35.00 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

mined silver, \$0.64646464+; and in 1935 the average weighted Treasury buying price for newly mined silver, \$0.71875 per ounce. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of gold, silver, copper, lead, and zinc, 1931–35

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1931	[1] \$20.67+	\$0.290	\$0.091	\$0.037	\$0.038
1932	[1] 20.67+	.282	.063	.030	.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	[3] .718+	.083	.040	.044

[1] \$20.671835. [2] \$0.64646464. [3] \$0.71875.

Mine production of gold, silver, and lead in South Dakota, 1931–35, in terms of recovered metals [1]

Year	Mines producing			Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)		Lead		Total value
	Lode	Placer	Total		Fine ounces	Value	Fine ounces	Value	Pounds	Value	
1931	6	83	89	1,404,153	432,075.39	\$8,931,791	113,562	\$32,933			\$8,964,724
1932	8	217	225	1,409,893	480,337.58	9,929,459	126,195	35,587	7,000	\$210	9,965,256
1933	4	215	219	1,432,555	512,403.77	13,097,040	125,417	43,896			13,140,936
1934	8	258	266	1,520,669	486,118.97	16,989,858	99,741	64,479			17,054,337
1935	15	199	214	1,487,235	567,230.20	19,853,057	151,047	108,565	7,000	280	19,961,902

[1] For total production of gold and silver in South Dakota, by years, see Henderson, Chas. W., Mineral Resources, 1913, pt. I, p. 42; Mineral Resources, 1922, pt. I, p. 194; and subsequent volumes of Mineral Resources and Minerals Yearbook.

Gold and silver produced at placer mines in South Dakota, 1931–35, in terms of recovered metals

Year	Gold		Silver		Total value
	Fine ounces	Value	Fine ounces	Value	
1931	96.17	\$1,988			\$1,988
1932	1,095.16	22,639	85	\$24	22,663
1933	1,269.75	32,455	97	34	32,489
1934	1,080.20	37,753	85	55	37,808
1935	936.86	32,790	103	74	32,864

Gold and silver produced at placer mines in South Dakota in 1935, by counties, in fine ounces

County	Sluicing and hydraulic		Dry land dredges [1]		Total	
	Gold	Silver	Gold	Silver	Gold	Silver
Custer	43.57	2	416.26	31	459.83	33
Lawrence	137.32	18	129.25	37	266.57	55
Pennington	210.46	15			210.46	15
	391.35	35	545.51	68	936.86	103
Total, 1934	508.45	44	571.75	41	1,080.20	85

[1] Includes drag-line and power-shovel excavators with sluices or special amalgamators.

MINING AND METALLURGIC INDUSTRY

With the exception of 30 tons of lead-silver-gold ore to smelters, all the ores mined in South Dakota in 1935 were classed as dry gold ores, of which 1,381,213 tons were treated by amalgamation followed by cyanidation of sands and slimes, 104,431 tons by cyanidation only, 961 tons by amalgamation only, and 600 tons by amalgamation and flotation concentration (only 5 tons of concentrates produced). 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, 1931–35

Year	Ore treated	Gold in bullion	Silver in bullion	Quicksilver used
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*
1931	1,404,106	288,155.99	67,857	15,305
1932	1,402,275	310,637.81	72,639	7,633
1933	1,432,555	328,449.02	71,985	29,410
1934	1,441,052	310,941.73	58,086	9,663
1935	1,382,774	335,553.97	75,858	15,550

Gold and silver bullion produced at mills in South Dakota by cyanidation, 1931–35

Year	Material treated			Gold in bullion product	Silver in bullion product	Sodium cyanide used [1]
	Crude ore	Sands and slimes	Total			
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*
1931	47	1,400,191	1,400,238	143,823.23	45,705	375,535
1932		1,396,330	1,396,330	168,561.00	50,166	437,773
1933		1,430,738	1,430,738	182,685.00	53,335	447,172
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	[2] 686,625

[1] In terms of 96- to 98-percent strength.
[2] Actually 1,361,579 pounds of cyanamid (49-percent strength) and 5,835 pounds of sodium cyanide (96- to 98-percent strength); cyanamid 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

Mine production of gold and silver in Custer County, S. Dak., 1931–35, in terms of recovered metals

Year	Mines producing		Ore	Gold (lode and placer)		Silver (lode and placer)	Total value
	Lode	Placer					
			Short tons	*Fine ounces*		*Fine ounces*	
1931		41		45.57	$942		$942
1932		80		697.81	14,425	50	14,439
1933		52		893.63	22,841	57	22,861
1934		44		528.81	18,482	34	18,504
1935	2	34	120	468.85	16,410	35	16,435

Placer operations on French Creek in the Custer district produced nearly all the metal output from Custer County in 1935. At the C. Palmer placer, one-half mile west of Custer, equipment consisting of two dragline excavators and a land-dredge sluicing installation handled 7,000 yards of gravel and recovered 178.63 fine ounces of gold and 13 fine ounces of silver. Similar sluicing equipment and one dragline were used at each of the two other principal producers—the Dorothy Van and Dickey placers. Some output was made from the Grand Hills Mining Co. placer, operated for a short period during the year. Small lots of placer gold were recovered by individual sluicing and panning operations on French Creek.

A little gold was produced during test runs made on ore taken from a gloryhole at the Penobscot lode mine, but the operators abandoned the project after the runs had been completed. The only other output from lode mines in Custer County in 1935 was a small quantity of gold bullion produced in a small stamp mill at the Old Bill mine.

LAWRENCE COUNTY

Mine production of gold, silver, and lead in Lawrence County, S. Dak., 1931–35, in terms of recovered metals

Year	Mines producing		Ore	Gold (lode and placer)		Silver (lode and placer)	Lead	Total value
	Lode	Placer						
			Short tons	*Fine ounces*		*Fine ounces*	*Pounds*	
1931	2	22	1,403,964	431,916.77	$8,928,512	113,507		$8,961,429
1932	3	17	1,409,211	479,300.90	9,908,029	126,103	7,000	9,943,800
1933	3	21	1,432,285	511,289.36	13,068,556	125,340		13,112,425
1934	4	43	1,520,578	485,223.18	16,958,550	99,680		17,022,990
1935	6	30	1,486,274	566,194.66	19,816,813	150,940	7,000	19,925,581

Homestake mine.—The Homestake mine and mills were operated continuously in 1935. The authorized new 5,000-foot, 3-compartment, 13- by 19-foot Ross shaft, begun in December 1932 to open the mine to a greater depth, reached the 3,650-foot level in 1935 and was completed and timbered to the 3,500-foot level. Hoisting of ore through the shaft was begun in November 1934, when it was operated to the 2,900-foot level. In 1935, an additional level at 3,150 feet was opened and served by the shaft. Other development work done in the mine during the year consisted of 22,187 feet of drifts, 7,341 feet of raises, and 12,004 feet of diamond drilling. Primary crushing of the ore hoisted through the Ross shaft was done on the surface at the shaft. At the Ellison shaft, the only other shaft used during 1935, primary crushing was done in the mine.

The main milling plant of the Homestake mine was the South mill, with a capacity of 3,900 tons per 24 hours. Here was done all the secondary crushing (by stamps), all the primary and nearly all the secondary grinding, all amalgamating, and part of the classifying. Three other mills—cyanide sand plant No. 1, cyanide sand plant No. 3, and the slime plant—with a combined capacity of 4,000 tons per 24 hours, completed classification and accomplished separate cyanidation of sands and slimes. The equipment of the South mill as of January 28, 1935, was given in Minerals Yearbook, 1935 (p. 309), and had not been changed materially up to February 4, 1936. Ore from the Homestake mine to the company mills totaled 1,379,163 tons in 1935, a decrease of 61,529 tons from 1934; but the ore mined in 1935 was of higher grade, and revenue from the sale of gold-silver bullion and a small quantity of assay laboratory slag was $19,191,013.19—$2,675,-329 more than in 1934. Dividends paid in 1935 were $14,064,960. From 1876 to 1935, inclusive, this mine yielded bullion and concentrates that brought a cash return of $302,001,503 after freight, express, insurance, mint, and smelter charges were deducted; the company has paid $88,020,442 in dividends.

The annual report of the general manager of the Homestake Mining Co. for the year ended December 31, 1935, says:

Production of ore from the mine during 1935 was maintained at a normal rate. Gross income from gold and silver produced was higher than for any previous year in the life of the mine.

The mine and treatment plants are in excellent condition. Production for 1936 comparable to 1935 may be expected.

Following is a condensed report of the mine engineer:

There are 205,441 tons of ore broken down and remaining in the stopes.

There are 14,918,132 tons of ore blocked out and remaining in the mine.

The Ross Shaft is completed and timbered to the 3,500-foot level. The full-size shaft has been excavated to the 3,650-foot level except for a 20-foot bulkhead below the 3,500-foot level. Only a part of the section between the 3,500-foot and 3,650-foot levels has been timbered.

The No. 2 winze is 136 feet below the 3,800-foot level.

Construction of the Kirk power plant is completed and the plant is now in operation.

Power from the hydro plants continues below normal owing to the subnormal rainfall.

Ore milled, receipts, and dividends, Homestake mine, 1931–35 [1]

Year	Ore milled	Receipts for bullion product		Dividends
		Total	Per ton	
	Short tons			
1931	1,403,939	$8,935,307.15	$6.3645	$2,122,302
1932	1,401,593	9,911,858.40	7.0719	2,662,296
1933	1,432,195	12,900,316.78	9.0074	3,767,400
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

[1] From 1876 to 1935, inclusive, this mine yielded bullion and concentrates which brought $302,001,503 and paid $88,020,442 in dividends.

Other mines.—The Bald Mountain Mining Co. operated its Decorah-Portland-Two Johns-Ajax group of mines and 250-ton all-sliming cyanide plant in the Bald Mountain area throughout 1935 and was the second largest producer of gold and silver in the State. The company did 2,168 feet of development work in the mine during the year and added a ball mill and Dorr classifier to its mill equipment, which on February 6, 1936, consisted of one Gates No. 5–K crusher, two 6- by 6-foot ball mills, one 5- by 8-foot ball mill, two Dorr duplex classifiers, one Dorr 10-inch bowl classifier, three Portland filters, five agitation tanks, five thickening tanks, and Merrill-Crowe precipitation equipment.

In May 1935 the Canyon Corporation completed the remodeling of the old mill at the Maitland mine in the Maitland district 3 miles northwest of Blacktail to a 110-ton roasting and cyanidation mill designed to treat the "blue ores" of that property (gold in a siliceous gangue with pyrite and arsenopyrite). The mill equipment installed included one Gates No. 5–K crusher, one 2-foot Symons crusher, one Marcy ball mill, one Dorr classifier, one 54-spindle Edwards 13- by 116-foot hearth roaster, two Dorr agitation tanks, five thickening tanks, and Merrill-Crowe precipitation equipment. The mill treated a daily average of 108 tons of ore during the latter half of 1935. The mine is opened by a vertical shaft with stations at the 220- and 320-foot levels. Development work done in 1935 totaled 1,009 feet.

At the Monarch mine in the Two Bit district the Black Hills Mining Corporation drove 2,000 feet of drifts and extracted 2,050 tons of "brown" gold ore, which it treated in its 25-ton cyanide mill built in 1932–33. The mill as originally built used the all-sliming method, but in 1935 corduroy placed between the classifier and thickener recovered 7 percent of the gold.

During part of 1935 the New Deal Mining Co. operated a 10-ton stamp mill, built in 1934, at its property at the head of Gimlet Creek. A car of lead ore was shipped from the Comet Queen mine at Pluma to the smelter at East Helena, Mont. At the old Clover Leaf property in the Bear Butte district, the Anaconda Mining & Milling Co., which in 1934–35, after partial success in its unwatering project, had abandoned the old steam pumps, installed in September 1935 two Diesel engines of 350 horsepower each with direct-connected electric generators. Two electric pumps were installed. Air lift also was used. By December 31 water was down to the 600-foot level. The shaft is 700 feet deep.

Placer gold was produced in Lawrence County in 1935 by a dragline and sluicing operation on Whitewood Gulch and by individuals sluicing and panning in Blacktail Gulch and on Two Bit and Whitewood Creeks in the central and eastern part of the county and on Iron and Potato Creeks in the Rawlings district.

PENNINGTON COUNTY

Mine production of gold and silver in Pennington County, S. Dak., 1931–35, in terms of recovered metals

Year	Mines producing		Ore	Gold (lode and placer)		Silver (lode and placer)	Total value
	Lode	Placer					
			Short tons	*Fine ounces*		*Fine ounces*	
1931	4	20	189	113.05	$2,337	55	$2,353
1932	5	120	682	338.87	7,005	42	7,017
1933	1	142	270	220.78	5,643	20	5,650
1934	4	171	91	366.98	12,826	27	12,843
1935	7	135	841	566.69	19,834	72	19,886

At the Golden Slipper mine the Empire Gold Mines, Inc., did development work consisting of 4,000 feet of drifting, raising, and sinking and erected a 100-ton amalgamation-flotation concentration mill in 1935. Ore extracted and treated for test runs of the mill yielded the larger part of the output of gold from lode mines in Pennington County during the year. The two owners of the Western Bell mine operated their mine and 4-ton stamp mill intermittently. Other lode mines in the county that produced amalgamation bullion from small-scale operations were the Doctor No. 2, Dolcoad, Greenback, Hornblende, and Sunbeam. Many small sluicing operations, chiefly on Castle, Rapid, and Spring Creeks, produced placer gold.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN TEXAS

(MINE REPORT)

By Chas. W. Henderson and A. J. Martin

SUMMARY OUTLINE

From 1885 through 1935 silver has been the most valuable metal produced in Texas, and most of the output has come from the Presidio mine in Presidio County, which since April 1926 has been the property of the American Metal Co. Through the recovery of a little gold and lead with the silver this mine has also been the largest producer of these metals in the State. The mine was operated continuously in 1935. The Hazel mine in Culberson County yielded most of the output of copper in the State during the year. Several other mines and prospects in the two counties named and in Hudspeth County were active during 1935, but their output was not large.

The total production of gold, silver, copper, lead, and zinc in Texas (in terms of recovered metals) from the beginning of production in 1885 to the end of 1935, according to Henderson,[1] has been 5,485 fine ounces of gold, 24,629,507 fine ounces of silver, 1,366,960 pounds of copper, 5,543,126 pounds of lead, and 1,488,474 pounds of zinc.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the figures given in the table that follows: Gold in 1931–32 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1835, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95, the average weighted yearly United States Government prices;[2] and in 1935 at $35.00 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1931–33 is the average New York price for bar silver; in 1934 the Treasury buying price for newly mined silver, $0.64646464+; and in 1935 the average weighted Treasury buying price for newly mined silver, $0.71875 per ounce. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

[1] For production from 1885 to 1927 and prices used in calculating values see Henderson, Chas. W., Mineral Resources, 1927, pt. I, pp. 477–478. *See also* Henderson, Chas. W., Mineral Resources, 1914, pt. I, p. 236.

[2] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35.00 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

Prices of gold, silver, copper, lead, and zinc, 1931–35

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1931	[1] $20.67+	$0.290	$0.091	$0.037	$0.038
1932	[1] 20.67+	.282	.063	.030	.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	[3] .718+	.083	.040	.044

[1] $20.671835. [2] $0.64646464. [3] $0.71875.

MINE PRODUCTION

Mine production of gold, silver, copper, and lead in Texas, 1931–35, in terms of recovered metals [1]

Year	Ore (short tons)	Gold		Silver		Copper		Lead		Total value
		Fine ounces	Value	Fine ounces	Value	Pounds	Value	Pounds	Value	
1932	185	8.66	$179	1,422	$401	7,000	$441	34,000	$1,020	$2,041
1933	63			160	56	2,000	128	6,000	222	406
1934	47,680	358.74	12,538	854,442	552,367	29,000	2,320	719,000	26,603	593,828
1935	72,222	518.00	18,130	1,000,960	719,440	28,000	2,324	1,043,000	41,720	781,614

[1] No production in 1931.

Mine production of gold, silver, copper, and lead in Texas in 1935, by counties, in terms of recovered metals

County	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Culberson	3	1,487	0.40	14,830	25,600	10,100
Hudspeth	7	345	19.20	5,863	2,150	41,100
Presidio	4	70,390	498.40	980,267	250	991,800
	14	72,222	518.00	1,000,960	28,000	1,043,000

REVIEW BY COUNTIES

Culberson County.—In 1935 silver-copper ore from the Hazel mine 14 miles north of Van Horn was shipped to the Peru mill at Deming, N. Mex., where it was concentrated as custom ore. The copper-silver concentrates made were shipped to the El Paso smelter. Shipments of crude ore also were made direct from the mine to the El Paso smelter. The other output of the county comprised two cars of copper-lead-silver ore shipped to the El Paso smelter, one from the Pecos mine and one from another property.

El Paso County.—At El Paso are the lead and copper plants of the American Smelting & Refining Co. At the end of 1935 the copper works consisted of two reverberators, with a total annual capacity of 600,000 tons of ore, and three converters; the lead plant was equipped with three furnaces having a total annual capacity of 200,000 tons. The lead plant treats lead ore and concentrates from Arizona, New Mexico, and Texas and lead ore in bond from Mexico. The copper plant was built originally in 1910 to handle copper concentrates from Chino Mines (closed in October 1934 for an indefinite period) at Santa Rita, N. Mex.; it also receives copper ore and concentrates from Arizona. Natural gas for fuel was introduced in these plants in 1930.[3] Both plants were operated intermittently in 1935.

[3] Marble, E. R., Natural-Gas Firing at El Paso Smelting Works: Min. and Met., October 1930, pp 466–467.

The Nichols electrolytic copper refinery, also at El Paso, was completed and set in operation in 1930 to treat copper anodes produced at the Arizona smelters of the Phelps Dodge Corporation and the Calumet and Arizona Mining Co. The yearly capacity is 100,000 tons of anodes.[4] The plant was not operated at full capacity during 1935.

Hudspeth County.—Several cars of lead-silver and copper-lead-silver ore were shipped to the El Paso smelter from mines and prospects near Sierra Blanca in 1935.

Presidio County.—The American Metal Co. operated its mill at Shafter for 365 days in 1935 at a daily average of 192 tons on ore from its Presidio mine. The mine is opened by two vertical shafts, one 400 feet and one 700 feet deep, and six levels aggregating about 50 miles of underground workings. In all, 10,339 feet of drifts, raises, and crosscuts were driven and 19,848 feet of diamond drilling done in 1935. 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. It is brought to the mill by a 1-mile aerial tramway, crushed to one-quarter inch, and ground to minus 65-mesh; the product is concentrated by gravity, and the slimes are cyanided. New equipment, consisting of one 8-foot by 36-inch Hardinge ball mill, one 8-foot Dorr classifier, and two 50-foot Dorr thickeners, was added to the mill which, with complete mill electrification by the installation of a 750-hp. Diesel plant, enabled the company to increase production from 175 tons to 275 tons a day on December 1, 1935.

Production of silver from the Presidio mine,[1] 1885–1935 [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	[3] 91.41	[3] 1,004,384
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		19,916,747
1930	24,985	(?)	(?)	(?)	365,439
1934	46,653	19.70	919,064	91.39	839,936
1935	70,166	(?)	(?)	(?)	978,303
Total, 1885–1935	1,472,113	(?)	(?)	(?)	22,100,425

[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.
[3] Using the company's 1927 report of 1,004,384 ounces of silver recovered gives 91.13 percent recovery; using 91.41 percent (Howbert and Gray, work cited, p. 6) as recovery gives 1,007,434 ounces of silver recovered.

The output from other mines in Presidio County comprised 153 tons of lead-silver-gold ore from the Chinati mine near Shafter, 32 tons from the Solitaire mine in Fresno Canyon, and 39 tons from another property in the Shafter district.

[4] Robie, E. H., A Trip Through the New Nichols Copper Refinery at El Paso, Tex.: Eng. and Min. Jour., vol. 129, January 1930, pp. 5–10; Furnace and Casting Equipment of the New Nichols Refinery: Eng. and Min. Jour., vol. 129, January 1930, pp. 73–76.
Corwin, F. R., and Harloff, C. S., El Paso Refinery of the Nichols Copper Co.: Min. and Met., October 1930, pp. 459–465.

GOLD, SILVER, COPPER, AND LEAD IN WYOMING

(MINE REPORT)

By Chas. W. Henderson and A. J. Martin

SUMMARY OUTLINE

Wyoming metal mines produced, in terms of recovered metals, 3,715.00 fine ounces of gold, 1,152 fine ounces of silver, 1,000 pounds of copper, and 5,000 pounds of lead in 1935 compared with 4,871.36 ounces of gold, 710 ounces of silver, 3,500 pounds of copper, and 2,000 pounds of lead in 1934. Gold constituted 99 percent of the total value of the four metals in 1935 and came chiefly from the Atlantic City district, Fremont County. There were 10 producing lode mines, as in 1934, and 38 placers compared with 41 in 1934.

The total recorded production of gold, silver, copper, and lead (in terms of recovered metals) in Wyoming from 1867 to 1935, inclusive, according to Chas. W. Henderson, has been 71,551 fine ounces of gold, 72,653 fine ounces of silver, 32,638,059 pounds of copper, and 16,800 pounds of lead.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the figures given in the table that follows: Gold in 1931–32 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1835, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95, the average weighted yearly United States Government prices [1]; and in 1935 at $35.00 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1931–33 is the average New York price for bar silver; in 1934 the Treasury buying price for newly mined silver, $0.64646464+; and in 1935 the average weighted Treasury buying price for newly mined silver, $0.71875 per ounce. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

[1] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35.00 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

Prices of gold, silver, copper, lead, and zinc, 1931–35

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1931	[1] $20.67+	$0.290	$0.091	$0.037	$0.038
1932	[1] 20.67+	.282	.063	.030	.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	[3] .718+	.083	.040	.044

[1] $20.671835. [2] $0.64646464. [3] $0.71875.

Mine production of gold, silver, copper, and lead in Wyoming, 1931–35, 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	
1931	23	56.36	$1,165	17	$5	9,000	$819	--------	--------	$1,989
1932	640	256.63	5,305	195	55	397	25	9,800	$294	5,679
1933	1,071	2,199.95	56,231	260	91	--------	--------	--------	--------	56,322
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

Mine production of gold, silver, copper, and lead in Wyoming in 1935, by counties, in terms of recovered metals

County	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	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*	
Albany and Carbon [1]	5	9	145	28.86	369.71	398.57	185	39	224	1,000	5,000	$14,394
Big Horn	----	3	------	--------	9.32	9.32	------	------	------	--------	--------	326
Fremont	4	18	4,041	980.20	2,310.00	3,290.20	168	312	480	--------	--------	115,502
Park	1	4	4	.74	11.88	12.62	447	1	448	--------	--------	764
Teton	----	4	------	--------	4.29	4.29	------	------	------	--------	--------	150
	10	38	4,190	1,009.80	2,705.20	3,715.00	800	352	1,152	1,000	5,000	131,136

[1] Combined to avoid disclosing metal production of one operator in Carbon County.

REVIEW BY COUNTIES AND DISTRICTS

ALBANY COUNTY

Centennial district.—In 1935 a small lot of gold concentrates, produced during test runs of the 35-ton concentrating mill at the Utopia group of claims 1 mile west of Centennial, was sold to the Golden Cycle mill at Colorado Springs.

Douglas Creek district (Holmes, Keystone).—The Medicine Bow Mining Corporation installed a dragline excavator and floating washing plant at the Home placer on Douglas Creek and handled 48,176 cubic yards of gravel from May 25 to September 14, 1935. Clean-ups from this operation yielded 286.84 fine ounces of gold and 34 fine ounces of silver. Small lots of placer gold were recovered by sluicing operations on Douglas and Little Beaver Creeks. At the Lucky Strike lode claim, opened by a 35-foot shaft, 20 tons of ore were mined and transported to the Utopia mill at Centennial for treatment. The ore was reduced to 1½ tons of gold concentrates which, with 2 tons of crude ore, were shipped to the Golden Cycle mill at Colorado Springs.

BIG HORN COUNTY

Individual sluicing operations on the Big Horn River yielded small lots of placer gold in 1935.

CARBON COUNTY

The operator of the Mohawk and Acme claims in the Gold Hill district, in secs. 15 and 16, T. 16 N., R. 80 W., sixth principal meridian, treated 70 tons of ore, which yielded 19.47 fine ounces of gold, in a 7-ton stamp mill with amalgamating plates. Other producing lode mines in Carbon County in 1935 were the King in the Seminoe district and the Meta in the Bridger district. The dry-land dredge on Sawmill Creek was operated for about 6 weeks, yielding gold 0.913 fine. Small sluicing operations were carried on by individuals on Spring and Savery Creeks.

FREMONT COUNTY

Atlantic City district.—The bulk of the output of gold and silver from Wyoming mines in 1935 came from five placer operations in the Atlantic City district—four on Rock Creek and one on Willow Creek. Each had a gasoline-powered dragline excavator and portable screening and sluicing equipment. The largest producer was the E. T. Fisher Co.[2] on Rock Creek, which was operated for its third season. The Fisher apparatus consists of a 1½-cubic yard dragline bucket; a washing, screening, and amalgamation plant; a pumping plant, which in 1935 was placed aboard the main plant and took water from a sump fed from the drain ditch instead of through a pipe line as before; and a conveyor belt and adjustable sluices—all mounted on rail tracks and pulled ahead by the power of the dragline. The other four operators were the Jett-Ross Mines, Inc., Colorado-Wyoming Placer Co., and Fremont Placer Co., on Rock Creek; and H. J. Arbogast, on Willow Creek. Small-scale sluicing operations by individuals contributed to the total yield from placers.

The principal producer from lode mines was the Iron Duke Mining Co., which in 1935 sank a 100-foot shaft and drove 100 feet of drifts at the Iron Duke-Hidden Hand group. The ore produced was sold to the Midvale (Utah) smelter. The Duncan mine and milling plant were operated intermittently. The products of the mill were amalgamation bullion, which was sold to the Denver Mint, and gold concentrates, which were sold to the Midvale (Utah) smelter. A few test runs were made at the Gold Dollar mill to test its efficiency in recovering the metal contained in the ores of the Gold Dollar group. The owner of the R. J. Reynolds group recovered gold from small, rich pockets by hand chiseling and pounding the ore.

[2] Ross, Charles L., and Gardner, E. D., Placer-Mining Methods of E. T. Fisher Co., Atlantic City, Wyo.: Inf. Circ. 6846, Bureau of Mines, 1935, 11 pp.

PARK COUNTY

Lessees of the Little Johnnie mine in the Kirwin district about 70 miles southwest of Cody cleaned out an old tunnel and extracted 4 tons of ore which were packed on horses to a highway and then hauled to the East Helena (Mont.) smelter. The ore contained 0.74 ounce of gold and 447 ounces of silver. Sluicing operations carried on by individuals on Clark Fork south of the Montana-Wyoming boundary line yielded small lots of placer gold.

TETON COUNTY

Two placer miners sluicing on Snake River and one on the Gros Ventre River produced placer gold totaling 2.58 ounces.

SECONDARY METALS

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 $155,036,800 in 1935, $27,750,700 more than in 1934; the total quantity increased 170,000 short tons. The increase in total value was due partly to higher average prices for copper, zinc, lead, and antimony, but the recovery of secondary copper, lead, tin, aluminum, antimony, zinc, and nickel also increased.

Secondary metals of certain classes recovered in the United States, 1934–35

	1934		1935	
	Short tons	Value	Short tons	Value
Copper, including that in alloys other than brass	292,500	$46,800,000	364,300	$60,473,800
Brass scrap re-treated	121,300	16,078,000	120,800	16,683,600
Lead as metal	124,500	15,421,600	156,800	21,632,000
Lead in alloys	83,900		113,600	
Zinc as metal	29,300	3,225,000	55,400	5,662,800
Zinc in alloys other than brass	8,200		8,950	
Tin as metal	8,250	25,487,600	9,600	27,498,200
Tin in alloys and chemical compounds	16,650		18,300	
Aluminum as metal	21,000	17,632,000	23,500	19,018,000
Aluminum in alloys	25,400		27,900	
Antimony as metal and in alloys	7,550	1,346,900	9,600	2,703,400
Nickel as metal	550	1,295,000	700	1,365,000
Nickel in nonferrous alloys and salts	1,300		1,250	
Total	740,400	127,286,100	910,700	155,036,800

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 from waste material vary in purity and in adaptability to use in making certain products. The figures furnished by producers cover seven metals—secondary copper, lead, zinc, tin, aluminum, antimony, and nickel—and supplement those on the primary metals.

[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.

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 more valuable in the future.

The variety of waste material (especially metallic wastes), 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 cover the subject of secondary metals and refer to many articles relating to secondary metals recovered.

The members of The National Association of Waste Material Dealers, Inc., are concerned over a growing tendency on the part of the large custom smelters to eliminate large wholesale dealers in scrap metals by buying as much scrap as possible directly from industrial plants or from the small dealers who buy from the peddlers.

The following paper on the importance of secondary metals presented at the twenty-third annual convention of the Association in New York on March 16, 1936, by Elmer W. Pehrson, of the United States Bureau of Mines, was received most favorably.

No better proof of the present importance of secondary metals in our national economy is required beyond the statement that here in the United States the value of metals reclaimed annually from scrap rivals the value of virgin metals won from the ground. In 1929 the value of metals recovered in the United States from materials entering the waste trade approximated 1 billion dollars, and seldom, indeed, has the annual value of the domestic output of primary metals, including pig iron, exceeded this total. Even in the boom year, 1929, the value of American metal-mine products fell short of 1½ billion dollars, while during some of the depression years the salavge of scrap metals has actually exceeded the output from primary sources.

I need not tell you that an industry of this size provides livelihood directly for tens of thousands of workers, that it supplies the railroads with millions of tons of freight, or that it also provides a useful and profitable outlet for capital. It suffices to say that in 1929 class I railroads collected freight revenues from iron and steel scrap alone to the value of nearly 30 million dollars. You are also familiar with the subject of conservation of our national resources. The reclamation of waste metals already has added decades to the lives of our mines, and when our ore reserves approach exhaustion this aspect of the scrap business will become even more vital, since it concerns not only our industrial prosperity but also our ability to cope with any military emergency that might arise. In the unfortunate event of war emergency the value of sample reserve of scrap and of a well-organized industry for pouring this material efficiently into munition plants can scarcely be underestimated. We must realize, on the other hand, that the conservation features of scrap-metal recovery are not so much altruistic as they are economic. Scrap normally can be used as raw material only when it costs no more than an equivalent amount of new metal derived from ore. Often it may not pay even to collect material that lies close at hand.

Scrap stocks stabilize metal prices.—Economists will tell you also that your industry exerts a stabilizing influence on metal prices. The stocks of scrap in brokers' and dealers' hands constitute in the aggregate a huge reservoir of metals. When prices are high supplies tend to flow out of this reservoir more freely. When prices come down the flow diminishes, and if they go down far enough the flow into the reservoir may be reduced temporarily because the material is not worth bringing to the dealers' yards.

The magnitude of your industry is revealed best by the enormous tonnages produced each year and by the steady increase in the ratio of secondary to primary metal production. Before taking up this subject in detail, however, I should like to dwell for a few moments on the historical incidents that have contributed to develop your industry to the outstanding position it now occupies. No one seems to have paid much attention to scrap as a factor in the metal market until the late 80's, when it played a leading role in the collapse of the Secretan copper syndicate. Encouraged by a sharp drop in copper prices, a group of French financiers undertook to corner the world market and then to sell out their holdings at an increased price. The scheme probably would have worked had it not been for two sources of weakness. It failed to take into account, first, the large potential production from scrap and, second, the rapid development of new mines in western United States. The syndicate, being unable to absorb all the copper that poured in from these sources, eventually collapsed.

Government interested.—Public attention again was focused on the scrap-metal industry through the report of the National Conservation Commission in 1909. This Commission, which was created to study the extent of our natural resources and the wastes accompanying their utilization, resulted from the fear that the consumption of metals and fuels was increasing at a rate that threatened early depletion of known mineral deposits. Its report pointed out that mining and smelting in effect merely transferred our resources from the form of ore to that of metal and, accordingly, that conservation should be exercised not only in mining metals but in utilizing them. About this same time, too, the Government began to collect annual production statistics for secondary nonferrous metals.

The next important step in the development of the secondary metal industry was the organization of a metals division of the National Association of Waste Material Dealers in 1914. This organization, under the able direction of Charles M. Haskins, imposed self-government on the scrap-metal trade, improving greatly the ethics of the business and increasing the efficiency of scrap-metal recovery by providing standard classifications for scrap. The accomplishments of your organization in these directions, together with the fact that it was one of the pioneers in the movement of self-government in industry, is a record to which you can point with pride. Those of you who have contributed to this work should feel amply repaid for the energy expended in behalf of the association.

The World War added greatly to the prestige of secondary metals. When facilities for the production of primary metals were taxed to the limit, your industry was able to contribute a larger portion of our metal requirements. At this time, too, technical control was introduced at many of the larger secondary smelters, enabling products of better and more consistent quality to be put on the market. As this practice became more general, an increasing number of official specifications ceased to designate virgin or primary metal; and as consumers gradually became accustomed to buying metals on specification, the prejudice formerly attached to secondary metals virtually disappeared. The statement that only virgin metal is used in a product has lost its appeal as a sales argument.

Primary smelters enter the field.—During the twenties the larger producers of primary metal began to realize that they could use scrap advantageously in their own plants, particularly as large quantities were then available at attractive prices. Moreover, many of the larger companies already had entered the fabricating business and were facing the problem of disposing of their own plant scrap. As the primary producers entered the secondary metal business on a large scale, they not only provided facilities for treating scrap at their own plants but also acquired existing secondary plants. Today most of the large primary producers are actively engaged in the production of secondary metals also.

A result of this development is that the larger smelters are able now to take back waste products from customers to whom they supply refined metals and are also purchasing scrap direct from producers, thereby depriving secondary dealers and smelters of a considerable volume of business and causing hardship in some parts of your industry.

Secondary metals worth a billion dollars a year.—Available statistics do not permit me to show just how rapidly the steady increase in prestige of the secondary metal industry has been reflected in total volume of sales. The main reason is lack of statistics on scrap iron and steel, which account for approximately half of the total value of secondary metal production. The government figures, however, do show that the value of production in the peak year 1929 was approximately as follows:

Iron and steel scrap valued as the equivalent of pig iron	$443,000,000
Nonferrous industrial metals	331,000,000
Gold and silver	29,000,000
Platinum	3,000,000
	806,000,000

This total is incomplete. It is confined principally to metals recovered from waste materials by remelting and so fails to include not only the large volume of articles recovered from the waste trade and reused with little or no change in form but even much of the secondary metal used in the manufacture of chemicals.

The estimate of at least one billion dollars is a conservative one, for it allows only 25 percent for the obvious omissions in these official figures. You will note, also, that so far I have not mentioned the value of metals recovered from scrap reworked in the same plant wherein it originated; such material does not enter the waste trade and accordingly cannot be credited to your industry. I mention it now merely because this home scrap cycle is just as important from the standpoint of national metal supplies as metal recovered from commercial scrap. When casting, forging, and rolling operations are conducted in the same plant as the smelting or refining, the resulting scrap naturally goes back again to the same furnaces and the only difference between much of this home scrap and commercial scrap is that no change of ownership occurs. I realize that this statement tends to make the problem appear much simpler than it really is, but I have not time to go into the matter of closed circuits either in individual plants

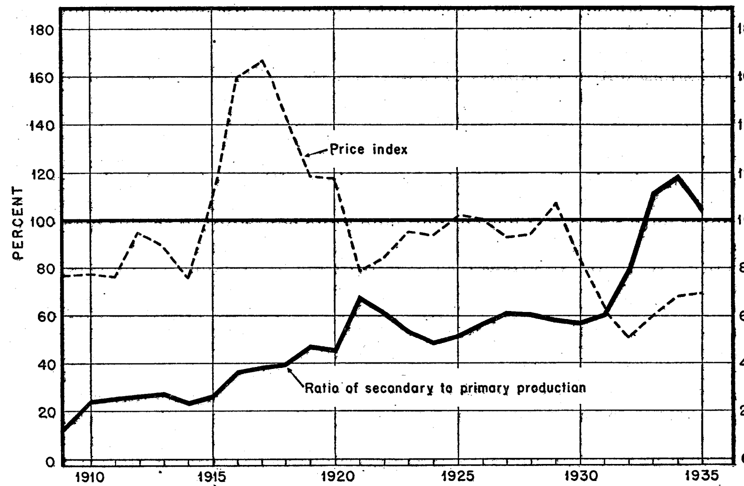

FIGURE 62.—Trends in the percentage ratio of secondary to primary nonferrous-metal production and the price index of nonferrous metals (U. S. Department of Labor, 1926=100), 1909–35

or in individual industries, of which the type-metal industry possibly furnishes the best example.

Secondary metal output increases faster than primary.—The production figures for nonferrous secondary metals used in this paper are from annual reports of J. P. Dunlop of the Bureau of Mines, who has been compiling these statistics since 1909. Comparing this record with that of primary-metal production we find that production of secondary metals has increased much more rapidly than that of primary metals. From 1909 to 1929, the value of the annual output of nonferrous metals derived from scrap increased from $24,000,000 to $331,000,000 while primary production rose from $200,000,000 to $570,000,000. In other words, production from scrap increased nearly fourteen fold during the two decades preceding the depression while production from ore increased less than threefold. During the depression production from both sources declined severely, but the drop was much less pronounced in scrap than in ore and consequently in 1933 (and again in 1934) the value of secondary metals exceeded that of primary metals for the first time.

Throughout this period, for which we have statistics, the ratio of secondary to primary production of nonferrous metals has increased remarkably. In 1909 the secondary output was worth only 12 percent of the primary output. By 1929 it had increased to about 58 percent and during the depression the ratio increased much more rapidly until in 1933 it reached 112 percent, passing the 100-percent mark for the first time. In 1934 it rose still higher—to 119 percent—secondary metals having been valued at $127,000,000 and primary metals at $107,000,000 in that year.

The superior vitality of secondary metal production during a depression has been demonstrated before. In 1921, for example, the production ratio rose to 68 percent from 46 percent in 1920, only to decline to 49 percent in 1924 as metal prices recovered again. With a normal pick up in demand we can anticipate some reduction in the ratio. Although secondary metal recoveries may continue to expand, mining for a time probably will expand even faster. The ratio may drop temporarily below the predepression level before resuming a steady, though perhaps less spectacular, rise.

New and old scrap.—Before discussing conditions with respect to individual metals it may be well to point out the confusion that may arise from the circumstance that available statistics on secondary metals include much new as well as old scrap. W. R. Ingalls, in a recent address to the Mining and Metallurgical Society of America, has already pointed out that erroneous deductions are likely to be made if the difference in economic significance of "old" and "new" scrap is not considered carefully. Old scrap, which we may define as material that has served a useful purpose and is retired from such use and returned for reworking and reuse, is indeed comparable to ore as a raw material for the production of metal. New scrap, on the other hand, which comprises scrap, dross, and other wastes incidental to manufacturing processes, never actually has come into use and accordingly, from the standpoint of ultimate consumption, is unused metal still in process of manufacture. For example, galvanizers' dross sold to a lithopone plant, in my opinion, is essentially new zinc for consumption in the chemical industry. The fact that it once was held in stock by a galvanizing establishment is of no more significance than if it had been retained at the smelter for a similar period. Under these circumstances the ordinary comparison of secondary and primary metals on the basis of production figures fails to give a true picture of their relative importance in final consumption. I do not intend to discuss this theoretical aspect of the economics of scrap at this time except to add these words of caution in case any of you desire to inquire further into the situation. I am mindful of the fact that these more or less academic considerations do not enter into the commercial side of buying, selling, or refining scrap metals. The secondary dealer and smelter naturally cares little whether the waste he purchases is old or new. He is concerned primarily with the total volume of his business. So is the producer of primary metals. Since production of primary and secondary metals are distinct and to a certain extent competitive industries, a comparison of their outputs does afford a useful basis for comparing their respective growths.

Domestic production of copper, lead, and zinc from primary and from secondary sources, 1914–34, in short tons.

[Data from U. S. Bureau of Mines]

Year	Copper		Lead		Zinc	
	Primary	Secondary	Primary	Secondary	Primary	Secondary
1914	605, 212	127, 882	512, 794	61, 062	343, 418	84, 600
1915	693, 853	196, 137	507, 026	78, 900	458, 135	108, 800
1916	944, 376	350, 000	552, 228	96, 300	564, 338	129, 200
1917	936, 773	383, 400	548, 450	93, 500	584, 597	132, 000
1918	941, 437	352, 670	539, 905	97, 100	492, 405	137, 000
1919	716, 743	287, 190	424, 433	122, 100	452, 272	130, 300
1920	591, 212	312, 460	476, 849	124, 650	450, 045	141, 000
1921	304, 707	217, 300	398, 222	103, 780	198, 232	93, 000
1922	452, 335	335, 900	468, 746	159, 560	353, 274	161, 000
1923	732, 082	410, 900	543, 841	194, 490	508, 335	164, 000
1924	837, 107	388, 300	566, 407	204, 500	515, 831	157, 000
1925	841, 448	420, 210	654, 921	226, 880	555, 631	156, 000
1926	865, 649	479, 800	680, 685	277, 300	611, 991	168, 000
1927	859, 476	490, 200	668, 320	276, 000	576, 960	168, 300
1928	895, 899	536, 400	626, 202	308, 600	591, 525	181, 700
1929	991, 366	626, 550	672, 498	311, 000	612, 136	176, 200
1930	695, 612	467, 200	573, 740	255, 800	489, 361	127, 400
1931	537, 303	347, 000	390, 260	234, 700	291, 996	102, 000
1932	222, 539	248, 180	255, 337	198, 300	207, 148	70, 600
1933	240, 669	338, 100	259, 616	224, 500	306, 010	120, 000
1934	233, 029	377, 400	299, 841	208, 400	355, 366	95, 000

Growth of secondary production of individual metals varies with uses.—Trends in the growth of secondary production of individual metals vary according to the degree to which the metal is dissipated in use. Relatively small proportions of copper, lead, and aluminum enter destructive uses, whereas very large proportions of tin and zinc are consumed in commodities from which there is little or no return of scrap. It follows that production of secondary copper, lead, or aluminum is larger in comparison with primary output than that of tin or zinc.

In 1929, the ratios of secondary to primary production of these five metals were, respectively, as follows: Copper, 63 percent; lead, 46 percent; aluminum, 45 percent; tin, 39 percent; and zinc, 24 percent.

The quantity of copper recovered from scrap increased from 45,000 short tons, equivalent to 8 percent of the primary output, in 1909 to 627,000 tons, equivalent to 63 percent, in 1929. In 1934 the ratio rose to 162 percent. Examination of the statistics for this metal reveal some interesting trends. Of the total secondary copper produced, 16 percent was recovered at plants that treat mainly primary metal in 1909, 27 percent in 1929, and 31 percent in 1934. The quantities of secondary copper recovered as metal and in alloys have increased in about the same proportion. Brass is supplying a smaller proportion of the copper recovered in alloys. From 1916 to 1929 the proportion of total copper from old scrap increased from 50 to 64 percent while that derived from new scrap decreased from 50 to 36 percent. While these latter figures are only rough approximations, they do indicate that the ever increasing stock of copper in use throughout the country tends to result in an ever increasing yield of old scrap.

Lead likewise shows a steady increase in the ratio of secondary to primary production, but in this industry the major growth has occurred during the last 20 years following the introduction of the use of storage batteries in automobiles. From 1909 to 1916 the ratio of secondary to primary lead production increased only from 12 to 17 percent, but from 1916 to 1928 it increased to 49 percent. After dropping only slightly in 1929 it reached a peak of 86 percent in 1933.

The uses of aluminum are such that a relatively large yield of scrap may be expected. In 1913 the ratio of secondary to primary metals was 23 percent, in 1929 it was 45 percent, and in 1934, 125 percent.

Die castings may increase supply of zinc scrap.—The ratio of secondary to primary zinc has been remarkably constant at approximately 25 percent. The reason is that a very large part of the secondary metal is recovered from new scrap such as galvanizer's drosses and ashes and, accordingly, the production of secondary rises and falls with the consumption of new zinc. Zinc that goes into galvanizing, pigments, and chemicals is lost ultimately. Rolled zinc is used chiefly in fruit jar tops and in dry battery cans, and as such articles become too widely disseminated to be brought together again the recovery of scrap therefrom is very small. Some zinc is salvaged from old brass and hitherto this has constituted the bulk of the old scrap recovered. However, the rapid increase in the use of die castings during the past 10 years, chiefly in automobiles and consequently likely to be salvaged, may result in a substantial increase in the relative importance of secondary zinc.

The recovery of tin from scrap is of special importance because the United States is entirely dependent on distant sources of supply. Moreover, the stock of tin in use is never large. The tin that goes into the manufacture of tin cans and chemicals, the outlets that normally consume about three-fourths of our imports, is lost ultimately. A large part of the tin used in tinfoil and collapsible tubes likewise never returns and even the tin used in bearing metals is partly lost by abrasion. A large source of secondary tin, therefore, is new scrap, such as drosses from tin-plate mills and tin-plate scrap from can factories, the supply of which fluctuates with the amount of new metal consumed. Since the World War the ratio of secondary tin production to imports of virgin tin has hovered around 40 percent. This statement does not mean, however, that scrap tin supplies forty one-fortieths or approximately 30 percent of our normal requirements, nor does it imply that 30 percent of our needs could be supplied by scrap tin in event our supply of virgin tin chanced to be cut off. Such a conclusion is seriously in error for the reason that so large a part of our secondary tin output is derived from the current utilization of virgin metal. It follows that any stoppage of imports of virgin metal would curtail the quantity of secondary tin that would be available. This situation brings out the economic implications of new versus old scrap.

Probable future expansion.—I have only a few words with regard to the future. Production of secondary metals will be determined largely by the over-all use of metals. If this use increases, as I confidently believe it will, the trend in secondary metal production will be upward. As metal-fabricating industries expand the supply of new scrap also will expand. At the same time the total stocks of metal in use will grow larger and will yield larger quantities of old scrap. There is further reason to expect that the production of secondary metal will continue to increase more rapidly than that of primary metals. These probabilities, however, apply only to metals as a group and cannot be extended to individual metals. Substitution of one metal for another is an ever-present possibility and already the substitution of aluminum and stainless steels for the older metals is being reflected in the scrap trade. New alloys with improved wearing and corrosion-resisting properties are coming constantly on the market, but I do not anticipate that this constitutes a threat to your industry. It may even prove a benefit. We are operating our machines faster than ever before, and a large part of articles fabricated from metal is not discarded because of wear but because of changes in style and obsolescence due to invention. I see no signs of decline in the tempo of invention; on the contrary, I believe it is accelerating, and as the materials of construction become better and more expensive the premium placed upon salvaging them for remelting becomes all the greater. * * * The Bureau is fully aware of the importance of secondary metals and values highly the important part they play in maintaining the nation's metal supply. We feel that we are rendering a useful service in compiling annual statistics on the production of secondary nonferrous metals, and we hope to do an even better job of it as opportunity affords. This year, for example, we are expanding the work to include scrap iron and steel. We are anxious to serve your industry still further and we invite your suggestions and cooperation to this end. I can assure you that your suggestions will be most welcome and will receive sympathetic consideration to the limit of our resources.

Among other papers presented at the annual meeting, which stated the needs of metal dealers and brokers in the scrap-metal industry were the following:

Wilson, Lester, T., Scrap-Metal Dealers an Economic Necessity: Waste Trade Jour., Mar. 28, 1936, pp. 30, 31, 111.

Overton, Carlton B., Function of a Broker in the Waste-Material Business: Waste Trade Jour., Mar. 28, 1936, pp. 35, 119, 123.

Lippa, Louis, True Function of the Scrap-Metal Dealer: Waste Trade Jour., Mar. 28, 1936, pp. 107, 114.

Lindenberger, H. J., Cooperation Vital between Dealer and Smelter of Aluminum: Waste Trade Jour., Mar. 28, 1936, p. 135.

Greenfield, Samuel, Trend in Scrap-Metal Industry Eliminating Wholesale Dealers: Waste Trade Jour., Mar. 28, 1936, p. 114.

Other articles relating to the importance of orderly, systematic sorting, and control of scrap metals and their influence as a factor in the production and prices of primary metals were by Von Bernewitz,[2] Haskins,[3] and Wertheimer.[4]

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 available data on an industry of growing importance.

Mints and refineries reported the recovery of 23,797,098 fine ounces of silver and 2,032,939 fine ounces of gold from waste or discarded material in 1934, but data for 1935 are not available.

Jewelry [5] and dental waste furnish the largest quantity of secondary gold, and silverware and photographic waste the largest quantity of secondary silver. The various types of scrap silver produced and the methods of handling them to recover the metallic values have been described by Smith.[6]

[2] von Bernewitz, M. W., How the U. S. Navy Department Handles its Nonferrous Scrap: Waste Trade Jour., Apr. 18, 1936, pp. 4, 35.

[3] Haskins, Charles M., Development of Salvage Operations in Industry and Commerce: Waste Trade Jour., Sept. 28, 1935, pp. 4, 5 and 39.

[4] Wertheimer, E. G., Classification and Preparation of Nonferrous Scrap: Metal Ind., September 1935, pp. 316-318.

[5] Hoke, C. M., Jewelers' Low-Grade Wastes. An Asset or a Liability?: Metal Ind., November 1934, pp. 382-384.

[6] Smith, E. A., Treating Waste From Silver Manufacture: Metal Ind., August 1934, pp. 272-273; September 1934, pp. 304-305; October 1934, pp. 341-342.

No data are collected by the Bureau of Mines showing the quantity and value of old rails, pipe, machinery, and other equipment renovated for original use. A glance at newspapers and trade publications shows that an enormous quantity of such ferrous material is salvaged and reused.

The price of heavy copper scrap ranged from 5.625 to 7.125 cents a pound in 1935, No. 1 composition scrap from 4.375 to 5.50 cents a pound, old scrap zinc from 1.875 to 2.125 cents a pound, cast-aluminum scrap from 9.75 to 12.75 cents a pound, and heavy lead scrap from 2.75 to 3.70 cents a pound. The average weekly quotations for many scrap metals and alloys can be found in the Waste Trade Journal, the Waste Trade Review, and Metal Industry.

Antimony showed the largest spread during 1935. Old tin pipe also showed considerable variation in price during 1935, but neither of these scrap metals is marketed in large quantities.

The favorable feature of the spread in secondary metal prices was that, in general, prices were lowest at the beginning of 1935 and highest in the last part of the year.

The financial mortality among dealers and secondary smelters in 1935, while not as large numerically as in 1934, included quite a number of those of prominent standing. Much of the trouble represented culmination of the losses of several successive years. Few western dealers in scrap had a favorable year, and itinerant collections continued small. There are large quantities of iron and steel scrap in the rural sections distant from smelters. The tendency to eliminate small plants and the increase in purchases of scrap and drosses by the large smelters and refineries continued in 1935.

In 1935 the waste-trade industry did show considerable improvement, and some dealers and smelters made fair profits. On the whole it was a fair year for the industry—the best in 4 years. The spread in the prices of metals (other than antimony) was not large, so that speculative profits were small. The good quality of most of the metals and alloys made from scrap has resulted in manufacturers drawing more heavily on scrap-metal ingots and alloys, which are equally efficient for many purposes and considerably cheaper than new metals.

In nearly all cases, prices were higher at the end of 1935 than at the end of 1934. Stocks of scrap metals and ingots made from scrap were not burdensome. Occasionally supplies were limited but always they were sufficient.

In general the secondary metal industry does not anticipate a gain in 1936 greater than 10 to 15 percent over 1935. It does expect a fair year, for more metal is being consumed and prices for primary metals apparently are stable.

Secondary copper and brass.—The copper produced in 1935 by smelters of secondary material includes 121,528 tons of pig copper (part of which was electrolytically refined), 84,600 tons of copper in remelted brass, and 94,300 tons of copper in alloys other than brass. These figures indicate an increase of 23,083 tons in pig copper, a decrease of 300 tons in copper in brass, and an increase of 22,200 tons in copper alloys other than brass. Regular copper smelters produced about 26,500 tons more secondary copper in 1935 than in 1934, so that they were partly responsible for the increase in secondary copper in 1935.

The total value of secondary copper as metal and in brass and other alloys, computed at 8.3 cents a pound (the average price in 1935 of all merchantable grades of new metal), was $74,517,400, about $14,133,400 more than in 1934.

Imports of brass scrap decreased 124 tons and those of copper scrap 63 tons. Brass scrap exported decreased 404 tons, and copper scrap exported decreased 3,048 tons.

Secondary copper recovered in the United States, 1934–35 and imports and exports of brass and copper scrap, in short tons

	1934	1935
Copper as metal	[1] 220,400	[1] 270,000
Copper in alloys other than brass	72,100	94,300
	292,500	364,300
Copper from new scrap (not including brass)	35,000	45,000
Copper from old scrap (not including brass)	257,500	319,300
	292,500	364,300
Brass scrap remelted:		
New clean scrap	45,000	60,000
Old scrap	76,300	60,800
	121,300	120,800
Copper content of brass scrap (averaging 70 percent copper):		
New scrap	31,500	42,200
Old scrap	53,400	42,400
	84,900	84,600

	1934	1935
Total secondary copper (including copper content of brass scrap):		
From new scrap	66,500	87,200
From old scrap	310,900	361,700
	377,400	448,900
As metal	220,400	265,000
In brass and other alloys	157,000	183,900
	377,400	448,900
Brass scrap imported	243	119
Scrap copper imported	63	---------
Brass scrap exported	30,196	29,792
Scrap copper exported	12,595	9,547

[1] Of these totals secondary copper reported by smelters and refiners that treat mainly primary metal comprised 121,955 tons in 1934 and 148,478 tons in 1935.

The terms "new brass scrap" and "new copper scrap," as applied in the preceding table, refer to the scrap that is 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 (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 solely on purchased scrap. Those that purchase only "new scrap" of certain grades and assay can give correct data; the others usually can make no 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 1935 show that railroads reused at their shops and foundries the following quantities of scrap metals—1,400 tons of brass, 800 tons of copper, 13,200 tons of copper in alloys other than brass, 1,150 tons of tin in babbitt, solder, and bronze, and 3,950 tons of lead in various alloys.

Apparently stocks of scrap copper and copper alloys are normal both at large dealers' yards, smelters, and at foundries. The pick-up by small collectors remote from smelters has not increased but urban collections from fabricating plants are not being held.

The use of various alloys (usually in small quantities) in the manufacture of brass is becoming more prevalent. It is thought that purchasing agents will be required to specify more closely in order to secure the type of metal desired. Secondary copper recovered by smelters of primary copper increased greatly in 1935 and more copper scrap was refined electrolytically.

Secondary lead.—The output of secondary lead in 1935 equaled 86 percent of the total production of refined primary lead from domestic and foreign sources in the United States compared with 67 percent in 1934. Much recovered lead is derived from discarded batteries, pipe, sheet, and lead-covered cable; other sources are solder, babbitt, and shot. The total lead (as oxide or metal) and antimony content of automobile batteries is figured as 185,000 tons compared with 163,000 tons in 1934.

Secondary lead recovered by smelters whose product is mainly primary metal increased 11,191 tons in 1935. The output of pig lead by secondary smelters increased about 21,109 tons and lead in scrap alloys 25,334 tons.

Collection of old batteries was at a higher rate in 1935 than in 1934. Collections were good in urban but only fair in rural areas.

Secondary lead recovered in the United States, 1934–35, in short tons

	1934	1935
Secondary lead recovered by smelters that treat mainly ore	33, 557	44, 748
Secondary lead recovered by smelters that treat only scrap and drosses	90, 943	112, 052
	124, 500	156, 800
Secondary lead recovered in remelted alloys:		
Estimated secondary lead content of antimonial lead produced at regular lead smelters [1]	8, 113	9, 479
Lead content of drosses and scrap alloys treated at secondary smelters	75, 787	104, 121
	83, 900	113, 600
Total secondary lead recovered	208, 400	270, 400

[1] Antimonial lead produced at primary smelters totaled 16,384 tons containing approximately 4,685 tons of primary domestic lead, 491 tons of primary foreign lead, 1,110 tons of primary domestic antimony, 26 tons of primary foreign antimony, 9,479 tons of secondary lead and 593 tons of secondary antimony in 1935 compared with 16,607 tons containing approximately 5,901 tons of primary domestic lead, 330 tons of primary foreign lead, 1,657 tons of primary domestic antimony, 18 tons of primary foreign antimony, 8,113 tons of secondary lead, and 588 tons of secondary antimony in 1934.

Refined primary lead produced in the United States, 1934–35, in short tons

	1934	1935
From domestic ore	299, 841	310, 505
From foreign ore and base bullion	11, 395	14, 055

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 difficulties in sampling old batteries are stated in an article by Johnstone.[7]

The question of the prices paid for battery plates is discussed in an article by Schoenback.[8]

The sampling of battery plates is much more difficult than the assaying, due to the moisture in the rubber and separators.

A large number of the 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 being paid for at the price of lead, though the price of antimony in 1935 was more than three times that of lead.

An interesting recovery of considerable secondary lead was reported by a reclamation plant constructed at the Baytown refinery of the Humble Oil Refining Co. at Goose Creek, Tex. The plant was designed to recover lead oxide used in treating the high-sulphur crude oil distilled at the refinery. It is estimated that about 10,000 tons of lead oxide have been used since the refinery began operations.

Secondary zinc.—Secondary zinc recovered as pig metal and in alloys (including brass) increased 27,850 short tons, largely in redistilled and remelted zinc from drosses. The quantity of remelted brass decreased, though the zinc in alloys other than brass increased slightly. The zinc content of brass remelted was 1,000 tons more in 1935 than in 1934. The total recovery of secondary zinc (including that in brass) equaled 21 percent of the total output of primary slab zinc in the United States (420,634 tons) in 1935. In addition, large quantities of the zinc dust, zinc chloride, and other compounds were made from zinc drosses and residues.

Secondary zinc[1] *recovered in the United States, 1934–35, and products made from zinc dross, skimmings, and ashes, in short tons*

	1934	1935
Secondary zinc recovered by redistillation	19,691	28,650
Secondary zinc recovered by sweating, remelting, etc.	9,609	26,750
Total zinc recovered unalloyed	29,300	55,400
Zinc recovered in alloys other than brass	8,200	8,950
Zinc recovered in brass (estimated)	29,000	30,000
Zinc dust made from zinc dross	10,856	12,453
Zinc dross used for zinc dust (estimated)	12,850	14,950
Zinc concentrates and ore exported Zinc dross exported	3,621	461
Lithopone made from zinc skimmings and ashes	54,489	67,512
Secondary zinc content of lithopone	10,836	13,512
Zinc chloride made from zinc skimmings, ashes, etc.	19,166	(2)
Zinc content of zinc chloride made from zinc skimmings, etc.	4,216	(2)
Zinc content of zinc sulphate made from zinc skimmings, ashes, etc.	411	483
Zinc oxide produced from zinc scrap and drosses	4,203	9,452

[1] Figures do not include scrap and dross used for lithopone or chloride. The use for zinc chloride, especially, is large.
[2] Figures not yet available.

Zinc recovered by redistillation increased from 19,691 tons in 1934 to 28,650 in 1935. Of the 1935 total 13,439 tons (an increase of 8,477 tons) were recovered at primary smelters from zinc drosses and 15,211 tons (an increase of 482 tons) at five secondary plants using large graphite retorts and two plants using clay retorts, which treated

[7] Johnstone, J. O., Sampling Battery Plates: Waste Trade Jour., May 4, 1935, p. 4.
[8] Schoenback, Walter, Pyramiding Battery Plate Prices: Waste Trade Jour., Mar. 28, 1936, p. 97.

only drosses and residues in 1935. The five active smelters using large graphite retorts in 1935 were:

Federated Metals Corporation, Trenton, N. J.
General Smelting Co., Philadelphia, Pa.
Nassau Smelting & Refining Co., Tottenville, N. Y.
Superior Zinc Corporation, Bristol, Pa.
Wheeling Steel Corporation, Wheeling, W. Va.

Of the total output of 159,486 tons of lithopone in 1935, 67,511 tons containing 13,512 tons of zinc were made from zinc skimmings and ashes.

The American Bureau of Metal Statistics estimates that 195,000 tons of zinc (43,000 tons more than in 1934) were used in 1935 in zincking (galvanizing) sheets, forms, tubes, wire, and other materials.

Secondary tin.—Secondary tin recovered amounted to 27,900 tons valued at $27,498,200 in 1935 compared with 24,900 tons valued at $25,487,600 in 1934. The total value assigned is based on the yearly average price (49.28 cents in 1935 and 51.18 cents a pound in 1934) given by the American Metal Market for 99-percent metal, prompt delivery at New York. The total recovery increased 3,000 tons, 1,650 tons being in tin in alloys. Recovery of tin from scruff and drosses increased from about 5,200 tons in 1934 to 6,850 in 1935.

Secondary tin recovered in 1935 was equivalent to about 39 percent of the tin imported into the United States as pig metal in 1935.

According to the American Iron and Steel Institute the quantity of tin plate and terneplate made in 1935 was 1,886,439 long tons. It is estimated that about 32,000 long tons of tin were used in these products.

Many earlier chapters of this series contain data on plants and processes followed, and a complete history of the different methods of detinning is given in an article entitled "Scrap Detinning Affords Big Outlet for Chlorine", by C. L. Mantell, in Chemical and Metallurgical Engineering, August 1926 (pp. 477–479).

In 1935 the detinning industry was handicapped by the export of large quantities of tin-plate scrap to Japan, though domestic plants were capable of handling all tin-plate clippings produced in the United States. This was remedied by the passing of the following act in February 1936:

(*Public—No. 448—74th Congress*)

(S. 3381)

AN ACT

To provide for the protection and preservation of domestic sources of tin.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That, in the interest of national defense, it is hereby declared to be the policy of Congress and the purpose and intent of this Act to protect, preserve, and develop domestic sources of tin, to restrain the depletion of domestic reserves of tin-bearing materials, and to lessen the present costly and dangerously dependent position of the United States with respect to resources of tin.

SEC. 2. There shall not be exported from the United States after the expiration of sixty days from the enactment of this Act any tin-plate scrap, except upon license issued by the President of the United States. The President is authorized to grant licenses upon such conditions and regulations as he may find necessary to assure in the public interest fair and equitable consideration to all producers of this commodity.

SEC. 3. Any violations of the provisions of this Act shall be a misdemeanor and shall be punished by a fine of not more than $500 or by imprisonment of not more than one year, or by both such fine and imprisonment.

Approved, February 15, 1936.

It is estimated that 34,928 long tons of tin-plate clippings and 24,525 long tons of waste tin-plate were exported to Japan and other countries in 1935. These clippings would yield Japanese detinners about 35 to 37 pounds of tin per long ton. The exports of tin-plate clippings and other tin-coated material probably would not yield more than 1,200 short tons of tin.

Undoubtedly the price paid for tin-plate clippings was advanced by reason of the exports. Usually the United States imports some tin-plate scrap from Canada and Mexico. These imports probably will go or already have gone to Japan. Other than the exporters of tin-plate scrap, the secondary metal brokers and smelters are satisfied to have confined the restrictions to tin-plate scrap. The dealers are utterly opposed to restrictions on the export of alloys containing tin in small quantities because many brasses and all bronzes contain tin. They also fear that restrictions might be extended to alloy steel and other scrap containing nickel, molybdenum, cobalt, etc.

Although the average yearly price of tin declined, it remained close to 50 cents a pound in 1935 and resulted in the detinning of old tin-coated containers (about 1,400 tons) for the second time in many years. The old cans yield much less tin than clean tin-plate clippings. Many more old cans may be treated at the plants now equipped to handle them, but the high cost of collecting and shipping them militates against their use. There are also the additional costs of cleaning and handling bulky material. Thus the use of old tin-coated containers probably will be confined to areas adjacent to the detinning plants.

Secondary tin recovered in the United States, 1934–35

	1934	1935
Tin recovered as pig tin.....short tons	8,250	9,600
Tin recovered in alloys and chemical compounds.....do	16,650	18,300
	24,900	27,900
Clean tin-plate scrap treated at detinning plants.....long tons	162,262	193,571
Metallic tin recovered at detinning plants.....pounds	2,106,920	2,413,081
Tin content of tin tetrachloride, tin bichloride, tin crystals, and tin oxide made at detinning plants.....pounds	3,944,171	4,886,479
Total tin recovered at detinning plants.....do	6,051,091	7,299,560
Tin tetrachloride, tin bichloride, tin crystals, and tin oxide made at detinning plants.....pounds	8,377,421	10,434,540
Average quantity of tin recovered per long ton of clean tin-plate scrap.....do	37.3	37.7

Tin (metal) and tin concentrates (tin content) imported into the United States, 1934–35, in short tons

	1934	1935
Tin imported as metal	44,784	71,969
Tin concentrates (tin content) imported	2	199

The quantity of tin-plate clippings treated at detinning plants increased about 31,300 long tons in 1935, and the average cost of such clippings delivered at plants increased from $13.64 a long ton in 1934 to $14.73 a ton in 1935. These clippings were treated at plants of the Vulcan Detinning Co. at Sewaren, N. J., Neville Island, Pa., and

Streator, Ill.; by the Johnston & Jennings Co. of Cleveland, Ohio; and at the plants of the Metal & Thermit Co., at South San Francisco, Calif., East Chicago, Ind., and Chrome, N. J.

Statistics of tin-plate clippings imported in 1935 are not available but the amount probably was less than in immediately preceding years, for it is reported that some tin-plate clippings normally shipped to the United States from Canada were diverted to Japan in 1935.

Exports of iron and steel scrap (including clean tin-plate clippings) in 1935 were 2,044,506 long tons, of which 1,061,143 tons, including all the tin-plate clippings, went to Japan.

The tin reported recovered in alloys and compounds in 1935 included the tin content of products made from clean tin-plate scrap. Most of the tin recovered at the plants listed was in tin bichloride, tin crystals, tin tetrachloride, and tin oxide.

The total recovery of tin as metal or in compounds from clean tin-plate scrap in 1935 was 3,650 short tons, whereas it is estimated that makers of tin plate and terneplate consumed more than 36,000 short tons of tin. Some old tin-coated containers treated at Sewaren, N. J., yielded 26 pounds of tin per long ton.

A plant in Los Angeles collected old cans locally for use in shredded scrap to precipitate copper from mine waters, but there was no attempt to recover the tin coating.

A book by C. L. Mantell, of Pratt Institute, Brooklyn, N. Y., Tin: Its Mining, Production, Technology, and Application, includes chapters on the sources of secondary tin and the various methods of detinning tin-plate scrap.

Secondary aluminum.—The recovery of secondary aluminum, including that in alloys, totaled 51,400 short tons valued at $19,018,000, compared with 46,400 tons valued at $17,632,000 in 1934. The value in 1934 was computed at 19 cents a pound and in 1935 at 18 cents a pound.

The value of primary aluminum produced in the United States increased from $14,094,000 in 1934 to $22,070,000 in 1935 owing to an increase of about 61 percent in output.

Secondary aluminum recovered in the United States, 1934–35, in short tons

	1934	1935
Secondary aluminum recovered unalloyed	21,000	23,500
Aluminum recovered in alloys (mainly No. 12)	25,400	27,900
	46,400	51,400

Primary aluminum produced in the United States and imported and exported, 1934–35, in pounds

	1934	1935
Primary aluminum produced in the United States	74,177,000	119,295,000
Aluminum (crude and semicrude) imported for consumption	18,591,591	21,291,235
Aluminum (crude and semicrude) exported	8,365,557	3,970,347

The spread in scrap-aluminum castings was 3 cents a pound in 1935; the demand was usually good, and the quantity available was cleaned up fairly well. Aluminum cylinder heads and aluminum-alloy pistons were used more extensively in motor cars than formerly, so that an increased quantity of scrap aluminum was consumed in the automobile industry. Scrap cast aluminum and old crankcases were in good demand.

A large number of alloys containing aluminum contribute to the secondary aluminum recovered, but No. 12 (a mixture of about 92 percent aluminum and 8 percent copper) constitutes the largest supply of material for remelting and refining. Other alloys are numerous but are used in smaller quantities. Many automobile aluminum crankcases are sold to foundries and do not reach the secondary smelters.

The approved standard methods of sampling and analyzing aluminum and its alloys are described in a pamphlet published by the Aluminum Research Institute in July 1932. A book [9] by Anderson is interesting to smelters and users of secondary aluminum.

The market for mixed cast-aluminum alloys was generally weak early in 1935 but rather active in the fall. Prices for scrap cast aluminum ranged from 9.75 cents a pound in January to as high as 12.75 cents in November.

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 a few 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 85 percent is certain to come back for reuse.

The production of secondary antimony in the United States, most of which was recovered in alloys, increased considerably in 1935. The average price for ordinary brands of antimony, as stated by the American Metal Market, was 14.08 cents a pound in 1935 compared with 8.92 cents in 1934. The price advanced rapidly late in 1934 and was quoted at about 14.5 cents a pound in January 1935. It advanced to 16.75 cents in October and closed at 14 cents in December. Smelters that ordinarily use primary ores, concentrates, or metal reported 1,136 tons of primary antimony and 593 tons of secondary antimony as contained in 16,384 tons of antimonial lead. The recovery of secondary antimony by secondary smelters increased 1,968 tons.

Imports of antimony in ore, as metal, or in oxide were 2,440 tons more than in 1934.

Secondary antimony recovered in and antimony imported into and exported from the United States, 1934–35, in short tons

	1934	1935
Secondary antimony in antimonial lead scrap smelted at regular smelters	588	593
Secondary antimony recovered at secondary smelters	6,962	9,007
	7,550	9,600
Antimony imported in ore, as metal, or as oxide or salts	5,374	7,814
Foreign antimony exported	402	818

[9] Anderson, R. J., Secondary Aluminum: The Sherwood Press, Inc., Cleveland, Ohio, 1931, 563 pp.

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 again in 1935.

The secondary nickel reported as recovered in 1935 came mainly from scrap-nickel anodes, nickel silver, copper-nickel alloys, and monel metal. Nickel is used also in white gold and in aluminum and zinc alloys for die castings.

There were large exports of nickel scrap and scrap alloys containing nickel. Scrap dealers are not especially desirous of reporting their exports, but the few who did report to the Bureau of Mines stated a total of 960 tons. Incidentally (although not specifically requested, some users of nickel reported the purchase of steel scrap containing about 1,630 tons of nickel.

The secondary recovery of nickel in ferrous alloys probably was larger than in 1934. It is estimated by Robert C. Stanley, president of the International Nickel Co., Ltd., that about 42 percent of the nickel consumed in the United States is used in nickel steel and iron, mainly in motor cars, railway equipment, heat-resistant alloys, and general machinery. The rest is used as monel metal, rolled nickel, sheets, rods, and shot, in nickel silver for nickel plating, and in alloys of copper and other nonferrous metals. Probably more secondary nickel is recovered from ferrous than from nonferrous alloys, but no total figures are available. The amount of nonferrous alloys actually recovered probably is greater than inquiries reveal, for it is difficult to ascertain the quantity of nickel in alloys remelted when the quantity of nickel in the alloy frequently is very small. It is estimated that the quantity of nickel now used yearly in special alloys of brass and bronze exceeds 700 tons.

Secondary nickel recovered in the United States, 1934–35, in short tons

	1934	1935
Nickel recovered as metal	550	700
Nickel recovered in nonferrous alloys and salts	1,300	1,250
	1,850	1,950

Primary nickel produced in the United States and imported and exported, 1934–35, in short tons

	1934	1935
Nickel produced as a byproduct from the electrolytic refining of copper at domestic refineries	157	160
Nickel imported for consumption in the United States as nickel or in nickel ores and matte, oxide, and alloys	29,298	37,848
Nickel, monel metal, and other alloys exported	2,308	1,726

Analyses of various nickel alloys were published in Mineral Resources for 1915.[10] Considerable information as to the uses of nickel, monel metal, and other nickel alloys is given in Inco and in special pamphlets on nickel and its various alloys, publications of the International Nickel Co. This company purchases nickel scrap and monel scrap.

[10] Hess, Frank L., Nickel: U. S. Geol. Survey, Mineral Resources of the U. S., 1915, pt. I, pp. 763–765.

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 (Circular M), effective March 16, 1932, follows:

STANDARD CLASSIFICATION FOR OLD METALS, EFFECTIVE FROM MARCH 16, 1932

1. *Delivery.*—(*a*) Delivery of more or less of the specified quantity up to 1¼ percent is permissible.

(*b*) If the term "about" is used, it is understood that 5 percent more or less of the quantity may be delivered.

(*c*) Should the seller fail to make deliveries as specified in the contract, the purchaser has the option of canceling all of the uncompleted deliveries or holding the seller for whatever damages the purchaser may sustain through failure to deliver, and if unable to agree on the amount of damages an arbitration committee of the National Association of Waste Material Dealers, Inc., appointed for this purpose, to determine the amount of such damages.

(*d*) In the event that buyer should claim the goods delivered on a contract are not up to the proper standard, and the seller claims that they are a proper delivery, the dispute shall be referred to an arbitration committee of the National Association of Waste Material Dealers, Inc., to be appointed for that purpose.

(*e*) A carload, unless otherwise designated, shall consist of the weight governing the minimum carload weight at the lowest carload rate of freight in the territory in which the seller is located. If destination of material requires a greater carload minimum weight, buyer must so specify.

(*f*) A ton shall be understood to be 2,000 pounds unless otherwise specified. On material purchased for direct foreign shipment a ton shall be understood to be a gross ton of 2,240 pounds unless otherwise specified.

(*g*) If, through embargo, a delivery cannot be made at the time specified, the contract shall remain valid and shall be completed immediately on the lifting of the embargo, and terms of said contract shall not be changed.

(*g*–1) When shipments for export for which space has been engaged have been delivered or tendered to a steamship for forwarding and through inadequacy of cargo space the steamship cannot accept the shipment, or where steamer is delayed in sailing beyond its scheduled time, shipment on the next steamer from the port of shipment shall be deemed a compliance with the contract as to time of shipment.

(*h*) In case of a difference in weight and the seller is not willing to accept buyer's weights, a sworn public weigher shall be employed, and the party most in error must pay the costs of handling and reweighing.

(*i*) When material is such that it may be sorted by hand, consignees cannot reject the entire shipment if the percentage of rejection does not exceed 10 percent. The disposition of the rejected material should then be arranged by negotiations; no replacement of the rejected material to be made.

Upon request of the shipper, rejections shall be returnable to the seller on domestic shipments within 1 week and on foreign shipments within 30 days from the time notice of rejection is received by them, and upon payment by them of 1 cent a pound on material rejected to cover cost of sorting and packing; the seller to be responsible for freight both ways.

2. *No. 1 copper wire.*—To consist of clean untinned copper wire not smaller than No. 16 B. & S. Wire gage to be free from burnt copper wire which is brittle and all foreign substances.

3. *No. 2 copper wire.*—To consist of miscellaneous clean copper wire which may contain a percentage of tinned wire and soldered ends but to be free of hair wire and burnt wire which is brittle; the tinned wire not to be over 15 percent of the total weight.

4. *No. 1 heavy copper.*—This shall consist of untinned copper not less than 1/16 inch thick, and may include trolley wire, heavy field wire, heavy armature wire, that is not tangled, and also new untinned and cleaned copper clippings and punchings, and copper segments that are clean.

5. *Mixed heavy copper.*—May consist of tinned and untinned copper, consisting of copper clippings, clean copper pipe and tubing, copper wire free of hair wire and burnt and brittle wire, free from nickel-plated material.

6. *Light copper.*—May consist of the bottoms of kettles and boilers, bathtub linings, hair wire, burnt copper wire which is brittle, roofing copper and similar copper, free from radiators, brass, lead and solder connections, readily removable iron, old electrotype shells, and free of excessive paint, tar, and scale.

7. *Composition or red brass.*—May consist of red scrap brass, valves, machinery bearings and other parts of machinery, including miscellaneous castings made of copper, tin, zinc and/or lead, no piece to measure more than 12 inches over any one part or to weigh over 60 pounds, to be free of railroad boxes and other similarly excessively leaded material, cocks and faucets, gates, pot pieces, ingots, and burned brass, aluminum composition, manganese, and iron.

8. *Railroad bearing.*—Shall consist of railroad boxes or car journal bearings, must be old standard used scrap, free of yellow boxes, also iron-backed boxes, and must be free of babbitt, also free of excessive grease and dirt.

9. *Cocks and faucets.*—To be mixed red and yellow brass, free of gas cocks and beer faucets, and to contain a minimum of 35 percent red.

10. *Heavy yellow brass.*—May consist of heavy brass castings, rolled brass, rod brass ends, chandelier brass, tubing, not to contain over 15 percent of tinned and/or nickel-plated material; no piece to measure more than 12 inches over any one part and must be in pieces not too large for crucibles. Must be free of manganese mixture, condenser tubes, iron, dirt, and excessive corroded tubing. Must be free of aluminum brass containing over 0.20 percent aluminum.

11. *Yellow brass castings.*—Shall consist of brass castings in crucible shape, that is, no piece to measure more than 12 inches over any one part; must be free of manganese mixtures, tinned and nickel-plated material, and must be free of visible aluminum brass.

12. *Light brass.*—May consist of miscellaneous brass, tinned or nickel plated that is too light for heavy brass, to be free of gun shells containing paper, ashes or iron, loaded lamp bases, clock works, and automobile gaskets. Free of visible iron unless otherwise specified.

13. *Old rolled brass.*—May consist exclusively of old pieces of sheet brass and pipe free from solder, tinned and nickel-plated material, iron, paint, and corrosion, ship sheathing, rod brass, condenser tubes, and Muntz metal material.

14. *New brass clippings.*—Shall consist of the cuttings of new sheet brass to be absolutely clean and free from any foreign substances and not to contain more than 10 percent of clean brass punchings to be not smaller than ¼ inch in diameter.

15. *Brass pipe.*—Shall consist of brass pipe, free of nickel-plated, tinned, soldered, or pipes with cast brass connections. To be sound, clean pipes free of sediment and condenser tubes.

16. *No. 1 red composition turnings.*—To be free of railroad car box turnings and similarly excessively leaded material, aluminum, manganese, and yellow brass turnings; not to contain over 2 percent free iron; to be free of grindings and foreign material, especially babbitt. Turnings not according to this specification to be sold subject to sample.

17. *No. 1 yellow rod brass turnings.*—Shall consist of strictly rod turnings, free of aluminum, manganese, composition, Tobin and Muntz metal turnings; not to contain over 3 percent free iron, oil, or other moisture; to be free of grindings and babbitts; to contain not more than 0.30 percent tin and not more than 0.15 percent combined iron.

18. *No. 1 yellow brass turnings.*—Shall consist of yellow brass turnings, free of aluminum, manganese, and composition turnings; not to contain over 3 percent of free iron, oil, or other moisture; to be free of grindings and babbitts. To avoid dispute, to be sold subject to sample.

19. *Auto radiators (unsweated).*—All radiators to be subject to deduction of actual iron. The tonnage specifications should cover the gross weight of the radiators, unless otherwise specified.

20. *No. 1 pewter.*—Shall consist of tableware and soda-fountain boxes, but in any case must test 84 percent tin. Siphon tops to be treated for separately.

21. *Zinc.*—Must consist of clean sheet and cast zinc, also cast batteries to be free of loose oxide and dross, sal ammoniac cans, and other foreign materials.

22. *Zinc dross.*—Must be unsweated in slabs and must contain a minimum of 92 percent of zinc.

23. *Tin foil.*—Shall consist of pure foil free of lead compositions and other foreign ingredients and matters.

24. *Electrotype shells.*—Must be hand picked and free of loose dross and chunks of dross.

25. *Scrap lead.*—Should be clean, soft scrap lead.

26. *Battery lead plates.*—Shall consist of dry battery lead plates, moisture not to exceed 1 percent, allowance to be made for wood, rubber, and paper and excess moisture, or lead plus antimony content, dry basis, less a treatment charge.

27. *New pure aluminum clippings.*—Shall consist of new, clean, unalloyed sheet clippings and/or aluminum sheet cuttings. Must be free from oil, grease, and any other foreign substance. Also to be free from punchings less than one-half inch square.

28. *New pure aluminum wire and cable.*—Shall consist of new, clean, dry, unalloyed aluminum wire or cable, free from iron, insulation, and any other foreign substance.

29. *Old pure aluminum wire and cable.*—Shall consist of old, unalloyed aluminum wire or cable containing not over 1 percent free oxide or dirt and free from iron, insulation, and any other foreign substance.

30. *Alloy sheet aluminum.*—To be sold on specification and sample.

31. *Painted sheet aluminum.*—Shall consist of clean, old, painted, unalloyed sheet aluminum, guaranteed free from iron, dirt, and any other foreign substance. To contain no radiator shells or aeroplane sheet.

32. *Old scrap sheet aluminum.*—Shall consist of clean, old, unalloyed sheet or manufactured sheet aluminum, guaranteed free from iron, dirt, or any other foreign substance, and to be free from hub caps, radiator shells, and airplane sheet.

33. *Scrap aluminum castings.*—Shall consist of clean, heavy automobile castings, containing not more than 12 percent industrial mixed castings, and to be free from die-cast aluminum, pattern metal, and hat blocks. All of above material also to be free from iron, babbitt, brass, and any other foreign substance. Oil and grease must not exceed 2 percent.

34. *Aluminum borings.*—To avoid dispute, should be sold subject to sample.

35. *Aluminum foil.*—Shall consist of pure aluminum foil, free from paper and any foreign ingredients.

36. *Babbitt metal.*—Shall contain bearing metal of all kinds. Shall not contain scrap hard metal, Allen metal (which is copper and lead alloy) die cast, ornamental metal, casket metal, zinc boxes, or type metal.

37. *Packages.*—Shall be good strong packages suitable for shipment and each package shall be plainly marked with separate shipping marks and numbers and with the gross and tare weights so that the packages may reach their destination and their weights can be easily checked.

No immediate changes are contemplated in the metal classification above quoted.

There is a growing demand for scrap-metal specialties (not specifically covered by the preceding classification), such as nickel alloys, German silver, Monel metal, cadmium, and molybdenum. Difficulties in making shipments to buyers' specifications have arisen, and with the object of eliminating some of the trouble the Waste Trade Journal published certain 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.

IRON ORE, PIG IRON, FERRO-ALLOYS, AND STEEL [1]

By O. E. Kiessling, H. W. Davis, and C. T. Herring [2]

SUMMARY OUTLINE

Economic recovery in the American iron and steel industry gained momentum in 1935, steel and pig-iron production rising 31 and 33 percent, respectively—much larger relative gains than were shown in 1934. The output of steel and pig iron in 1935 required 49 and 42 percent, respectively, of the potential productive capacities of steel mills and blast furnaces compared with 37 and 31 percent, respectively, in 1934. The higher rate of operation in 1935 reacted to the benefit of producers of other mineral products, such as iron ore, manganiferous iron ore, fluorspar, fluxing stone, and coke, that depend upon the iron and steel furnaces as their principal market.

The relative consumption of iron and steel products shifted noticeably in 1935 owing to the substantial improvement in demand by consumer-goods industries. The automobile industry, for example, which produced 4,009,496 cars in 1935 compared with 2,753,111 cars in 1934, took about one-fourth of the total steel output. The increased income of the farmer—the largest since 1930—and his ability to purchase new equipment resulted in farm-implement manufacturers taking about 9½ percent of the total steel output compared with 7½ percent in 1934. Demand for tin plate by metal-container fabricators increased substantially in 1935, and there was also a sharp increase in the steel requirements of manufacturers of electrical appliances and household and office equipment.

The demand for iron and steel by capital-goods industries, on the other hand, fell off as less steel was consumed by railroads, in ship-

[1] Figures on production and shipments of iron ore in 1935 are preliminary; detailed data with final revisions will be released later.

[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.

building, and for highway construction in 1935 than in the preceding year. The building industry used more steel than in 1934 and was

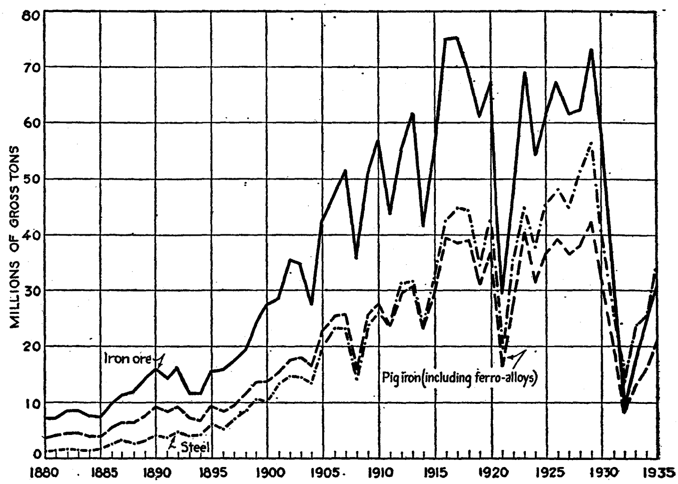

FIGURE 63.—Trends in production of iron ore, pig iron, and steel in the United States, 1880–1935.

the most important market among the capital-goods industries, and steel requirements for pipe and machinery manufacture increased slightly.

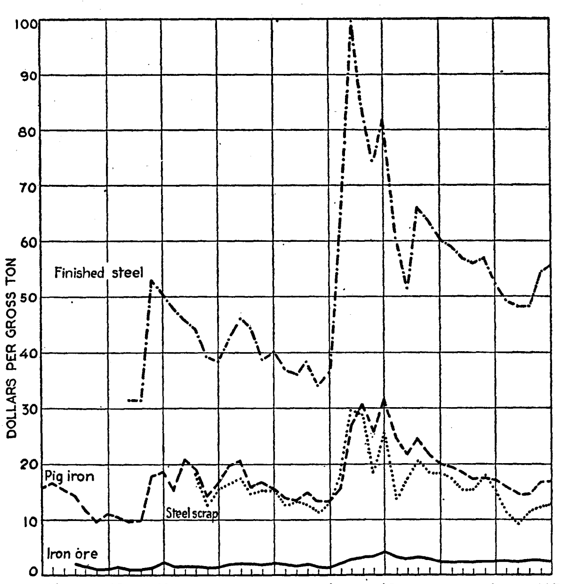

FIGURE 64.—Trends in prices of iron ore, pig iron, finished steel, and steel scrap. The prices of iron ore and pig iron are the averages f. o. b. mines and furnaces, respectively, as reported to the Bureau of Mines; the price of finished steel is an average composite computed by American Metal Market; that of steel scrap is an average at Pittsburgh of No. 1 heavy melting computed by Iron Age.

The trends in production of iron ore, pig iron, and steel for more than half a century are illustrated in figure 63.

Prices in general were unusually stable in 1935. Average quotations on rods, shapes, and plates were slightly more than in 1934, those on bars and tin plate were about the same, and quotations on hot-rolled annealed sheets, no. 24 gage, declined slightly.

The average prices of pig iron, ferromanganese, spiegeleisen, and iron and steel scrap in 1935 also changed little from the 1934 averages. Figure 64 shows trends in prices of iron ore, pig iron, finished steel, and steel scrap.

The export trade in iron and steel products declined slightly in 1935. Large losses in 1935 were recorded for tin plate, rails, and casing and oil-line pipe. Substantial gains, however, occurred in the overseas movement of many items, such as steel ingots, etc., steel bars, unfabricated plates, skelp iron and steel, galvanized iron or steel sheets, black steel sheets, and castings and forgings. The exports of iron and steel scrap (including tin-plate scrap) increased from 1,835,170 gross tons in 1934 to 2,079,434 tons in 1935.

Imports of iron and steel products increased substantially in 1935. Steel bars, structural iron and steel, pipes and tubes, barbed wire, wire rods, nails, and scrap accounted for the bulk of the imports.

Salient statistics of iron ore, pig iron, ferro-alloys, and steel in the United States, 1934–35

	1934		1935	
	Gross tons	Value	Gross tons	Value
Iron ore:				
Production:				
Hematite	[1] 23,390,993	(2)	28,864,000	(2)
Brown ore	286,073		267,300	
Magnetite	[1] 909,910		1,352,000	
Carbonate	640		700	
	24,587,616	(2)	30,484,000	(2)
Open-pit	[3] 14,054,417	(2)	20,449,000	(2)
Underground	[3] 10,533,199		10,035,000	
	24,587,616	(2)	30,484,000	(2)
Shipments (exclusive of ore for paint)	25,792,606	$66,483,846	33,308,000	$82,864,000
Average value per ton at mines		2.58		2.49
Stocks at mines	10,340,690	(2)	7,616,000	(2)
Imported	1,427,521	3,307,504	1,492,435	3,482,438
Exported	608,922	2,243,066	660,553	1,913,463
Pig iron:				
Production	15,686,442	(2)	20,827,196	(2)
Shipments	[4] 15,626,192	[4] 261,399,963	21,178,353	358,145,499
Average value per ton at furnaces		[4] 16.73		16.91
Imported for consumption	114,488	1,465,475	130,937	1,979,324
Exported	4,096	97,050	4,107	96,272
Ferro-alloys:				
Production	452,607	(2)	545,316	(2)
Shipments:				
Ferromanganese	147,947	12,345,697	194,627	16,374,328
Spiegeleisen	45,769	1,099,922	54,793	1,303,574
Ferrosilicon	181,209	7,401,799	263,264	11,630,793
Other varieties	53,873	13,787,539	79,492	19,582,897
	428,798	34,634,957	592,176	48,891,592
Imported for consumption:				
Ferromanganese	23,349	1,441,360	27,240	1,731,401
Spiegeleisen	21,184	595,017	32,384	915,134
Ferrosilicon	6,537	189,954	5,274	135,422
Steel production:				
Open hearth:				
Basic	23,256,417	(2)	30,361,237	(2)
Acid	274,688		354,192	
Bessemer	2,162,357		2,835,031	
Crucible	531		642	
Electric	361,296		541,492	
	26,055,289	(2)	34,092,594	(2)

[1] Some hematite included with magnetite.
[2] Figures not available.
[3] Some open-pit included with underground.
[4] Revised figures.

Men employed and output per man at iron-ore mines.—Although complete information on employment at iron-ore mines in 1935 is not yet available, the increased operating rates at blast furnaces and steel works were accompanied by a gain of about 5,896,000 tons in the output of iron ore, indicating that iron-ore miners worked about 6,100,000 man-hours more in 1935 than in 1934. The complete record for 1934 on iron-ore mining shows that greater activity at blast furnaces and steel works in that year also materially benefited the miners. In 1934, for example, 16,513 men working 25,478,440 man-hours produced 24,587,616 tons of merchantable ore, equivalent to an average output of 0.965 ton per man-hour. In 1933, 15,125 men working 17,931,479 man-hours produced 17,553,188 tons of merchantable ore, equivalent to an average output of 0.979 ton per man-hour. Thus, from 1933 to 1934 the total man-hours worked

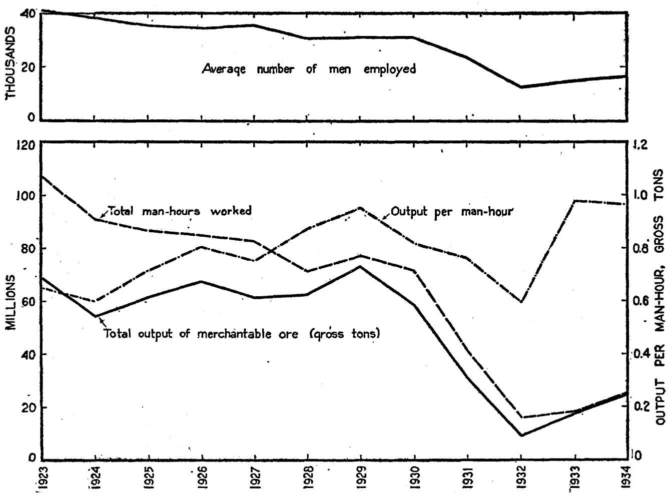

FIGURE 65.—Trends in number of men employed at iron-ore mines, output of merchantable ore, man-hours worked, and output per man-hour in the United States, 1923–34.

increased 42 percent and the total merchantable ore production increased 40 percent, while the average output per man-hour decreased 1.43 percent. The average output per man-hour in 1934, however, was 28 percent greater than the average for the 10-year period 1923–32, which was 0.754 ton per man-hour. The decline in the output per man-hour in 1934 compared with 1933 was due mainly to a shift in the production of ore from open-pit mines to underground mines and to the stripping of proportionately more overburden in preparation for future mining. Specifically, 65 percent of the iron-ore output came from open-pit mines in 1933 compared with only 57 percent in 1934.

In 1934 in the Lake Superior district 12,006 men working 19,120,480 man-hours produced 21,031,019 tons of merchantable ore, equivalent to an average output of 1.100 tons per man-hour. In 1933, 11,598 men working 12,586,959 hours produced 14,611,032 tons of merchantable ore, equivalent to an average output of 1.161 tons per man-hour. Thus, from 1933 to 1934 the total man-hours worked increased 52 percent and the total merchantable ore production 44 percent, while the average output per man-hour decreased 5.25 percent. The average output per man-hour in 1934, however, was 20 percent greater than the average of 0.916 ton per man-hour for the 10-year period 1923–32.

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, improved mining methods, operation of larger units, and efficient management of mines, the gain in 1933 and 1934 compared with the 10 years 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, 83 percent was so produced in 1933 and 1934. The significance of this shift is appreciated when it is recalled that Minnesota contributed 60 percent of the total

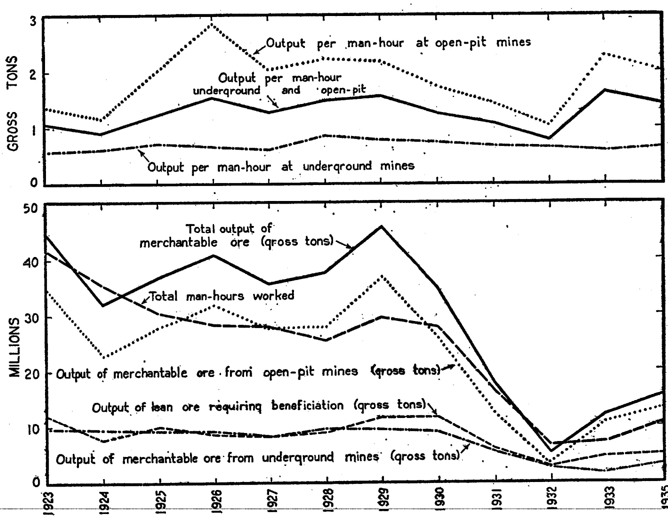

FIGURE 66.—Trends in output of merchantable iron ore per man-hour at open-pit and underground mines in Minnesota compared with production of merchantable and lean ore and total man-hours worked, 1923–34.

merchantable ore produced during the period 1923–34 and that during this period the output of men at open-pit operations averaged 1.809 tons per man-hour as compared with only 0.679 ton per man-hour for workers at underground mines.

The greater output per man-hour in recent years was also due partly to the stripping of proportionately less overburden in Minnesota in 1933 and 1934 in preparation for future mining than in the period 1923–32. In 1933–34, for instance, only about one-fourth cubic yard of overburden was removed to each ton of merchantable ore mined at both open-pit and underground mines in Itasca and St. Louis Counties, Minn., whereas during the 10-year period 1923–32 about one-half cubic yard of overburden was removed to each ton of merchantable ore mined. Obviously, any material shift in the labor force to the direct mining of ore at the expense of that used for stripping in preparation for future mining will result in a much lower man-hour cost of mining. This is strikingly illustrated in figure 66, which shows that in 1926, 1933, and 1934, when only about one-fourth cubic yard of overburden was removed to each ton of merchantable ore mined at both open-pit and underground mines, the average output per worker increased substantially, whereas during the other years, when one-third to four-fifths cubic yard of overburden was removed to each ton of ore so mined, a decrease in the output of the worker resulted.

Still another factor that affects the output per man-hour is the tendency toward mining leaner ore. Proportionately more lean ore requiring beneficiation was mined in Minnesota in 1933 and 1934 than during the period 1923–32. In 1933–34, for instance, beneficiated ore represented 20.72 percent of the total merchantable ore produced in Minnesota compared with an average of only 16.07 percent during the period 1923–32.

In the Southeastern district the average output of merchantable ore per man-hour increased from 0.471 ton per man-hour in 1933

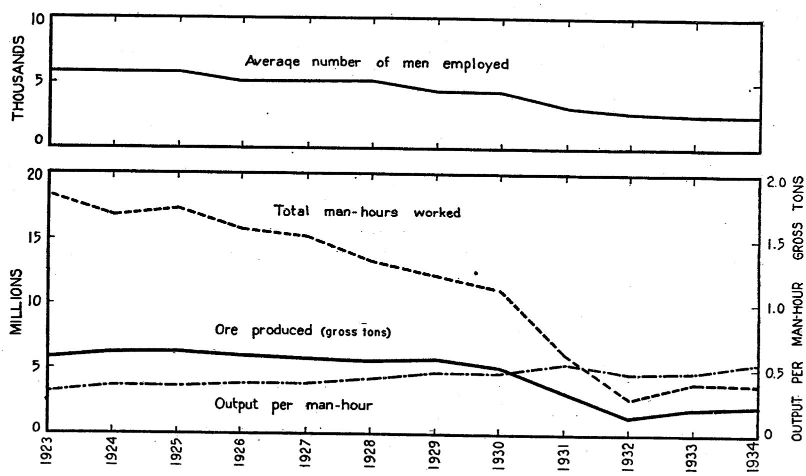

FIGURE 67.—Trends in production, man-hours worked, output per man-hour, and number of men employed at iron-ore mines in Jefferson County, Ala., 1923–34.

to 0.503 ton in 1934. The largest and most consistent producing mines in the Southeastern district are in Jefferson County, Ala., where 2,444 men working 3,726,143 man-hours in 1934 produced 2,049,915 tons of merchantable ore, equivalent to an average output per man-hour of 0.550 ton; 2,556 men working 3,965,744 hours in 1933 produced 1,925,090 tons of merchantable ore, equivalent to an average output per man-hour of 0.485 ton. 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 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 declined from 0.835 ton in 1933 to 0.639 ton in 1934, a decrease of 23 percent. This decrease was due mainly to the fact that 42 percent of the merchantable ore produced in 1934 came from underground mines compared with only 33 percent in 1933. The average output per man-hour of workers mining ore underground and concentrating it decreased 21 percent from 1933, whereas the average output per man-hour of workers producing ore at open-pit operations in this district increased 22 percent.

The average length of the man-shift in the entire iron-ore industry declined from 8.5 hours in 1933 to 8 hours in 1934. With few exceptions mines employed the 8-hour shift throughout 1934.

The two following tables, prepared in collaboration with W. W. Adams, show employment at iron-ore mines and beneficiating plants, quantity and tenor of ore produced, and average output per man by districts for 1923–34 and by States for 1933–34. Corresponding statistics by States for 1923–32, as well as other supplementary data, are given in the chapter on Iron Ore, Pig Iron, Ferro-Alloys, and Steel in Minerals Yearbook, 1934 (p. 322 to 339).

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Employment at iron-ore mines and beneficiating plants, quantity and tenor of ore produced, and average output per man, 1923–34, by districts

[Exclusive of ore containing 5 percent or more manganese]

Year	Employment: Average number of men employed	Employment: Time employed: Average number of days	Employment: Time employed: Total man-shifts	Employment: Time employed: Man-hours: Average per day	Employment: Time employed: Man-hours: Total	Production: Crude ore (partly estimated), gross tons	Production: Merchantable ore: Gross tons	Production: Merchantable ore: Iron (natural) contained: Gross tons	Production: Merchantable ore: Iron (natural) contained: Percent	Average per man (gross tons): Crude ore (partly estimated): Per day	Average per man (gross tons): Crude ore (partly estimated): Per hour	Average per man (gross tons): Merchantable ore: Per day	Average per man (gross tons): Merchantable ore: Per hour	Average per man (gross tons): Merchantable ore: Iron (natural) contained: Per day	Average per man (gross tons): Merchantable ore: Iron (natural) contained: Per hour
UNITED STATES															
1923	41,294	286	11,797,682	9.1	107,551,244	80,669,623	69,351,442	34,970,464	50.42	6.838	0.750	5.878	0.645	2.964	0.325
1924	38,765	263	10,201,678	9.0	91,324,498	61,458,841	54,267,419	27,082,183	49.91	6.024	.673	5.319	.594	2.655	.297
1925	35,757	270	9,665,877	8.9	86,286,684	70,474,965	61,907,997	31,090,824	50.22	7.291	.817	6.405	.717	3.217	.360
1926	34,399	273	9,395,178	9.0	84,225,524	75,943,775	67,623,000	34,099,262	50.43	8.083	.902	7.198	.803	3.629	.405
1927	34,755	264	9,177,979	8.9	82,004,761	69,923,057	61,741,100	30,879,989	50.02	7.619	.853	6.727	.753	3.365	.377
1928	30,238	265	8,008,647	8.9	71,403,631	70,940,916	62,197,088	31,149,584	50.08	8.858	.994	7.766	.871	3.889	.436
1929	30,763	281	8,638,234	8.9	77,111,086	83,164,881	73,027,720	36,637,660	50.17	9.628	1.079	8.454	.947	4.241	.475
1930	30,975	259	8,037,096	8.9	71,620,115	68,551,913	58,408,664	29,212,457	50.01	8.529	.957	7.267	.816	3.635	.408
1931	22,867	201	4,596,504	8.9	40,928,283	35,563,994	31,131,502	15,625,050	50.19	7.737	.869	6.773	.761	3.399	.382
1932	12,649	145	1,828,002	9.0	16,427,009	11,181,678	9,846,916	4,948,243	50.25	6.117	.681	5.387	.599	2.707	.301
1933	15,125	140	2,121,494	8.5	17,931,479	21,225,958	17,553,188	8,777,574	50.01	10.005	1.184	8.274	.979	4.137	.490
1934	16,513	193	3,186,232	8.0	25,478,440	28,252,926	24,587,616	12,384,257	50.37	8.867	1.109	7.717	.965	3.887	.486
LAKE SUPERIOR															
1923	28,756	292	8,397,782	8.8	74,197,870	63,737,822	59,394,180	30,860,060	51.96	7.590	.859	7.073	.800	3.675	.416
1924	27,651	269	7,449,720	8.7	64,679,800	47,561,165	44,942,898	23,351,488	51.96	6.384	.735	6.033	.695	3.135	.361
1925	25,472	268	6,837,245	8.6	58,916,445	55,569,424	52,163,922	27,160,188	52.07	8.127	.943	7.629	.885	3.972	.461
1926	24,483	271	6,645,613	8.6	57,094,412	60,410,352	57,272,643	29,737,718	51.92	9.090	1.058	8.618	1.003	4.475	.521
1927	24,904	258	6,424,947	8.6	55,268,641	54,744,797	51,627,335	26,647,001	51.61	8.521	.991	8.035	.934	4.147	.482
1928	20,881	266	5,562,599	8.6	47,996,087	56,059,314	52,525,581	27,061,370	51.52	10.078	1.168	9.443	1.094	4.865	.564
1929	21,811	286	6,243,609	8.7	54,615,027	67,609,545	62,825,826	32,294,527	51.40	10.829	1.238	10.062	1.150	5.172	.591
1930	22,301	261	5,823,736	8.8	51,197,616	54,323,659	49,383,385	25,295,164	51.22	9.328	1.061	8.480	.965	4.343	.494
1931	16,487	207	3,404,984	8.8	30,017,397	28,188,521	25,877,416	13,408,123	51.81	8.279	.939	7.600	.862	3.938	.447
1932	8,768	163	1,427,926	8.9	12,638,707	9,160,742	8,139,427	4,267,074	52.42	6.415	.725	5.700	.644	2.988	.338
1933	11,598	130	1,512,172	8.3	12,586,959	16,608,574	14,611,032	7,571,079	51.82	10.983	1.320	9.662	1.161	5.007	.602
1934	12,006	199	2,391,091	8.0	19,120,480	22,862,450	21,031,019	10,880,320	51.73	9.562	1.196	8,796	1.100	4.550	.569

SOUTHEASTERN																
1923	9,220	286	2,633,776	10.2	26,836,560	13,866,000	7,383,403	2,771,682	37.54	5.265	.517	2.803	.275	1.052	.103
1924	8,428	267	2,254,179	9.9	22,394,244	11,791,000	7,388,822	2,742,748	37.12	5.231	.527	3.278	.330	1.217	.122
1925	7,995	287	2,295,030	10.0	22,860,533	12,395,000	7,455,085	2,783,059	37.33	5.401	.542	3.248	.326	1.213	.122
1926	6,992	285	1,989,600	10.4	20,608,685	11,674,198	7,102,607	2,659,468	37.44	5.868	.566	3.570	.345	1.337	.129
1927	6,737	271	1,825,168	10.3	18,872,054	10,965,528	6,714,810	2,498,225	37.20	6.008	.581	3.679	.356	1.369	.132
1928	6,383	259	1,654,319	10.2	16,827,784	11,281,000	6,537,726	2,451,191	37.49	6.819	.670	3.952	.389	1.482	.146
1929	5,917	260	1,541,248	10.0	15,391,042	11,138,675	6,645,237	2,497,520	37.58	7.227	.724	4.312	.432	1.620	.162
1930	5,303	254	1,347,721	9.8	13,145,780	10,039,100	5,838,105	2,196,940	37.63	7.449	.764	4.332	.444	1.630	.167
1931	3,752	195	731,303	9.6	7,011,326	5,364,000	3,644,606	1,359,470	37.30	7.335	.765	4.984	.520	1.859	.194
1932	2,891	106	305,489	9.7	2,964,520	1,634,925	1,375,459	514,142	37.40	5.352	.551	4.502	.464	1.683	.173
1933	3,025	171	515,862	8.9	4,583,196	3,785,589	2,159,958	811,077	37.55	7.338	.826	4.187	.471	1.572	.177
1934	2,987	195	582,511	8.0	4,664,688	3,867,738	2,347,625	883,250	37.62	6.640	.829	4.030	.503	1.516	.189
NORTHEASTERN																
1923	2,418	220	531,780	8.7	4,634,464	2,277,701	1,843,096	946,525	51.36	4.283	.491	3.466	.398	1.780	.204
1924	1,790	151	270,748	8.9	2,414,316	1,253,305	1,128,481	549,179	48.67	4.629	.519	4.168	.467	2.028	.227
1925	1,519	222	337,770	8.7	2,949,278	1,521,014	1,302,841	612,835	47.04	4.503	.516	3.857	.442	1.814	.208
1926	2,077	250	519,808	8.8	4,594,321	2,395,664	1,943,471	997,575	51.33	4.609	.521	3.739	.423	1.919	.217
1927	2,213	293	649,069	8.7	5,633,706	2,984,673	2,244,254	1,124,976	50.13	4.598	.530	3.458	.398	1.733	.200
1928	1,977	244	482,305	8.5	4,093,401	2,381,804	1,986,959	1,034,908	52.09	4.938	.582	4.120	.485	2.146	.253
1929	2,097	269	563,692	8.5	4,787,157	2,843,595	2,195,601	1,140,708	51.95	5.045	.594	3.895	.459	2.024	.238
1930	2,731	262	714,189	8.5	6,058,999	3,107,185	2,248,682	1,238,005	55.05	4.351	.513	3.149	.371	1.733	.204
1931	1,688	175	295,217	8.7	2,570,050	1,224,797	936,960	509,590	54.39	4.149	.477	3.174	.365	1.726	.198
1932	585	101	58,906	9.0	530,682	218,990	165,009	78,960	47.85	3.718	.413	2.801	.311	1.340	.149
1933	310	186	57,625	8.2	474,644	445,825	396,228	190,213	48.01	7.737	.939	6.876	.835	3.301	.401
1934	1,263	142	178,930	8.0	1,422,916	1,222,710	908,944	459,258	50.53	6.833	.859	5.080	.639	2.567	.323
WESTERN																
1923	900	260	234,344	8.0	1,882,350	788,100	730,763	392,197	53.67	3.363	.419	3.118	.388	1.674	.208
1924	896	253	227,031	8.1	1,836,138	853,371	807,218	438,768	54.36	3.759	.465	3.556	.440	1.933	.239
1925	771	254	195,832	8.0	1,560,428	989,527	986,149	534,742	54.23	5.053	.634	5.036	.632	2.731	.343
1926	847	284	240,157	8.0	1,928,106	1,463,561	1,304,279	704,501	54.01	6.094	.759	5.431	.676	2.934	.365
1927	901	309	278,795	8.0	2,230,360	1,228,059	1,154,701	609,787	52.81	4.405	.551	4.142	.518	2.187	.273
1928	997	310	309,424	8.0	2,486,359	1,218,798	1,146,822	602,115	52.50	3.939	.490	3.706	.461	1.946	.242
1929	938	309	289,685	8.0	2,317,860	1,573,066	1,361,056	704,905	51.79	5.430	.679	4.698	.587	2.433	.304
1930	640	237	151,450	8.0	1,217,720	1,081,969	938,492	482,348	51.40	7.144	.889	6.197	.771	3.185	.396
1931	940	176	165,000	8.1	1,329,510	786,676	672,520	347,867	51.73	4.768	.592	4.076	.506	2.108	.262
1932	405	88	35,681	8.2	293,100	167,021	167,021	88,067	52.73	4.681	.570	4.681	.570	2.468	.300
1933	192	187	35,835	8.0	286,680	385,970	385,970	205,205	53.17	10.771	1.346	10.771	1.346	5.726	.716
1934	257	131	33,700	8.0	270,356	300,028	300,028	161,429	53.80	8.903	1.110	8.903	1.110	4.790	.597

Employment at iron-ore mines and beneficiating plants, quantity and tenor of ore produced, and average output per man, 1933–34, by districts and States

[Exclusive of ore containing 5 percent or more manganese]

District and State	Employment: Average number of men employed	Employment: Time employed: Average number of days	Employment: Time employed: Total man-shifts	Employment: Time employed: Man-hours: Average per day	Employment: Time employed: Man-hours: Total	Production: Crude ore (partly estimated), gross tons	Production: Merchantable ore: Gross tons	Production: Merchantable ore: Iron (natural) contained: Gross tons	Production: Merchantable ore: Iron (natural) contained: Percent	Production: Average per man (gross tons): Crude ore (partly estimated): Per day	Production: Average per man (gross tons): Crude ore (partly estimated): Per hour	Production: Average per man (gross tons): Merchantable ore: Per day	Production: Average per man (gross tons): Merchantable ore: Per hour	Production: Average per man (gross tons): Merchantable ore: Iron (natural) contained: Per day	Production: Average per man (gross tons): Merchantable ore: Iron (natural) contained: Per hour
1933															
Lake Superior:															
Michigan	4, 822	121	583, 896	8. 3	4, 832, 064	2, 433, 949	2, 433, 949	1, 254, 603	51. 55	4. 168	0. 504	4. 168	0. 504	2. 149	0. 260
Minnesota	6, 549	133	872, 188	8. 4	7, 283, 050	13, 946, 138	11, 948, 596	6, 194, 413	51. 84	15. 990	1. 915	13. 700	1. 641	7. 102	. 851
Wisconsin	227	247	56, 088	8. 4	471, 845	228, 487	228, 487	122, 063	53. 42	4. 074	. 484	4. 074	. 484	2. 176	. 259
	11, 598	130	1, 512, 172	8. 3	12, 586, 959	16, 608, 574	14, 611, 032	7, 571, 079	51. 82	10. 983	1. 320	9. 662	1. 161	5. 007	. 602
Southeastern:															
Alabama	2, 940	171	504, 146	8. 9	4, 485, 588	3, 749, 000	2, 133, 457	799, 099	37. 46	7. 436	. 836	4. 232	. 476	1. 585	. 178
Georgia	} 85	} 138	} 11, 716	} 8. 3	} 97, 608	} 36, 589	1, 302	587	45. 00	} 3. 123	} . 375	} 2. 262	} . 272	} 1. 022	} . 123
Tennessee							24, 912	11, 262	45. 21						
Virginia							287	129	45. 00						
	3, 025	171	515, 862	8. 9	4, 583, 196	3, 785, 589	2, 159, 958	811, 077	37. 55	7. 338	. 826	4. 187	. 471	1. 572	. 177
Northeastern:															
New Jersey	} 310	} 186	} 57, 625	} 8. 2	} 474, 644	80, 180	73, 144	44, 742	61. 17	} 7. 737	} . 939	} 6. 876	} . 835	} 3. 301	} . 401
New York						101, 150	58, 718	40, 369	68. 75						
Pennsylvania						264, 495	264, 366	105, 102	39. 76						
	310	186	57, 625	8. 2	474, 644	445, 825	396, 228	190, 213	48. 01	7. 737	. 939	6. 876	. 835	3. 301	. 401

Western:															
California						25	25	11	42.00						
Missouri	65	228	14,826	8.0	118,608	395	395	264	66.74	6.565	.821	6.565	.821	3.441	.430
Utah						95,279	95,279	49,746	52.21						
Washington						1,631	1,631	993	60.85						
Wyoming	127	165	21,009	8.0	168,072	288,640	288,640	154,191	53.42	13.739	1.717	13.739	1.717	7.339	.917
	192	187	35,835	8.0	286,680	385,970	385,970	205,205	53.17	10.771	1.346	10.771	1.346	5.726	.716
	15,125	140	2,121,494	8.5	17,931,479	21,225,958	17,553,188	8,777,574	50.01	10.005	1.184	8.274	.979	4.137	.490
1934															
Lake Superior:															
Michigan	4,885	192	938,068	8.0	7,505,151	5,039,144	5,039,144	2,612,255	51.84	5.372	.671	5.372	.671	2.785	.348
Minnesota	6,717	201	1,347,498	8.0	10,779,945	17,221,301	15,389,870	7,945,555	51.63	12.780	1.598	11.421	1.428	5.897	.737
Wisconsin	404	261	105,525	7.9	835,384	602,005	602,005	322,510	53.57	5.705	.721	5.705	.721	3.056	.386
	12,006	199	2,391,091	8.0	19,120,480	22,862,450	21,031,019	10,880,320	51.73	9.562	1.196	8.796	1.100	4.550	.569
Southeastern:															
Alabama	2,927	198	579,796	8.0	4,638,936	3,859,972	2,343,819	881,583	37.61	6.657	.832	4.042	.505	1.521	.190
Georgia							164								
Tennessee	60	45	2,715	9.5	25,752	7,766	3,345	1,667	43.80	2.860	.302	1.402	.148	.614	.065
Virginia							297								
	2,987	195	582,511	8.0	4,664,688	3,867,738	2,347,625	883,250	37.62	6.640	.829	4.030	.503	1.516	.189
Northeastern:															
New Jersey						239,374	138,685	80,891	58.33						
New York	1,263	142	178,930	8.0	1,422,916	457,886	244,962	165,647	67.62	6.833	.859	5.080	.639	2.567	.323
Pennsylvania						525,450	525,297	212,720	40.50						
	1,263	142	178,930	8.0	1,422,916	1,222,710	908,944	459,258	50.53	6.833	.859	5.080	.639	2.567	.323
Western:															
California						16,333	16,333								
Missouri	127	167	21,246	8.0	170,724	4,104	4,104	97,087	52.92	8.635	1.075	8.635	1.075	4.570	.569
Utah						161,109	161,109								
Washington						1,920	1,920								
Wyoming	130	96	12,454	8.0	99,632	116,562	116,562	64,342	55.20	9.359	1.170	9.359	1.170	5.166	.646
	257	131	33,700	8.0	270,356	300,028	300,028	161,429	53.80	8.903	1.110	8.903	1.110	4.790	.597
	16,513	193	3,186,232	8.0	25,478,440	28,252,926	24,587,616	12,384,257	50.37	8.867	1.109	7.717	.965	3.887	.486

IRON ORE

Production and shipments.—The iron ore mined in the United States in 1935, exclusive of ore that contained 5 percent or more manganese in the natural state, is estimated at 30,484,000 gross tons, an increase of 24 percent over 1934. The ore shipped from the mines in 1935 is estimated at 33,308,000 gross tons valued at $82,864,000, an increase of 29 percent in quantity and 25 percent in total value over 1934.

The average value of the ore per gross ton at the mines in 1935 is estimated at $2.49.

Lake Superior district.—About 84 percent of the iron ore shipped in 1935 came from the Lake Superior district, in which approximately 25,360,000 gross tons were mined and 27,923,000 tons shipped, increases of 21 and 28 percent, respectively, compared with 1934. The ore shipped in 1935 was valued at the mines at $72,941,000, an increase of 24 percent over 1934. These totals include the ore shipped from all mines by rail and water but exclude manganiferous ores amounting to approximately 509,000 gross tons in 1935 and 198,560 tons in 1934 that contained 5 percent or more manganese in the natural state. The average value of the ore at the mines in the Lake Superior district was $2.61 a ton in 1935.

Southeastern States.—The Southeastern States, in which the Birmingham district is the largest iron-ore producing area, mined approximately 3,256,000 gross tons of iron ore in 1935, an increase of 38 percent over 1934. Shipments of iron ore from mines in these States in 1935 totaled 3,537,000 gross tons valued at $5,784,000, increases of 30 and 31 percent, respectively, over 1934. The average value of the ore produced in these States in 1935 was $1.64 per gross ton.

Iron ore mined and shipped in the United States, 1934–35, by States and principal districts [1]

District	Ore mined (gross tons)		Ore shipped			
			1934		1935	
	1934	1935	Gross tons	Value	Gross tons	Value
Lake Superior:						
Michigan	5,039,144	5,214,000	5,497,953	$15,646,165	7,185,000	$20,537,000
Minnesota	15,389,870	19,359,000	15,768,418	41,843,148	20,016,000	50,454,000
Wisconsin	602,005	787,000	595,891	1,565,958	722,000	1,950,000
	21,031,019	25,360,000	21,862,262	59,055,271	27,923,000	72,941,000
Southeastern States:						
Alabama	2,343,819	3,240,000	2,720,923	4,379,827	3,520,000	5,745,000
Georgia	164		1,098	1,845		
Missouri	4,104		4,154	13,271		
North Carolina	----------	16,000	----------	----------	17,000	39,000
Tennessee	3,345		3,040	6,080		
Virginia	297		297	594		
	2,351,729	3,256,000	2,729,512	4,401,617	3,537,000	5,784,000
Northern States:						
New Jersey	138,685	72,000	145,326	1,533,857	82,000	1,551,000
New York	244,962	302,000	235,025		322,000	
Pennsylvania	525,297	978,000	524,657	1,052,770	928,000	1,861,000
	908,944	1,352,000	905,008	2,586,627	1,332,000	3,412,000
Western States	295,924	516,000	295,824	440,331	516,000	727,000
Grand total	24,587,616	30,484,000	25,792,606	66,483,846	33,308,000	82,864,000

[1] Figures for 1935 are preliminary and subject to revision.

Northeastern States.—The Northeastern States, which include the Adirondack district, New York, and the Cornwall district, Pennsylvania, in 1935 mined 1,352,000 gross tons of iron ore, an increase of 49 percent over 1934. The iron ore shipped from mines in these States totaled 1,332,000 tons valued at $3,412,000, increases of 47 and 32 percent, respectively, compared with 1934. The average value of the ore in these States in 1935 was $2.56 per gross ton.

Western States.—In 1935 California, Idaho, Utah, Washington, and Wyoming mined and shipped 516,000 gross tons of iron ore valued at $727,000.

Iron ore consumed.—The production of 20,827,196 gross tons of pig iron in 1935 required 35,497,954 gross tons of iron and manganiferous iron ores, 2,637,464 tons of cinder and scale, and 666,220 tons of purchased scrap, an average of 1.863 tons of metalliferous materials per ton of iron made. In addition, 883,500 tons of home scrap and 1,147,000 tons of flue dust were consumed in 1935.

The greater part of the iron ore used in Alabama furnaces in 1935 was hematite, chiefly from mines in Jefferson County, but some came from Etowah County, Ala. Considerable brown ore and small quantities of ferruginous manganese ore, iron sinter, and imported iron ore also were used. The brown ore was chiefly from mines in the Birmingham and Russellville districts, Alabama; the ferruginous manganese ore was chiefly from mines in Alabama, Arkansas, and Georgia; and the iron sinter was from Tennessee. In 1935 Alabama furnaces consumed an average of 2.364 tons of ore in making 1 ton of pig iron, the highest average of any State.

In 1935 Maryland furnaces used chiefly foreign ores obtained from Australia, Chile, Cuba, Spain, Sweden, and U. S. S. R. (Russia). These furnaces consumed an average of only 1.385 tons of ore in making 1 ton of pig iron; however, they used proportionately more cinder, scale, and scrap than the furnaces in any other State except Kentucky.

Blast furnaces in Illinois, Indiana, Kentucky, Michigan, Ohio, and West Virginia used Lake Superior iron ore and manganiferous iron ore exclusively in 1935. The consumption of ores per ton of iron made in these States ranged from 1.191 tons in Kentucky to 1.729 tons in Indiana.

In New York the furnaces in the Buffalo district used ores chiefly from the Lake Superior district; the furnace at Standish used chiefly magnetite from the Chateaugay mine at Lyon Mountain, N. Y.; and the furnace at Troy used chiefly magnetite from the mines at Mineville, N. Y. In making 1 ton of pig iron these furnaces required an average of 1.667 tons of ore in 1935.

The furnaces in western Pennsylvania used ore from the Lake Superior district. Those in the eastern part of the State used some lake ores; magnetite from mines in New Jersey, New York, and Pennsylvania; and considerable quantities of ores from Africa, Brazil, Chile, Cuba, Spain, Sweden, and U. S. S. R. (Russia). An average of 1.676 tons of ore was used to make 1 ton of pig iron in Pennsylvania in 1935.

The furnace in Tennessee used brown iron ore and iron sinter from Tennessee.

The blast furnaces at Pueblo, Colo., used hematite from the Sunrise mine in Wyoming, rhodochrosite from the Emma mine in Montana, and ferruginous manganese ore from Colorado and Utah.

The blast furnace at Provo, Utah, used iron ore chiefly from the Desert Mound mine in the Iron Springs district, Utah. Most of the ferruginous manganese ore used was obtained from Montana.

Iron ore and other metallic materials consumed and pig iron produced in 1935, by States, in gross tons

State	Metalliferous materials consumed: Iron and manganiferous iron ores: Domestic	Metalliferous materials consumed: Iron and manganiferous iron ores: Foreign	Metalliferous materials consumed: Cinder, scale, and scrap	Metalliferous materials consumed: Total	Pig iron produced, exclusive of ferroalloys	Materials consumed per ton of iron made: Ores	Materials consumed per ton of iron made: Cinder, scale, and scrap	Materials consumed per ton of iron made: Total
Alabama	3,059,883	7,820	66,812	3,134,515	1,297,960	2.364	0.051	2.415
Illinois	3,434,381		274,266	3,708,647	2,014,116	1.705	.136	1.841
Indiana	3,671,548		431,558	4,103,106	2,124,241	1.729	.203	1.932
Kentucky	254,763		77,832	332,595	213,837	1.191	.364	1.555
Maryland	19,059	1,176,652	276,719	1,472,430	863,308	1.385	.321	1.706
Michigan	1,226,985		113,777	1,340,762	774,237	1.585	.147	1.732
New York	2,413,628	5,777	124,917	2,544,322	1,451,394	1.667	.086	1.753
Ohio	9,405,174		837,707	10,242,881	5,634,530	1.669	.149	1.818
Pennsylvania	9,004,060	180,459	928,444	10,112,963	5,479,792	1.676	.170	1.846
West Virginia	1,119,807		160,026	1,279,833	686,350	1.632	.233	1.865
Undistributed [1]	517,958		11,626	529,584	287,431	1.802	.040	1.842
	34,127,246	1,370,708	3,303,684	38,801,638	20,827,196	1.704	.159	1.863

[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, 1934–35, by sources of ore, in gross tons

Source of ore	1934	1935	Source of ore	1934	1935
Africa	57,413	13,640	Spain	32,888	9,638
Australia	54,653	66,879	Sweden	28,089	20,547
Brazil	351	97	U. S. S. R. (Russia)	140,327	125,646
Canada		1,830	Undistributed	232	
Chile	866,469	864,060			
Cuba	134,191	268,371		1,314,623	1,370,708
India	10				

Stocks of ore at mines.—According to the reports of producers the quantity of iron ore in stock at the mines at the end of 1935 totaled 7,616,000 gross tons, a decrease of 26 percent from 1934.

Stocks of iron ore at mines, Dec. 31, 1934–35, by States, in gross tons

State	1934	1935	State	1934	1935
Alabama	398,895	120,501	North Carolina	200	200
Iowa	12,165	12,165	Pennsylvania	450	50,000
Michigan	6,658,952	4,732,000	Virginia	3,473	3,363
Minnesota	2,775,198	2,179,000	Wisconsin	278,164	340,000
Missouri	4,571	3,771			
New Jersey	118,611	109,000		10,340,690	7,616,000
New York	90,011	66,000			

Iron-ore analyses.—The iron content of the iron ore and manganiferous iron ore shipped from the Lake Superior district in 1935 averaged 51.44 percent (natural) compared with 51.49 percent (revised figure) in 1934 and 51.85 percent in 1933.

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, of course, mean that the average grade of the 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.

Average analyses of total tonnages of all grades of iron ore from all ranges of Lake Superior district, 1931–35

Year	Gross tons	Iron (natural)	Phosphorus	Silica	Manganese	Moisture
		Percent	*Percent*	*Percent*	*Percent*	*Percent*
1931	23,281,333	51.53	0.087	8.60	0.80	10.84
1932	3,552,575	52.16	.099	9.05	.68	9.92
1933	21,455,174	51.85	.090	8.96	.71	10.47
1934	21,841,382	[1] 51.49	.087	8.93	.76	10.66
1935	28,214,056	51.44	.093	8.93	.79	10.75

[1] Revised figure.

Stocks of ore at Lake Erie ports.—According to the Lake Superior Iron Ore Association, 5,313,265 gross tons of iron ore were in stock at Lake Erie ports at the close of navigation in 1935, compared with 5,248,555 tons on the corresponding date in 1934. At the opening of navigation in May 1936, 4,129,948 tons were in stock at these ports, indicating a withdrawal of 1,183,317 tons during the winter of 1935–36.

Prices of Lake Superior ore.—The unit prices in 1935 for the four standard grades of Lake Superior ore were the same as those in 1929–34, as follows: Old-range Bessemer, 9.32 cents; Mesabi Bessemer 9.029 cents; old-range non-Bessemer, 9.029 cents; and Mesabi non-Bessemer, 8.738 cents. The prices per ton that corresponded to these prices were, respectively, $4.80, $4.65, $4.65, and $4.50. The base of Bessemer ore, old-range and Mesabi, for 1925–35 was a metallic iron content of 51.5 percent (natural), instead of 55 percent as for 1924 and many earlier years. The base of non-Bessemer ore, old-range and Mesabi, remained at 51.5 percent (natural).

Iron-ore reserves.—Estimates of ore reserves for Minnesota, furnished by the Minnesota Tax Commission, and for Michigan, furnished by the Michigan Board of State Tax Commissioners, cover developed and prospective ore in the ground and ore in stock piles. These estimates show decreases of 16,272,000 tons in Minnesota and 3,789,000 tons in Michigan from 1934.

Iron-ore reserves in Minnesota, May 1, 1931–35, in gross tons

Range	1931	1932	1933	1934	1935
Mesabi	1,162,776,979	1,190,295,183	1,205,213,398	1,195,271,786	1,178,270,779
Vermilion	14,789,137	14,237,637	14,007,192	13,243,125	13,656,569
Cuyuna	66,756,610	69,699,960	70,024,921	47,553,536	47,869,112
	1,244,322,726	1,274,232,780	1,289,245,511	1,256,068,447	1,239,796,460

Iron-ore reserves in Michigan, Jan. 1, 1932–36, in gross tons

Range	1932	1933	1934	1935	1936
Gogebic	50, 793, 057	50, 473, 546	48, 612, 579	47, 721, 016	45, 615, 323
Marquette	56, 335, 788	55, 894, 039	54, 564, 005	53, 513, 561	52, 461, 173
Menominee (including Iron River and Crystal Falls districts)	59, 940, 058	58, 264, 532	60, 845, 357	60, 978, 904	60, 347, 752
	167, 068, 903	164, 632, 117	164, 021, 941	162, 213, 481	158, 424, 248

Foreign trade in iron ore.—The iron ore imported into the United States totaled 1,492,435 gross tons valued at $3,482,438 in 1935, an increase of 4.5 percent in quantity and 5.3 percent in total value over 1934. Chile continued to be the chief source of imports, furnishing 53 percent of the total, while Cuba supplied 15 percent, Australia 11 percent, U. S. S. R. (Russia) 8 percent, and Norway 7 percent.

Iron ore imported into the United States, 1933–35, by countries

Country	1933		1934		1935	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Africa:						
Algeria and Tunisia	28, 280	$101, 296	49, 850	$179, 929	13, 900	$33, 941
Morocco	15, 510	63, 181	6, 100	25, 900	----------	----------
Australia	----------	----------	49, 689	89, 568	160, 016	337, 464
Brazil	3, 600	14, 757	----------	----------	----------	----------
Canada	90	316	11, 126	56, 486	20, 453	111, 096
Chile	467, 650	940, 753	938, 376	1, 914, 069	788, 725	1, 460, 073
Cuba	143, 150	330, 526	154, 500	363, 674	221, 010	528, 518
Germany	700	11, 944	20	614	149	2, 602
India, British	1, 199	4, 678	----------	----------	----------	----------
Iran	1, 500	25, 549	----------	----------	2, 950	46, 664
Italy	9	50	----------	----------	----------	----------
Mexico	148	310	1, 618	3, 584	2, 105	5, 136
Netherlands	----------	----------	169	3, 374	----------	----------
Norway	62, 334	247, 202	68, 249	240, 738	110, 027	394, 596
Spain	900	8, 711	1, 159	13, 676	946	10, 130
Sweden	2	10	40, 535	202, 079	57, 753	289, 164
U. S. S. R. (Russia)	135, 840	297, 574	100, 605	177, 374	113, 840	249, 303
United Kingdom	241	7, 455	5, 525	36, 439	561	13, 751
	861, 153	2, 054, 312	1, 427, 521	3, 307, 504	1, 492, 435	3, 482, 438

Exports of iron ore from the United States totaled 660,553 gross tons valued at $1,913,463 ($2.90 a ton) in 1935 compared with 608,922 tons valued at $2,243,066 ($3.68 a ton) in 1934. All the iron ore exported in 1935 went to Canada. Of the exports in 1934, 608,697 tons went to Canada, 212 to Japan, and 13 to Mexico.

Iron-ore mining in Cuba.—Iron ore totaling 224,800 gross tons was shipped from Cuba to the United States in 1935, an increase of 26 percent over 1934. It comprised 122,766 tons of hematite carrying 57.62 percent iron (dried) and 54,362 tons of siliceous ore carrying 31.77 percent iron from the Daiquiri and Juragua mines on the southern coast and 47,672 tons of brown ore (chiefly nodulized) carrying 54.44 percent iron from the Mayari mines near the northern coast.

Iron ore shipped from mines in the Province of Oriente, Cuba, 1884–1935, 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
1884–1933	[1] 20,609,036	20, 438	3, 681, 949	41, 241	903, 103	25, 255, 767
1934	166, 883	----------	11, 377	----------	----------	178, 260
1935	177, 128	----------	47, 672	----------	----------	224, 800
	20, 953, 047	20, 438	3, 740, 998	41, 241	903, 103	25, 658, 827

[1] Of this quantity, 5,932 tons were sent to Pictou, Nova Scotia, and 64,228 tons to ports outside of the United States.

The total stock of ore reported on hand was 571,987 gross tons at the end of 1935 compared with 565,864 tons at the end of 1934.

The preceding table shows the shipments of iron ore from Cuba since the mines were opened in 1884. Statistics of the shipments of Cuban iron ore are collected by the Bureau of Mines.

Brown iron ore in eastern Texas.[3]—During 1934 the brown iron-ore deposits of eastern Texas were examined by Edwin B. Eckel and Paul E. M. Purcell of the U. S. Geological Survey. A preliminary report summarizing the geology was published during 1935 [4] and a final report, to be published later by either the Texas Bureau of Economic Geology or the United States Geological Survey, was completed by Mr. Eckel early in 1936.

The deposits of iron ore occupy part of the coastal plain province in eastern and northeastern Texas. Cass, Cherokee, Marion, and Morris Counties appear to contain the largest deposits, but smaller promising deposits occur in parts of Anderson, Henderson, Nacogdoches, Smith, and Upshur Counties. Since 1855 somewhat less than 700,000 tons of iron ore have been produced, largely for use in local furnaces, all of which have been abandoned for some years.

The most abundant type of ore is limonite, or hydrated iron oxide, which is popularly called "brown ore." In the northern part of the field the ore occurs chiefly as nodules or concretionary forms or as thin lense-shaped bodies and irregular ledges. These are distributed irregularly through a more or less thoroughly weathered zone in the upper part of the greensand. The ore-bearing material which consists of masses of iron oxide in a matrix of altered greensand and light-colored clay ranges from 5 to 30 feet in thickness. In many places 2 or 3 feet of ore occurs within 5 feet of the surface, and the ratio of waste material to ore is seldom more than 5 to 1. Washed ore, ready for shipping to the blast furnace, usually contains from 48 to 57 percent of metallic iron, 5 to 13 percent of silica, 2 to 7 percent of alumina, and less than 0.12 percent of phosphorus.

In the southern part of the area the ore occurs as one solid and almost continuous bed of brown ore, ranging from a few inches to 3 or 4 feet in thickness. The top of the ore bed is nearly flat, and over it there is commonly a thin layer of hard sandstone, above which are layers of loose sand of variable thickness. The base of the ore bed is very irregular, and below it is a layer of white clay which grades downward into the usual weathered greensand. Little or no washing or other concentration of ore of this type is necessary. The southern ores, ready for the furnace, are somewhat lower in grade than the northern ores and usually contain from 42 to 48 percent of iron, 10 to 12 percent of silica, 8 to 12 percent of alumina, and less than 0.25 percent of phosphorus.

Iron carbonate, or siderite, is somewhat plentiful in the ore beds, especially in the northern area. It occurs as white or gray, dense nodules or thin beds, at or near the ground-water level.

With certain limitations as to grade of ore, ratio of ore to waste, and ratio of ore-bearing material to overburden, it is estimated that the total reserves of ore in the northern part of the area are about 109,800,000 long tons within an area of 35,300 acres. The estimated total reserves in the southern part are about 66,808,000 tons within an area of 21,655 acres. Between 150 and 200 million tons of comparatively high-grade iron ore are therefore apparently available in eastern Texas. These figures do not take into account an enormous tonnage of low-grade ferruginous material that might possibly be used in the distant future.

The future of the district appears to depend on the solution of transportation problems. Whether the ores are shipped to other States or used in local furnaces, the freight rates on ore or on coal and limestone have been so high in the past that reasonable profits could hardly be obtained by the operators. If present plans for the development of water transportation should be realized, the Texas ores could probably be utilized in the near future. It seems more probable that they will be shipped to existing iron centers rather than that they will be reduced in local furnaces.

WORLD PRODUCTION

The following table shows the production of iron ore by countries from 1931 to 1935, so far as figures are obtainable. Figures for previous years appear in earlier volumes of Mineral Resources. Com-

[3] Published by permission of the Director, U. S. Geological Survey.

[4] Eckel, Edwin B., and Purcell, Paul E. M., Iron Ores of East Texas: Texas Univ. Bull. 3401, 1935, pp. 482-503.

plete returns for 1935 are not yet available, but those for 1934 and earlier years are fairly complete. Thus, the figures for 1934 indicate a total world production of about 120,400,000 metric tons, of which the United States furnished about 26 percent. In 1933 the United States contributed about 20 percent of the world total, which was about 91,300,000 metric tons.

Iron ore produced, 1931–35, by countries, in metric tons

[Compiled by M. T. Latus]

Country	1931	1932	1933	1934	1935
North America:					
Cuba [1]	92, 407	82, 610	169, 490	181, 121	228, 408
Mexico	65, 156	27, 122	77, 714	105, 799	(2)
Newfoundland [3]	716, 579	150, 867	240, 934	661, 477	(2)
United States	31, 631, 163	10, 004, 959	17, 834, 917	24, 982, 047	30, 973, 000
South America:					
Brazil [4]	30, 000	30, 000	30, 000	30, 000	30, 000
Chile [5]	741, 650	172, 681	559, 598	969, 285	841, 300
Europe:					
Austria	511, 945	306, 796	267, 032	466, 835	772, 611
Belgium	125, 820	92, 810	106, 200	115, 890	(2)
Czechoslovakia	1, 235, 078	602, 215	428, 772	538, 742	(2)
France	38, 558, 650	27, 599, 320	30, 245, 000	32, 015, 000	32, 339, 000
Germany [6]	2, 574, 049	1, 319, 142	2, 534, 768	4, 213, 869	(2)
Greece	235, 967	46, 022	85, 221	147, 408	(2)
Hungary	84, 033	52, 864	50, 021	68, 862	(2)
Italy	560, 853	412, 326	507, 995	484, 583	593, 450
Luxemburg	4, 764, 926	3, 212, 618	3, 362, 417	3, 833, 847	3, 126, 000
Norway	574, 887	373, 907	473, 863	567, 414	740, 000
Poland	284, 653	76, 869	160, 661	247, 365	332, 536
Portugal	(7)		4, 500	2, 895	795
Rumania	61, 907	8, 051	13, 831	83, 590	(2)
Spain	3, 190, 203	1, 760, 471	1, 815, 484	2, 094, 001	2, 700, 000
Sweden	7, 070, 868	3, 298, 989	2, 698, 750	5, 253, 058	(2)
Switzerland [8]	34, 239	11, 862	7, 089	18, 961	(2)
U. S. S. R. (Russia) [10]	10, 612, 000	12, 200, 000	14, 500, 000	21, 700, 000	(2)
United Kingdom: Great Britain [9]	7, 748, 255	7, 445, 807	7, 581, 481	10, 756, 765	(2)
Yugoslavia	133, 411	26, 635	52, 465	179, 841	(2)
Asia:					
China [12]	2, 202, 875	2, 294, 219	2, 456, 870	(11)	(2)
Chosen	164, 712	390, 937	258, 267	176, 008	(2)
India, British	1, 650, 962	1, 788, 757	1, 248, 344	1, 947, 685	(2)
Indochina			420	1, 500	(2)
Japan	208, 182	226, 722	320, 670	(11)	(2)
Unfederated Malay States	703, 092	699, 224	778, 774	1, 153, 876	(2)
U. S. S. R. (Russia)	(10)	(10)	(10)	(10)	(2)
Africa:					
Algeria	900, 850	466, 936	761, 454	1, 326, 437	(2)
Belgian Congo	19, 000	14, 614	(11)	(11)	(2)
Egypt		25		203	(2)
Morocco, Spanish [8]	500, 650	171, 182	515, 838	824, 812	1, 167, 606
Rhodesia:					
Northern	771	722			(2)
Southern	535				(2)
Sierra Leone			24, 944	233, 148	(2)
South-West Africa	22, 214	(11)	(11)	(11)	(2)
Tunisia	446, 600	209, 000	291, 000	546, 500	(2)
Union of South Africa [1]	15, 447	16, 024	60, 060	228, 913	304, 046
Oceania:					
Australia:					
New South Wales			2, 471		
Queensland	4, 629	8, 364	8, 690	3, 282	(2)
South Australia	293, 820	546, 562	732, 760	1, 264, 205	1, 898, 712
New Zealand [13]	7, 031		6, 588	2, 851	(2)
	118, 780, 000	76, 200, 000	91, 300, 000	120, 400, 000	(2)

[1] Shipments.
[2] Data not available.
[3] Shipments from Wabana mines.
[4] Approximate production.
[5] Production of Tofo mines.
[6] Exclusive of manganiferous iron ore carrying 12 to 30 percent manganese.
[7] Less than 1 ton.
[8] Exports.
[9] Exclusive of bog ore, which is used mainly for the purification of gas.
[10] Russia in Asia included with Russia in Europe.
[11] Estimate included in total.
[12] Including Manchuria.
[13] Quantity smelted; production not available.

PIG IRON

Production and shipments.—The total production of pig iron, exclusive of ferro-alloys, reported by manufacturers to the Bureau of Mines, was 20,827,196 gross tons in 1935, compared with 15,686,442 tons in 1934. The production in 1935 consisted of 20,752,456 tons made with coke as fuel and 74,740 tons made with charcoal. Ohio, second to Pennsylvania in 1934 in the production of pig iron, regained first place in 1935. Of the pig iron manufactured in 1935, it is calculated that 832,366 gross tons valued at $12,389,357 were made from 1,370,708 gross tons of foreign ore from Africa, Australia, Brazil, Canada, Chile, Cuba, Spain, Sweden, and U. S. S. R. (Russia), indicating an average pig-iron yield of 60.74 percent from imported ore. Domestic ore (34,127,246 gross tons) and 3,303,684 tons of cinder, scale, and purchased scrap, amounting in all to 37,430,930 tons, were reported as used in making 19,994,830 tons of pig iron, indicating an average pig-iron yield of 53.42 percent from domestic materials. In addition, 883,500 tons of home scrap and 1,147,000 tons of flue dust were consumed in making pig iron in 1935.

Pig iron manufactured in the United States, 1934–35, by States, in gross tons

State	1934	1935	State	1934	1935
Alabama	1,171,650	1,297,960	New York	1,062,820	1,451,394
Illinois	1,269,154	2,014,116	Ohio	4,207,944	5,634,530
Indiana	1,563,350	2,124,241	Pennsylvania	4,244,566	5,479,792
Kentucky	169,290	213,837	West Virginia	444,824	686,350
Maryland	704,850	863,308	Undistributed [1]	226,807	287,431
Michigan	621,187	774,237		15,686,442	20,827,196

[1] 1934: Colorado, Iowa, and Utah; 1935: Colorado, Iowa, Minnesota, Tennessee, Utah, and Virginia.

The number of furnaces in blast on June 30 and December 31 and the total number of stacks recorded for 1934 and 1935, exclusive of electric-reduction furnaces, were as follows:

Blast furnaces (including ferro-alloy blast furnaces) in the United States, 1934–35 [1]

State	In blast June 30, 1934	Dec. 31, 1934			In blast June 30, 1935	Dec. 31, 1935		
		In	Out	Total		In	Out	Total
Alabama	10	6	16	22	7	12	10	22
Colorado	1	--------	3	3	1	1	2	3
Illinois	6	5	20	25	8	10	15	25
Indiana	6	5	13	18	6	10	8	18
Kentucky	2	1	1	2	2	1	1	2
Maryland	3	3	3	6	3	4	2	6
Massachusetts	--------	--------	1	1	--------	--------	1	1
Michigan	6	5	3	8	6	7	--------	7
Minnesota	--------	--------	3	3	--------	1	1	2
Missouri	--------	--------	1	1	--------	--------	1	1
New York	7	4	15	19	8	8	11	19
Ohio	26	19	36	55	25	29	23	52
Pennsylvania	26	17	73	90	26	35	50	85
Tennessee	1	--------	5	5	1	1	4	5
Utah	1	1	--------	1	1	1	--------	1
Virginia	--------	--------	6	6	1	1	5	6
West Virginia	3	2	1	3	2	3	--------	3
	98	68	200	268	97	124	134	258

[1] American Iron and Steel Institute.

The total shipments of pig iron, exclusive of ferro-alloys, reported by manufacturers to the Bureau of Mines, were 21,178,353 gross tons valued at $358,145,499 in 1935, an increase of 36 percent in quantity and 37 percent in total value over 1934. Compared with the 5-year average for 1927–31, which amounted to 32,487,488 tons, the 1935 shipments decreased 35 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 in trade journals.

Pig iron shipped from blast furnaces in the United States, 1934–35, by States

State	1934		1935	
	Gross tons	Value	Gross tons	Value
Alabama	1,144,900	$15,805,365	1,324,942	$19,437,381
Colorado	(1)	(1)	(1)	(1)
Illinois	1,430,841	[2] 25,357,717	2,224,132	39,092.488
Indiana	1,545,011	[2] 27,187,989	2,182,798	38,809,232
Iowa	(1)	(1)	(1)	(1)
Kentucky	170,399	(1)	213,837	(1)
Maryland	704,304	(1)	863,861	(1)
Massachusetts	(1)	(1)	(1)	(1)
Michigan	644,895	9,987,451	781,458	12,225,499
Minnesota	(1)	(1)	(1)	(1)
New York	961,679	14,621,274	1,479,921	23,603,728
Ohio	4,147,116	[2] 68,201,509	5,600,757	93,530,895
Pennsylvania	4,173,412	[2] 75,383,683	5,549,538	102,027,692
Tennessee	10,760	(1)	(1)	(1)
Utah	(1)	(1)	(1)	(1)
Virginia	3,843	(1)	(1)	(1)
West Virginia	[2] 439,261	(1)	672,104	(1)
Undistributed	[3] 249,771	[2 3] 24,854,975	[3] 285,005	[3] 29,418,584
	[2] 15,626,192	[2] 261,399,963	21,178,353	358,145,499

[1] Included under "Undistributed."
[2] Revised figures.
[3] Includes figures for States entered as "(1)" above.

Pig iron shipped from blast furnaces in the United States, 1934–35, by grades

Grade	1934			1935		
	Gross tons	Value		Gross tons	Value	
		Total	Average		Total	Average
Charcoal	56,753	$1,128,479	$19.88	82,969	$1,688,196	$20.35
Foundry	1,326,861	21,278,038	16.04	1,924,141	32,417,342	16.85
Basic	10,204,967	[1] 165,226,871	[1] 16.19	14,030,001	228,351,983	16.28
Bessemer	[1] 3,038,938	[1] 55,381,219	18.22	3,792,064	69,893,237	18.43
Low-phosphorus	148,817	3,133,095	21.05	148,686	3,263,967	21.95
Malleable	805,686	14,324,481	17.78	1,102,155	20,501,306	18.60
Forge	14,587	255,168	17.49	10,226	187,309	18.32
All other (not ferro-alloys)	29,583	672,612	22.74	88,111	1,842,159	20.91
	[1] 15,626,192	[1] 261,399,963	[1] 16.73	21,178,353	358,145,499	16.91

[1] Revised figures.

Value at blast furnaces.—The average value of all kinds of pig iron given in the accompanying table is based on the reports of the 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 $16.91 a gross ton in 1935—18 cents more than in 1934.

Average value per gross ton of pig iron at blast furnaces in the United States, 1931–35

State	1931	1932	1933	1934	1935
Alabama	$12.38	$11.01	$11.53	$13.81	$14.67
Illinois	16.89	15.77	15.80	[1] 17.72	17.58
Indiana	16.53	15.45	15.42	[1] 17.60	17.78
Michigan	17.25	15.22	15.19	15.49	15.64
New York	15.35	14.38	14.50	15.20	15.95
Ohio	16.08	15.12	14.56	[1] 16.45	16.70
Pennsylvania	17.04	15.83	15.89	[1] 18.06	18.38
Tennessee	22.39	(2)	(2)	(2)	(2)
Other States [3]	14.81	13.40	14.00	[1] 15.75	14.46
Average for United States	16.01	14.80	14.86	[1] 16.73	16.91

[1] Revised figures.
[2] Included under "Other States."
[3] 1931: Colorado, Iowa, Kentucky, Maryland, Massachusetts, Minnesota, Utah, Virginia, and West Virginia; 1932–35: Colorado, Iowa, Kentucky, Maryland, Massachusetts, Minnesota, Tennessee, Utah, Virginia, and West Virginia.

Commercial quotations.—The average monthly prices, according to published market quotations of foundry, basic, and Bessemer pig iron at Valley furnaces and of foundry pig iron at Birmingham furnaces, are summarized in the following table.

Average monthly prices per ton of chief grades of pig iron, 1934–35 [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	
	1934	1935	1934	1935	1934	1935	1934	1935
January	$17.50	$18.50	$13.50	$14.50	$18.00	$19.00	$17.00	$18.00
February	17.50	18.50	13.50	14.50	18.00	19.00	17.00	18.00
March	17.50	18.50	13.50	14.50	18.00	19.00	17.00	18.00
April	17.90	18.50	14.02	14.50	18.40	19.00	17.40	18.00
May	18.50	18.50	14.50	14.50	19.00	19.00	18.00	18.00
June	18.50	18.50	14.50	14.50	19.00	19.00	18.00	18.00
July	18.50	18.50	14.50	14.50	19.00	19.00	18.00	18.00
August	18.50	18.50	14.50	14.50	19.00	19.00	18.00	18.00
September	18.50	18.50	14.50	14.50	19.00	19.00	18.00	18.00
October	18.50	18.50	14.50	14.50	19.00	19.00	18.00	18.00
November	18.50	19.50	14.50	14.50	19.00	20.00	18.00	19.00
December	18.50	19.50	14.50	14.50	19.00	20.00	18.00	19.00
Average	18.20	18.67	14.71	14.50	18.70	19.17	17.70	18.17

[1] Metal Statistics, 1936.

Foreign trade in pig iron.—The pig iron imported for consumption in the United States in 1935 was 130,937 gross tons compared with 114,488 tons imported for consumption in 1934. Netherlands (48,122 tons) and India (37,016 tons) were the chief sources of supply in 1935.

Pig iron imported into the United States, 1931–35, by countries, in gross tons

Country	1931	1932	1933	1934	1935
North America:					
Canada	2,789	2,113	12,259	8,984	13,771
South America: Chile				89	
Europe:					
Belgium	300	200	225	100	100
France	25	97			50
Germany	202	361	200	100	4,877
Netherlands	7,209	74,372	68,341	65,439	48,122
Norway	227	140	806	1,203	2,420
Sweden	1,900	561	632	991	907
U. S. S. R. (Russia)					9,124
United Kingdom	2,656	23,378	5,495	600	14,500
Asia:					
Hong Kong	2				
India, British	67,930	28,820	68,036	36,013	37,016
Japan	20	279	208		50
Kwantung	1,098	309	2,394	969	
Oceania: Australia	53				
	84,411	130,630	158,596	114,488	130,937
Value	$978,683	$1,301,625	$1,439,206	$1,465,475	$1,979,324

Exports of pig iron from the United States in 1935 were 4,107 gross tons compared with 4,096 tons in 1934. Canada (1,296 tons) and Japan (652 tons) were the chief customers in 1935.

Pig iron exported from the United States, 1934–35, by countries, in gross tons

Country	1934	1935	Country	1934	1935
North America:			Europe—Continued.		
Canada	907	1,296	Italy	64	
Cuba	46	50	Poland and Danzig	50	56
Mexico	478	350	United Kingdom	41	10
Panama	295	320	Other countries	25	
Other countries	101	4	Asia:		
South America:			China	109	275
Colombia	304	123	Japan	1,037	652
Peru	2	204	Philippine Islands	254	437
Other countries	9	62	Oceania: New Zealand		17
Europe:					
Belgium	374	191		4,096	4,107
Germany		60	Value	$97,050	$96,272

World production of pig iron.—World production of pig iron (including ferro-alloys) in 1935 was approximately 73,000,000 metric tons, an increase of 17 percent over 1934 but 11 percent below the average for 1927–31. In 1935 the output of the United States represented about 30 percent (26 percent in 1934) of the world output, and it was about 53 percent (60 percent in 1934) less than that of the producing countries of Europe combined. The production of pig iron increased 12 percent in Europe in 1935 compared with an increase of 32 percent in the United States.

Pig iron (including ferro-alloys) produced, 1931–35, by countries, in metric tons

[Compiled by M. T. Latus]

Country [1]	1931	1932	1933	1934	1935
Australia	[2] 386,000	[2] 400,000	[2] 425,000	[2] 450,000	[2] 500,000
Austria	145,016	94,466	87,949	133,492	193,400
Belgium	3,197,790	2,748,740	2,710,430	2,952,520	3,060,447
Brazil	28,114	28,809	46,772	56,924	[2] 75,000
Canada	474,294	162,179	261,582	441,916	667,235
China	[2] 300,000	[2] 300,000	[2] 300,000	[2] 300,000	[2] 300,000
Chosen	147,855	163,653	163,937	175,502	[2] 190,000
Czechoslovakia	1,164,726	450,106	498,980	600,324	811,000
Finland	12,329	13,671	12,004	7,577	[2] 10,000
France	8,206,130	5,537,460	6,359,000	6,155,000	5,799,000
Germany (exclusive of the Saar)	6,061,068	3,932,364	5,265,000	8,716,739	12,800,000
Saar	1,515,429	1,349,493	1,591,200	1,825,670	
Hungary	159,630	66,281	93,072	140,220	186,008
India, British	1,089,919	928,345	1,082,664	1,347,024	[2] 1,400,000
Italy	552,852	494,667	566,895	581,455	[2] 700,000
Japan	934,191	1,036,680	1,456,880	1,763,260	[2] 1,800,000
Luxemburg	2,053,158	1,958,930	1,887,538	1,995,193	1,872,378
Mexico	52,926	[2] 60,000	53,500	[2] 54,000	[2] 60,000
Netherlands	256,717	236,426	252,645	257,841	[2] 260,000
New Zealand	3,516	----------	3,339	1,358	[2] 1,500
Norway	118,837	103,092	112,653	126,932	[2] 150,000
Philippine Islands	163	168	100	[2] 150	[2] 200
Poland	347,114	198,674	305,625	381,587	394,097
Rumania	25,894	8,752	2,013	61,635	[2] 60,000
Spain	479,215	300,617	338,853	372,366	356,018
Sweden	417,506	282,163	345,526	558,129	566,200
Union of South Africa	8,940	13,107	26,492	[2] 30,000	[2] 30,000
U. S. S. R. (Russia)	5,007,000	6,173,000	7,133,000	10,400,000	12,480,000
United Kingdom	3,833,150	3,631,363	4,202,383	6,074,455	6,529,544
United States	18,715,216	8,920,878	13,590,926	16,398,077	21,715,541
Yugoslavia	37,733	9,973	30,756	32,620	[2] 35,000
	55,732,000	39,604,000	49,207,000	62,400,000	73,000,000

[1] In addition to countries listed, pig iron is produced in Chile, but figures of production are not available.
[2] Approximate production.

FERRO-ALLOYS

Production and shipments.—The production of ferro-alloys was 545,316 gross tons in 1935 compared with 452,607 tons in 1934, an increase of 20 percent. Ferro-alloys were made in 1935 at 11 blast furnaces, 14 electric furnaces, and 2 alumino-thermic plants; in addition, 2 plants made ferrophosphorus and 2 plants ferrosilicon as a byproduct.

The shipments of ferro-alloys of all classes in 1935 were 592,176 gross tons valued at $48,891,592, an increase of 38 percent in quantity and 41 percent in total value over 1934. Compared with the 5-year average for 1927–31, which amounted to 663,861 tons, the 1935 shipments decreased 11 percent.

Ferro-alloys shipped from furnaces in the United States, 1934–35, by varieties

Variety of alloy	1934		1935	
	Gross tons	Value	Gross tons	Value
Ferromanganese	147,947	$12,345,697	194,627	$16,374,328
Spiegeleisen	45,769	1,099,922	54,793	1,303,574
Ferrosilicon (7 percent or more silicon)	181,209	7,401,799	263,264	11,630,793
Ferrotungsten	1,188	2,459,432	1,501	3,167,301
Ferrovanadium	864	(1)	814	(1)
Other varieties [2]	51,821	[1] 11,328,107	77,177	[1] 16,415,596
	428,798	34,634,957	592,176	48,891,592

[1] Value of ferrovanadium included with "Other varieties."
[2] Ferrochromium, ferromolybdenum and calcium-molybdenum compounds, ferrophosphorus, ferrotitanium, ferrozirconium, silicomanganese, silicospiegeleisen, ferrocolumbium, and zirconium-ferrosilicon.

Ferromanganese.—The shipments of ferromanganese in 1935 were 194,627 gross tons, an increase of 32 percent over 1934. Compared with the 5-year average for 1927–31, which amounted to 273,630 tons, the 1935 shipments decreased 29 percent. The average value per ton f. o. b. furnaces reported for ferromanganese was $84.13 in 1935 compared with $83.45 in 1934.

Ferromanganese was made at 7 furnaces in 1935 and at 6 furnaces in 1934.

The production of ferromanganese in 1935 was 214,290 gross tons containing 170,168 tons of manganese, an average of 79.41 percent manganese. In the production of ferromanganese in 1935, 401,846 gross tons of foreign manganese ore, 4,286 tons of domestic manganese ore, 9,195 tons of iron ore, and 8,921 tons of cinder, scale, and scrap were used. In 1935, 1.895 tons of manganese ore were used per ton of ferromanganese made; in 1934, 1.853 tons; and in 1933, 1.793 tons. Of the foreign manganese ore used in 1935, U. S. S. R. (Russia) supplied 147,471 gross tons; India, 76,983 tons; Cuba, 56,411 tons; Brazil, 47,663 tons; Africa, 21,917 tons; Chile, 2,941 tons; Philippine Islands, 520 tons; and undistributed, 47,940 tons. The quantity of domestic manganese ore used in the manufacture of ferromanganese in 1935 represented 1.06 percent of the total manganese ore used compared with 0.33 percent in 1934. The domestic manganese ore used in 1935 was produced in Georgia and Virginia.

Ferromanganese produced in the United States and metalliferous materials consumed in its manufacture, 1931–35

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 scrap	
		Percent	Gross tons	Foreign	Domestic			
1931	166,937	78.59	131,200	287,973	12,277	19,214	3,405	1.799
1932	56,350	77.66	43,760	90,677	10,666	5,270	1,499	1.798
1933	136,267	79.30	108,059	233,607	10,695	10,795	1,655	1.793
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

Quantity and tenor of manganese ore used in manufacture of ferromanganese in the United States, 1934–35

Source of ore	1934		1935	
	Gross tons	Manganese content (percent, natural)	Gross tons	Manganese content (percent, natural)
Africa	18,076	49.69	21,917	48.65
Brazil	55,778	43.86	47,663	43.84
Chile	451	44.28	2,941	44.19
Cuba	16,242	51.64	56,411	49.39
India	21,460	50.94	76,983	51.06
Philippine Islands			520	37.72
U. S. S. R. (Russia)	116,953	48.54	147,471	47.48
United States	853	37.00	4,286	39.66
Undistributed	28,020	50.32	47,940	50.00
	257,833	48.15	406,132	48.24

Spiegeleisen.—The shipments of spiegeleisen in 1935 were 54,793 gross tons (20 percent more than in 1934). Compared with the 5-year average for 1927–31 (94,239 tons) the 1935 shipments decreased 42 percent. The average value per ton at the furnaces was $23.79 in 1935 and $24.03 in 1934.

Spiegeleisen was made at four furnaces in 1935 and at three furnaces in 1934.

The production of spiegeleisen in 1935 was 60,018 gross tons containing 12,310 tons of manganese, an average of 20.51 percent.

Ferrosilicon.—The shipments of ferrosilicon were 263,264 gross tons containing 57,812 tons of silicon in 1935 compared with 181,209 tons containing 40,659 tons of silicon in 1934. Compared with the 5-year average for 1927–31 (248,203 tons) the 1935 shipments showed an increase of 6 percent.

The production of ferrosilicon in 1935 was 198,068 gross tons, including 94,171 tons made by the blast-furnace process, 103,375 tons by the electric-furnace process, and 522 tons as a byproduct of the manufacture of artificial abrasives in electric furnaces.

Ferrotungsten.—The shipments of ferrotungsten in 1935 were 1,501 gross tons containing 2,690,315 pounds of tungsten, and the average value per pound of contained tungsten was $1.18 f. o. b. furnaces ($1.16 in 1934). Compared with the 5-year average for 1927–31 (1,584 tons) the 1935 shipments decreased 5 percent.

The production of ferrotungsten in 1935 was 1,415 gross tons averaging 80 percent tungsten. The ferrotungsten produced in 1935 was made from ores chiefly from China, Bolivia, Arizona, Colorado, and Nevada.

Ferrovanadium.—The shipments of ferrovanadium in 1935 were 814 gross tons containing 704,286 pounds of vanadium. Compared with the 5-year average for 1927–31 (1,315 tons) the 1935 shipments decreased 38 percent.

The production of ferrovanadium in 1935 was 945 gross tons averaging about 39 percent vanadium. It was reduced from vanadium oxide made from roscoelite-carnotite ore mined in Colorado and from patronite and its oxidation products from Peru.

Foreign trade in ferro-alloys.—Imports of all alloys of the rarer metals are not recorded separately but are grouped as shown in the following table. Ferromanganese and spiegeleisen constituted the bulk of the imports in 1934 and 1935.

The imports for consumption of ferromanganese in 1935 (chiefly from Norway) were 27,240 gross tons, an increase of 17 percent over 1934.

The imports for consumption of spiegeleisen in 1935 (chiefly from Canada) were 32,384 gross tons, an increase of 53 percent over 1934.

Ferro-alloys and ferro-alloy metals imported for consumption in the United States, 1934–35, by varieties

Variety of alloy	1934			1935		
	Gross weight (gross tons)	Content (gross tons)	Value	Gross weight (gross tons)	Content (gross tons)	Value
Ferromanganese:						
Containing over 1 percent carbon	23,088	18,483	$1,401,123	26,693	21,369	$1,660,120
Containing not over 1 percent carbon	261	219	40,237	547	460	71,291
Manganese silicon (manganese content)	(1)	17	5,813	(1)	121	8,468
Manganese boron, manganese metal, and spiegeleisen not more than 1 percent carbon (manganese content)	(1)	2	1,327	(1)	13	8,343
Spiegeleisen	21,184	(1)	595,017	32,384	(1)	915,134
Ferrochrome or ferrochromium containing less than 3 percent carbon	110	72	15,242	61	30	6,112
Ferrophosphorus	33	(1)	1,901			
Ferrosilicon: Containing 8 percent and less than 60 percent silicon	6,537	984	189,954	5,274	781	135,422
Chrome or chromium metal	16	(1)	21,617	49	(1)	61,719
Chromium and zirconium silicon and calcium silicide	534	(1)	72,965	1,203	(1)	150,959
Ferromolybdenum, molybdenum metal and powder, calcium molybdate, and other compounds and alloys of molybdenum (molybdenum content)	(1)	(2)	86	(1)	(3)	211
Ferrotitanium	1	(1)	434	2	(1)	654
Tungsten and combinations, in lumps, grains, or powder:						
Tungsten metal (tungsten content)	(1)	48	69,879	(1)	34	64,420
Tungsten carbide (tungsten content)	(1)	2	14			
Combinations containing tungsten or tungsten carbide (tungsten content)				(1)	(4)	12,011
Tungsten acid and other compounds of tungsten, n. s. p. f. (tungsten content)	(1)	(5)	2,306	(1)	(6)	1,874

[1] Not recorded. [2] 15 pounds. [3] 39 pounds. [4] 1,552 pounds. [5] 705 pounds. [6] 537 pounds.

Ferromanganese and ferrosilicon imported into the United States, 1934–35, by countries

Country	Ferromanganese (manganese content)[1]				Ferrosilicon (silicon content)[2]			
	1934		1935		1934		1935	
	Gross tons	Value	Gross tons	Value	Gross tons	Value	Gross tons	Value
Belgium	21	$1,100						
Canada	2,226	250,443	40	$4,500	970	$188,005	781	$135,422
France	440	43,814	2,091	193,006				
Germany	79	4,105	1,025	64,694				
Italy	516	69,704	709	97,523				
Netherlands	258	11,855	1,095	61,166				
Norway	12,387	884,760	14,365	1,156,488	9	955		
Poland and Danzig	734	41,043	157	9,889				
Switzerland					5	994		
United Kingdom	2,041	134,536	2,347	144,145				
	18,702	1,441,360	21,829	1,731,411	984	189,954	781	135,422

[1] Includes small quantities of other manganese alloys.
[2] Includes small quantities of chromium and zirconium-silicon and calcium silicide.

The exports of ferro-alloys are relatively unimportant. Tungsten and ferrotungsten constitute most of the total exports, amounting to 445 gross tons in 1935 compared with 314 tons in 1934. The exports of ferromanganese and spiegeleisen decreased from 222 gross tons in 1934 to 131 tons in 1935.

Ferro-alloys and ferro-alloy metals exported from the United States, 1933–35, by varieties

Variety of alloy	1933		1934		1935	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Ferromanganese [1] / Spiegeleisen [1]	47	$3,393	222	$12,580	131	$10,389
Tungsten and ferrotungsten (including tungsten wire)	381	460,966	314	453,813	445	743,592

[1] Not separately classified.

STEEL

Production.—The following tables covering the production of steel were compiled by the American Iron and Steel Institute. No data whatever are available on the value of the output of crude steel at the mills, but the weekly issues and annual statistical reviews of Iron Age give market quotations of prices of steel billets and some of the leading forms of finished steel. The price of open-hearth steel billets at Pittsburgh ranged from $27 to $28 a gross ton in 1935 and from $26 to $29 a ton in 1934. Tank plates and structural shapes at Pittsburgh were 1.8 cents a pound in 1935; in 1934 they ranged from 1.7 to 1.85 cents a pound. Hot-rolled annealed sheets, no. 24 gage, at Pittsburgh were 2.4 cents a pound in 1935; in 1934 they ranged from 2.25 to 2.65 cents a pound.

The production of steel in 1935 was 34,092,594 gross tons, of which 30,715,429 tons were open-hearth, 2,835,031 tons Bessemer, 642 tons crucible, and 541,492 tons electric steel. In 1934 the production was 26,055,289 tons, of which 23,531,105 tons were open-hearth, 2,162,357 tons Bessemer, 531 tons crucible, and 361,296 tons electric steel.

Bessemer steel ingots and castings manufactured in the United States, 1931–35, by States, in gross tons

State	1931	1932	1933	1934 [1]	1935 [1]
Ohio	1,393,875	939,228	1,219,494	1,017,629	1,361,933
Pennsylvania	786,767	233,215	598,672	570,817	764,403
Illinois	420,569	250,983	379,483	299,157	375,445
Other States	422,235	108,650	231,142	274,754	333,250
	3,023,446	1,532,076	2,428,791	2,162,357	2,835,031

[1] The figures for 1934 and 1935 include only that portion of the steel for castings which was produced in foundries operated by companies producing steel ingots.

Open-hearth steel ingots and castings manufactured in the United States, 1931–35, by States, in gross tons

State	1931	1932	1933	1934 [1]	1935 [1]
New England States	175,673	128,227	227,445	209,527	248,778
New York and New Jersey	1,144,839	589,945	907,512	1,086,189	1,275,496
Pennsylvania	7,384,091	3,506,451	5,733,772	6,477,890	7,850,710
Ohio	4,954,069	2,849,170	5,285,122	5,649,785	7,702,018
Indiana	2,746,899	1,428,091	2,649,190	3,098,343	4,376,998
Illinois	1,450,637	695,936	1,407,581	1,642,437	2,534,811
Other States	4,653,358	2,709,510	4,171,050	5,366,934	6,726,618
	22,509,566	11,907,330	20,381,672	23,531,105	30,715,429

[1] The figures for 1934 and 1935 include only that portion of the steel for castings which was produced in foundries operated by companies producing steel ingots.

According to these tables, the production of both open-hearth and Bessemer steel increased 31 percent compared with 1934; the total production of steel also increased 31 percent. Of the total output in 1935, 90.1 percent was open-hearth, 8.3 percent Bessemer, and 1.6 percent other classes of steel.

Of the total output of open-hearth steel, 30,361,237 gross tons were made by the basic process and 354,192 tons by the acid process, compared with 23,256,417 tons of basic steel and 274,688 tons of acid steel in 1934.

The production of steel by the electric process increased 50 percent compared with 1934.

Steel electrically manufactured in the United States, 1931–35, in gross tons

Year	Ingots	Castings	Total	Year	Ingots	Castings	Total
1931	235, 376	175, 566	410, 942	1934 [1]	349, 095	12, 201	361, 296
1932	141, 328	99, 783	241, 111	1935 [1]	521, 818	19, 674	541, 492
1933	299, 808	121, 395	421, 203				

[1] The figures for 1934 and 1935 include only that portion of the steel for castings which was produced in foundries operated by companies producing steel ingots.

Figures for the total production of electric steel in 1935 include 412,563 tons of alloy-steel ingots and castings that were alloyed with nickel, vanadium, tungsten, chromium, molybdenum, and other metals compared with 299,236 tons so alloyed in 1934.

Foreign trade in steel.—Exports of iron and steel products decreased slightly in 1935, but imports increased substantially.

Iron and steel imported for consumption in the United States, 1934–35

Article	1934		1935	
	Gross tons	Value	Gross tons	Value
Bar iron	805	$53, 403	1, 855	$88, 341
Steel bars: Concrete reinforcement	1, 276	32, 742	3, 108	88, 410
Hollow bars, and hollow drill steel	918	121, 536	1, 171	154, 098
Bars, whether solid or hollow	18, 762	984, 876	24, 768	1, 164, 847
Boiler or other plate iron or steel	280	8, 404	682	21, 339
Steel ingots, blooms, slabs, etc	2, 136	113, 550	2, 097	115, 677
Sheets of iron or steel, common or black, and boiler or other plate iron or steel	2, 736	119, 618	9, 034	341, 406
Sheets and plates (including steel circular-saw plates) and steel, n. s. p. f.	1, 624	84, 320	2, 017	123, 095
Tin plates, terneplates, and taggers tin	126	31, 821	187	48, 867
Structural iron and steel	25, 023	727, 099	41, 601	1, 207, 544
Rails and bars for railways and rail braces	2, 967	79, 634	5, 279	133, 740
Railway fishplates or splice bars, and tieplates	106	6, 325	379	10, 403
Cast-iron pipe and fittings	65	1, 834	121	8, 422
Other pipes and tubes	4, 808	590, 328	20, 584	1, 765, 311
Barbed wire	8, 859	493, 103	24, 948	1, 227, 822
Round iron and steel wire	2, 442	391, 607	3, 238	515, 360
Bailing wire	136	6, 515	686	36, 476
Flat wire and steel strips not thicker than ¼ inch, and not over 16 inches wide	1, 805	1, 008, 499	1, 888	1, 088, 446
Wire rope and wire strand	1, 512	256, 940	2, 142	354, 155
Wire rods, nail rods, and flat rods	10, 657	776, 398	16, 780	1, 053, 085
Hoop or band iron or steel, cut to lengths, for bailing	2, 007	78, 421	10, 743	456, 107
Hoop, bands, strips, or scroll iron or steel, n. e. s	15, 857	566, 645	19, 838	686, 429
Nails	7, 016	578, 059	21, 318	1, 391, 073
Iron and steel scrap	44, 421	358, 363	64, 768	527, 211
Castings and forgings, n. e. s	1, 392	232, 111	1, 313	232, 579

Iron and steel exported from the United States, 1934–35

Article	1934 Gross tons	1934 Value	1935 Gross tons	1935 Value
Semimanufactures:				
Steel ingots, blooms, billets, slabs, and sheet bars	19,586	$576,860	39,782	$900,605
Iron and steel bars and rods:				
Iron bars	1,004	83,655	1,200	110,126
Steel bars	42,960	2,126,320	52,286	2,630,649
Alloy-steel bars	2,910	525,351	2,817	583,447
Wire rods	23,732	814,678	26,092	1,012,926
Iron and steel plates, sheets, skelp, and strips:				
Boiler plates	1,564	106,711	1,369	83,773
Other plates, not fabricated	34,228	1,505,422	42,909	1,894,316
Skelp iron or steel	57,367	2,099,281	64,420	2,146,139
Iron or steel sheets, galvanized	68,539	4,630,247	74,997	5,208,474
Steel sheets, black	91,003	6,025,326	100,483	6,549,830
Iron sheets, black	4,325	316,604	5,183	349,976
Strip iron and steel, cold rolled	14,171	1,110,294	20,145	1,501,674
Hoop, band, and scroll iron or steel	15,137	822,718	24,509	1,283,478
Tin plate and terneplate	184,651	16,872,564	134,499	13,021,779
Manufactures—steel-mill products:				
Structural iron and steel:				
Structural shapes:				
Not fabricated	31,392	1,321,587	36,656	1,493,788
Fabricated	18,173	1,391,074	14,980	1,190,809
Plates fabricated, punched or shaped	2,606	134,790	1,611	102,278
Metal lath	1,113	159,497	850	143,802
Frames, sashes, and sheet piling	2,896	178,393	4,827	319,952
Railway track material:				
Rails for railways	69,159	2,121,372	51,672	1,454,679
Rail joints, splice bars, fishplates, and tieplates	10,632	596,402	5,818	323,764
Switches, frogs, and crossings	1,756	263,269	1,436	234,917
Railroad spikes	3,254	224,873	2,477	143,919
Railroad bolts, nuts, washers, and nut locks	1,287	161,557	557	68,072
Tubular products:				
Boiler tubes	8,245	1,084,555	8,644	1,153,770
Casing and oil-line pipe	57,111	5,665,673	23,721	2,401,595
Welded black pipe	21,660	1,621,227	18,313	1,463,244
Welded galvanized pipe	24,496	2,030,996	18,080	1,448,289
Malleable-iron screwed pipe fittings	2,980	954,946	3,466	1,050,960
Cast-iron screwed pipe fittings	2,641	479,174	1,876	390,288
Cast-iron pressure pipe and fittings	10,315	580,158	11,127	627,214
Cast-iron soil pipe and fittings	4,746	376,189	4,506	291,045
Wire and manufactures:				
Barbed	36,076	2,052,840	31,963	1,713,637
Galvanized wire	21,189	1,236,258	20,856	1,146,870
Iron or steel wire, uncoated	15,330	977,584	18,208	1,066,727
Wire rope	2,681	715,573	4,040	956,194
Woven-wire fencing and screen cloth	2,336	425,157	3,219	538,977
All other	4,771	1,020,332	6,021	1,277,286
Nails and bolts (except railroad):				
Horseshoe nails	784	185,705	676	154,323
Wire nails	13,200	747,750	11,141	615,651
All other nails, including tacks and staples	4,151	431,462	3,026	349,229
Bolts, nuts, rivets, and washers (except railroad)	5,145	1,339,766	6,370	1,544,640
Castings and forgings:				
Horseshoes	174	20,452	199	22,629
Iron and steel, including car wheels and axles	20,853	2,275,378	36,548	3,253,630
Advanced manufactures:				
House heating boilers and radiators:	----------	215,920	----------	211,096
Tools:				
Axes	----------	547,562	----------	519,357
Hammers and hatchets	----------	139,541	----------	194,566
Saws, wood and metal cutting	----------	945,404	----------	1,076,366
Shovels and spades	----------	163,680	----------	184,358
All other tools	----------	5,826,533	----------	7,112,097

BAUXITE AND ALUMINUM [1]

By R. B. Miller and C. T. Herring

SUMMARY OUTLINE

The aluminum industry enjoyed a successful year in 1935, as production increased, stocks were lowered, trade in bauxite, alumina, and aluminum goods improved, and technological advances were made. The principal problems disturbing aluminum producers were created chiefly by forces beyond the control of the industry, such as politico-commercial restrictions regarding the export of bauxite and alumina, the appearance of several new producers, and the consequent erection of tariff barriers by countries with nationalistic tendencies. Plans are indicated not only for the construction of new plants in hitherto nonproducing countries but in many instances for enlarging the present capacity of smelting and fabrication plants.

Salient statistics of the bauxite and aluminum industries, 1934–35

	1934	1935	Increase (+) or decrease (−) percent
Bauxite:			
World production ... metric tons	1,315,000	[1] 1,600,000	+21.7
United States:			
Production ... do	160,371	237,666	+48.2
Do ... long tons	157,838	233,912	+48.2
Value ... dollars	1,129,053	1,556,595	+37.9
Price per ton ... do	7.15	6.65	−7.0
Imports ... long tons	166,653	199,959	+20.0
Exports ... do	51,415	82,491	+60.4
Aluminum:			
World production ... metric tons	170,200	257,000	+51.0
United States:			
Production ... do	33,646	54,111	+60.8
Do ... short tons	37,089	59,648	+60.8
Value ... dollars	14,094,000	22,070,000	+56.6
Price per pound, new, 98–99 percent ... cents	22.9	20.5	−10.5
Secondary production ... short tons	46,400	51,400	+10.8
Imports, value ... dollars	4,038,374	4,279,014	+6.0
Exports, value ... do	2,379,325	2,067,230	−13.1

[1] Estimated.

[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.

BAUXITE

Bauxite owes its preëminent position to its high alumina content and its relatively low content of silica, ferric oxide, and other impurities. A typical bauxite contains 55 to 65 percent alumina, 2 to 5 percent silica, 1 to 25 percent ferric oxide, 1 to 3 percent titanium oxide, and 10 to 30 percent combined water. Bauxites of the United States average about 58 percent alumina and 5 to 6 percent silica. Leucite, a volcanic rock, has been used in Italy as a source of alumina.

About 2 tons of bauxite are required to make 1 ton of alumina, and 2 tons of alumina are required to make 1 ton of aluminum. The location of sites for reduction plants is controlled by the abundance of cheap electrical power and by transport advantages. In the United States alumina is made from Arkansas and Surinam (Dutch Guiana) bauxites at East St. Louis, but the alumina is shipped to Niagara Falls and Massena, N. Y., Alcoa (near Knoxville), Tenn., and Badin, N. C. Alumina is also exported to Canada and to Norway for reduction purposes.

Bauxite produced in the United States and shipped in 1931–35

Year	Alabama and Georgia		Arkansas		Total	
	Long tons	Value f. o. b. mine	Long tons	Value f. o. b. mine	Long tons	Value f. o. b. mine
1931	9,198	$59,179	186,697	$1,081,450	195,895	$1,140,629
1932	6,570	40,471	89,779	507,697	96,349	548,168
1933	11,997	69,541	142,179	853,718	154,176	923,259
1934	12,074	71,991	145,764	1,057,062	157,838	1,129,053
1935	14,121	91,293	219,791	1,465,302	233,912	1,556,595

The bauxite production of the United States in 1935 amounted to 233,912 long tons, valued at $1,556,595, compared with 157,838 long tons, valued at $1,129,053, in 1934. This represents an increase of 76,074 long tons, or 48.2 percent, in tonnage and $427,542, or 37.9 percent, in value over 1934.

Figure 68 illustrates the trends of bauxite production, imports, and exports for the United States.

The first bauxite was mined in the United States in 1889 in northern Georgia and in 1891 Alabama began producing. Arkansas began mining in 1896, but its influence was not really felt until 1900. The first shipments of bauxite from Tennessee were made in 1907; however, none has been shipped since 1928. Total domestic production from 1889 to 1935 was 8,668,569 long tons. Of the bauxite produced in 1935, Arkansas accounted for 94 percent while Alabama and Georgia together produced 6 percent.

Arkansas shipped 219,791 long tons of bauxite in 1935 from seven mines. Four mines in Pulaski County produced 42,834 long tons of bauxite while three mines in Saline County produced 176,957 long tons, an increase of 51 percent over 1934 production.

E. C. Eckel reports [2] that the low-grade bauxites of Mississippi can be used in the manufacture of a high-grade alumina cement as well as a series of iron products ranging from pig iron to ferrosilicon.

[2] Eckel, E. C., Utilization of Mississippi Low-Grade Bauxites; Manufacturers Record, vol. 104, no. 2, Baltimore, Md., February 1935, p. 58.

In the United States the largest consumers of bauxite own their own sources of supply, with the result that a limited amount of new or casual bauxite is produced, and prices quoted vary widely.

Prices.—In 1935 the producers of bauxite in the United States reported prices ranging from \$5.50 to \$13.50 per ton. Arkansas bauxite sold at an average of \$6.67 per ton while that of Alabama and Georgia brought \$6.47, an average for the United States of \$6.65 per

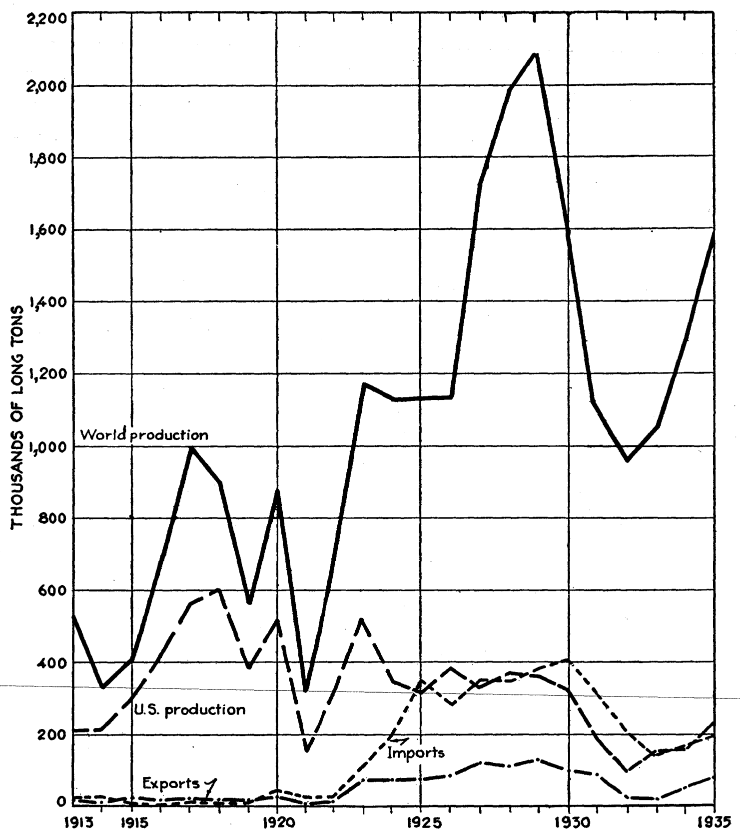

FIGURE 68.—Trends in bauxite production in the United States and in the world compared with shipments into the United States and domestic exports, 1913-35.

ton. The quoted prices[3] for bauxite were as follows: Domestic—chemical ore, crushed, and dried, 55 to 58 percent Al_2O_3 and 1.5 to 2.5 percent Fe_2O_3, \$6 to \$7.50 a long ton f. o. b. Alabama and Arkansas mines. Foreign—Dalmatian, 50 to 55 percent Al_2O_3 and 1 to 3 percent SiO_2, \$4.50 to \$6; Istrian, 54 to 57 percent Al_2O_3 and 3 to 5 percent SiO_2, \$5.50 to \$6; and French, 56 to 59 percent Al_2O_3, \$5.50 to \$6.50 a metric ton c. i. f. Atlantic ports.

The United States-Canada trade agreement of November 15, 1935, did not alter the existing tariff on bauxite and alumina.

Markets and uses.—Bauxite is sold principally to the manufacturers of aluminum, abrasives, commercial chemicals, and refractories.

[3] Metal and Mineral Markets, vol. 6, 1935.

Alumina cement manufacturers use imported bauxites chiefly. Some manufacturers of refractories and aluminum-bearing chemicals are using increasing quantities of clay as a raw material instead of bauxite.

In 1935 the chemical industries consumed 66,316 long tons (28 percent of the total production); 112,154 long tons (48 percent) were used in aluminum production; and manufacturers of abrasives used 53,684 long tons (23 percent). Aluminous abrasives are employed in powdered and granulated material for grinding wheels and sandpaper.

United States patent 2009807 of July 30, 1935, describes a process for preparing bauxite for use in paints.

Patents were issued in the United States and Germany on a process for making tools and other objects by sintering and molding alumina. The use of alumina in the manufacture of laboratory ware has recently been described.[4]

Domestic bauxite sold by producers in the United States, 1931–35, in long tons, by industries

Year	Aluminum	Chemical	Abrasive [1]	Cement and refractory [1]	Total	Year	Aluminum	Chemical	Abrasive [1]	Cement and refractory [1]	Total
1931	83,340	58,424	53,631	500	195,895	1934	55,630	67,153	34,580	475	157,838
1932	28,899	61,838	5,612		96,349	1935	112,154	66,316	53,684	1,758	233,912
1933	46,506	89,226	18,444		154,176						

[1] Small quantity of bauxite sold to makers of refractories probably included under "Abrasive."

Aluminum salts.—Consumption of 129,400 long tons of bauxite, having an average value of $11.09 per ton, was reported by the manufacturers of aluminum salts in 1935. This is an increase in quantity of 7 percent over the 120,600 long tons reported in 1934, but the average price was the same. In the manufacture of aluminum salts, 4,676 short tons of alumina hydrate and 685 short tons of aluminum were consumed. These statistics do not include the bauxite made into alumina as a preliminary to manufacturing aluminum. Neither do those in the following tables include the quantity of alumina made as a preliminary step in the manufacture of aluminum.

Value of aluminum and aluminum salts made from bauxite in the United States, 1931–35

Year	New aluminum	Aluminum salts	Year	New aluminum	Aluminum salts
1931	$37,284,000	[1] $9,228,228	1934	$14,094,000	[1] $9,630,464
1932	20,453,000	[1] 8,113,437	1935	22,070,000	10,527,869
1933	16,174,000	[1] 9,355,698			

[1] Revised figures.

[4] Chemical Age, vol. 33, London, Nov. 16, 1935, pp. 453–454.

Aluminum salts produced in the United States and shipped in 1934–35

Salt	1934				1935			
	Number of producers reporting	Short tons	Value		Number of producers reporting	Short tons	Value	
			Total	Average			Total	Average
Alum:								
Ammonia	5	4,859	$240,466	$49	5	4,904	$264,861	$54
Potash	3	2,869	145,674	51	3	2,718	152,948	56
Other	1				1			
Sodium-aluminum sulphate	3	17,767	967,766	54	3	18,067	1,038,463	57
Aluminum chloride:								
Liquid	5	877	45,857	52	5	1,322	65,474	50
Crystal	3	443	46,261	104	3	839	80,997	97
Anhydrous	4	3,984	495,923	124	4	4,424	477,511	108
Aluminum sulphate:								
Commercial:								
General	11	306,532	6,091,284	20	12	336,474	6,906,235	21
Municipal	10	10,227	170,674	17	10	10,511	166,153	16
Iron-free	7	14,653	463,140	32	7	17,098	555,674	32
Other aluminum salts and hydrate	[1,2] 5	[2] 11,119	[2] 963,419	--------	[1] 6	12,399	819,553	--------
	--------	[2] 373,330	[2] 9,630,464	--------	--------	408,756	10,527,869	--------

[1] 1934: 3 producers each of alumina and sodium aluminate; 1935: 4 producers each of alumina and sodium aluminate.
[2] Revised figures.

Aluminum salts produced in the United States, 1931–35, in short tons

Salt	1931	1932	1933	1934	1935
Alum:					
Ammonia	4,085	4,032	4,156	4,739	5,121
Potash	2,404	1,198	1,858	3,003	2,685
Other	-------	-------	-------		
Sodium-aluminum sulphate	15,945	16,428	18,941	17,742	18,216
Aluminum chloride:					
Liquid	1,589	1,998	1,595	1,381	1,302
Crystal	5,518	2,439	3,261	4,455	4,936
Anhydrous					
Aluminum sulphate:					
Commercial	299,864	271,537	316,608	317,535	346,177
Iron-free	14,636	14,029	16,016	14,852	17,806
Other aluminum salts and hydrate	[1] 7,546	[1] 7,175	[1] 11,074	[1] 11,761	12,848
	[1] 351,587	[1] 318,836	[1] 373,509	[1] 375,468	409,091

[1] Revised figures.

Aluminum salts shipped in, imported into, and exported from the United States, 1931–35

Year	Domestic shipments		Imports		Exports (aluminum sulphate) [1]	
	Short tons	Value	Short tons	Value	Short tons	Value
1931	[2] 355,910	[2] $9,228,228	1,770	$82,337	27,668	$568,490
1932	[2] 320,016	[2] 8,113,437	1,505	65,859	21,550	462,954
1933	[2] 370,879	[2] 9,355,698	1,094	51,490	28,270	543,945
1934	[2] 373,330	[2] 9,630,464	726	38,620	30,881	594,440
1935	408,756	10,527,869	1,499	76,316	33,091	685,347

[1] Also "other aluminum compounds" as follows: 1931, 875 short tons valued at $170,585; 1932, 326 tons, $58,789; 1933, 428 tons, $70,011; 1934, 488 tons, $93,440; 1935, 691 tons, $126,435.
[2] Revised figures.

Bauxite producers in the United States in 1935

American Cyanamid & Chemical Corporation, 30 Rockefeller Plaza, New York, N. Y.
Arkansas Bauxite Corporation, Bauxite, Ark.
Crouch Mining Co., Inc., P. O. Box 35, Bridge Station, Niagara Falls, N. Y.
Dixie Bauxite Co.. Inc., Sweet Home, Ark.
Benjamin Easterlin, Americus, Ga.
Charles Lennig & Co., Inc., 222 West Washington Square, Philadelphia, Pa.
Republic Mining & Manufacturing Co., 230 Park Avenue, New York, N. Y.

Consumers of bauxite in the United States in 1935

Aluminum Ore Co., East St. Louis, Ill.
American Cyanamid & Chemical Corporation, 30 Rockefeller Plaza, New York, N. Y.
Atlas Lumnite Cement Co., 208 South La Salle Street, Chicago, Ill.
Birmingham Water Works Co., Birmingham, Ala.
Board of Public Utilities, Kansas City, Kans.
Bogalusa Paper Co., Bogalusa, La.
Brown Co., Berlin, N. H.
Bureau of Water Supply, Baltimore, Md.
Calumet Chemical Co., Joliet, Ill.
The Carborundum Co., Niagara Falls, N. Y.
City of Columbus Purification Works, Columbus, Ohio.
Columbus Water Works, Columbus, Ga.
Dalecarlia Filter Plant, Washington, D. C.
Exolon Co., Blasdell, N. Y.
Federal Abrasives Co., Anniston, Ala.
General Abrasive Co., Inc., Niagara Falls, N. Y.
General Chemical Co., 40 Rector Street, New York, N. Y.
General Refractories Co., 106 South Sixteenth Street, Philadelphia, Pa.
Grasselli Chemical Co., Cleveland, Ohio.
Gulf Refining Co., Gulf Building, Pittsburgh, Pa.
Harbison-Walker Refractories Co., Pittsburgh, Pa.
William F. Jobbins, Inc., Aurora, Ill.
Laclede-Christy Clay Products Co., St. Louis, Mo.
Charles Lennig & Co., Inc., 222 West Washington Square, Philadelphia, Pa.
Louisiana Chemical Co., Inc., Bastrop, La.
Massillon Stone & Fire Brick Co., Massillon Ohio.
Merrimac Chemical Co., 148 State Street, Boston, Mass.
Metropolitan Utilities District, Omaha, Nebr.
Norton Co., Worcester, Mass. (also Niagara Falls, N. Y.).
Paper Makers Chemical Corporation, Wilmington, Del.
Passaic Valley Water Commission, 141 Ellison Street, Paterson, N. J.
Pennsylvania Salt Manufacturing Co., Widener Building, Philadelphia, Pa.
Sacramento Filtration Works, Sacramento, Calif.
Stauffer Chemical Co., 624 California Street, San Francisco, Calif.
Vanadium Corporation of America, Bridgeville, Pa.
Water Department of Kansas City, Kansas City, Mo.
Welch Chemical Co., 8 East Long Street, Columbus, Ohio.
Westvaco Chlorine Products, Inc., Carteret, N. J.

Imports and exports.—Imports and exports of bauxite continued to increase in 1935—imports from 166,653 to 199,959 long tons (20 percent), while exports made even greater gains from 51,415 long tons to 82,491 long tons (60 percent). Exports in 1934 had more than doubled those of 1933. The total supply, including domestic production and the excess of imports over exports, increased by 351,380 long tons (29 percent). In 1933 the total supply amounted to 281,964 long tons, while in 1934 the supply was somewhat less, or 273,076 long tons.

Bauxite imported into and exported from the United States, 1931–35

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
1931	306,490	$1,495,577	88,370	$3,309,208	1934	166,653	$1,201,710	51,415	$1,039,955
1932	205,620	1,042,829	28,474	1,162,238	1935	199,959	1,448,592	82,491	2,191,167
1933	149,548	899,696	21,760	645,688					

ALUMINUM

The production of new aluminum in the United States in 1935 increased 61 percent, from 74,177,000 pounds (37,089 short tons) to 119,295,000 pounds (59,648 short tons), and its value increased 57 percent. According to data gathered by J. P. Dunlop, of the Bureau of Mines, the production of secondary aluminum increased 11 percent over that of 1934, or from 92,800,000 to 102,800,000 pounds. The combined domestic production of new and secondary aluminum recovered as metal and in alloys amounted to 111,048 short tons in 1935 compared with 83,489 short tons in 1934. Of the 1935 production, new metal amounted to 54 percent and secondary or recovered metal 46 percent.

Aluminum produced in the United States, 1931–35

Year	Primary metal		Secondary metal		Year	Primary metal		Secondary metal	
	Pounds	Value	Pounds	Value [1]		Pounds	Value	Pounds	Value [1]
1931	177,544,000	$37,284,000	60,600,000	$12,726,000	1934	74,177,000	$14,094,000	92,800,000	$17,632,000
1932	104,885,000	20,453,000	48,000,000	10,992,000	1935	119,295,000	22,070,000	102,800,000	19,018,000
1933	85,126,000	16,174,000	67,000,000	15,343,000					

[1] 1931: Value of secondary aluminum based on average price as reported to Bureau of Mines; 1932–33: Based on average price of 22.9 cents a pound; 1934–35: Based on average price as reported to Bureau of Mines.

Figure 69 shows the primary aluminum produced in the United States and in the world, 1913–35, compared with imports into the United States and with domestic consumption, exports, secondary production, and trend of the average New York quoted price (No. 1 virgin 98–99 percent).

Price.—The price for 99 percent pure virgin ingot aluminum, delivered, remained at 20.50 cents a pound throughout 1935 according to American Metal Market.

Consumption and uses.—Aluminum is frequently combined with other metals to secure certain special properties. In general, when strength is desired copper is added; for corrosion resistance, manganese; for polish and decoration, nickel or silver; for wearing resistance, silicon; and for cheapness, zinc. Regarding the treatment or fabrication of aluminum, alloys have been developed which may be heat-treated and which are self-aging and free-milling (U. S. Patents 2026540–2026579), and still others whose coefficients of expansion require a precise adjustment between heated moving parts.

The light alloys have properties of strength and excellent corrosion resistance. The aluminum alloys are not attacked by foods or beverages and are particularly adaptable for use in the manufacture of equipment and for packaging purposes. They have excellent thermal and electrical conductivity properties. Such alloys may be cast, welded, or riveted and are easily worked to present an attractive, smooth, shiny surface. New processes are being developed which

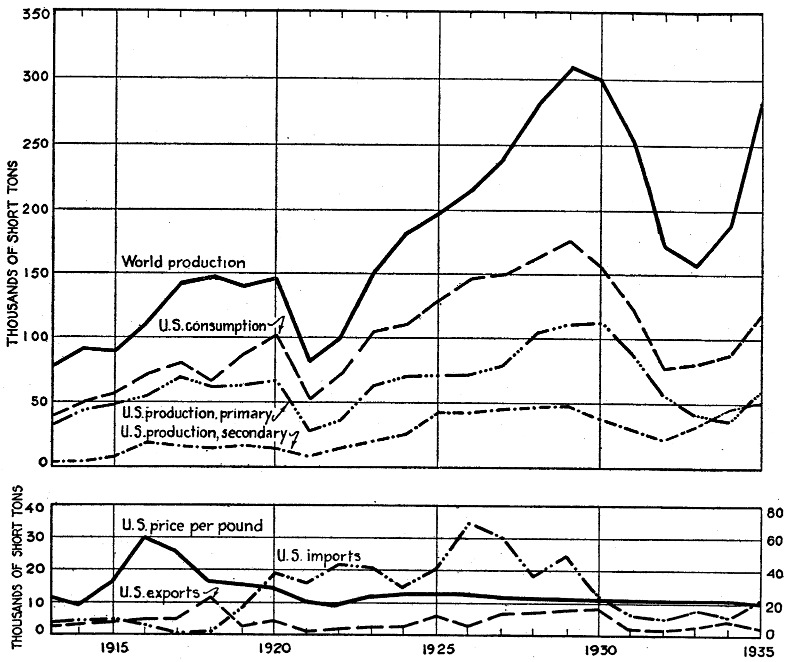

FIGURE 69.—Primary aluminum produced in the United States and in the world, compared with imports into the United States and with domestic consumption, exports, secondary production and trend of the average New York quoted price (No. 1 virgin 98–99 percent), 1913–35.

enable such alloys to be hardened, colored, or used as plating over other metals.[5]

Aluminum coated by the Alumilite process to resist abrasion is used in the construction of escalators in department stores. Aluminum is also being used for store fronts.[6] In the home aluminum is used to secure artistic effects. Aluminum foil or sheet is finding an extensive use ranging from the lining of tropical helmets to rooms and refrigerator cars. The French experience with several disastrous ship fires led to the construction of aluminum bulkheads in the passenger quarters of the *Normandie*. Aluminum was used, also, in the construction of the new British liner, the *Queen Mary*. New parts, composed of an aluminum alloy, are being installed in one of the New York City bridges.

In the chemical industry aluminum is being used more and more in processing equipment, such as driers, desulphurizing machinery,

[5] Revue de l'Aluminium, Méthode simple de différenciation des alliages d' aluminium: Vol. 12, no. 74, Paris, September–October 1935, pp. 3009–3013. Quotation of the work of E. Zurbrügge.

[6] Revue de l'Aluminium, Magasins et boutiques présentation et aluminium: Vol. 13, no. 78, Paris, February 1936, pp. 65–80.

spinning-machine parts, carbon bisulphide apparatus, and machinery used in preparing fatty acids, naval stores, cellulose acetate, synthetic resins, tartaric acid, turpentine, and aspirin and in the refining of edible oils. Aluminum equipment is used in storing oil, acetic acid, and various beverages. Because of its high visibility and corrosion resistance, aluminum paint was applied to the San Francisco-Oakland Bay bridge and to bridges in the vicinity of Pittsburgh.

Aluminum was used extensively in several dairies and breweries, and preparations are being made to manufacture aluminum-plated beer cans. Aluminum is replacing tin in the manufacture of collapsible tubes, particularly in Germany. The use of aluminum in food containers has been discussed extensively during the year.[7]

Aluminum alloys are being used extensively in the fabrication of surgical instruments, orthopedic devices, and hospital supplies.[8]

A development of the Eloxal process of electrolytically applying corrosion-resistant coatings to aluminum is the impregnating of the pores of coatings with photosensitive materials.[9] The importance of aluminum as a noncorrosive reflecting material has been demonstrated by its use in the construction of the mirror of the new 200-inch telescope.[10]

A 32-cubic-yard shovel dipper of aluminum-alloy shapes and plates was constructed for an open-pit coal mine in Illinois.[11]

The *China Clipper* and her sister transport planes were constructed of aluminum and its alloys during the year. In recently built giant French hydroplanes weighing 17 tons, about 10 tons (60 percent) is composed of light aluminum alloys. The new German dirigible *Hindenburg*, under construction during 1935, made use of aluminum alloys. In the automotive industry aluminum is now used for truck bodies, cylinder heads, and pistons. Better business conditions in this industry increased the demand for aluminum in 1935. Aluminum passenger trains and freight cars are new features of American railways. Four all-aluminum trains were ordered in addition to the four already in service. Aluminum street cars are shortly to be placed in service in Oslo, Norway.

Imports and exports.—Aluminum imports increased 6 percent in total value—from $4,038,374 in 1934 to $4,279,014 in 1935. Aluminum metal scrap, alloy, etc., imported into the United States increased 2 percent in value and 15 percent in quantity in 1935 over 1934. The 1935 imports of aluminum manufactures were 41 percent greater than in 1934.

Although aluminum exports increased 79 percent in value in 1934 over 1933, the 1935 exports declined 13 percent. Exports of manufactured aluminum increased 21 percent in value, but this was more than offset by the 44-percent decrease in crude and semicrude aluminum exports.

[7] Monier-Williams, G. W., Aluminum in Food: United Kingdom, Ministry of Health, Reports on Public Health and Medical Subjects 78, London, 1935, pp. 34, Chemical Age, Aluminum in Food: Vol. 33, no. 853, London, Nov. 2, 1935, p. 392; no. 358 (editorial), Dec. 7, 1935, p. 510.

[8] Revue de l'Aluminium, Les applications médicales de l'électricité. L'aluminium dans leur matériel: Vol. 12, no. 69, Paris, March 1935, pp. 2769–2788; L'appareillage orthopdéique et prothétique: Vol. 12, no. 73, Paris, July–August 1935, pp. 2941–2950.

[9] Jenny, A., and Budiloff, N., Details of the Seo Process for Photography on Aluminum Surfaces: Chemische Fabrik, Sept. 18, 1935; Chemical Age, vol. 33, London, Sept. 28, 1935, p. 289.

[10] Johnson, B. K., Reflecting Power of Aluminized Surfaces: Nature, vol. 134, London, Aug. 11, 1934, p. 216. Strong, J., and Gaviola, E., Shaping Telescope Mirrors by Aluminum Coating: Science, vol. 82, supp. 6, Lancaster, Pa., Sept. 20, 1935.

[11] Steel, Aluminum Alloys and Steel Combined in Large Shovel Dipper for Coal-Stripping Work: Vol. 97, July 15, 1935, pp. 36–37.

Aluminum imported for consumption in the United States, 1933–35, by classes

Class	1933		1934		1935	
	Pounds	Value	Pounds	Value	Pounds	Value
Crude and semicrude:						
Crude form, scrap, alloy, etc	15,077,597	$2,699,700	18,371,690	$3,561,833	21,075,683	$3,645,704
Plates, sheets, bars, rods, circles, squares, etc	169,099	46,738	219,901	62,700	215,552	48,634
	15,246,696	2,746,438	18,591,591	3,624,533	21,291,235	3,694,338
Manufactures:						
Leaf (5½ by 5½ inches)	(1)	24,923	(1)	57,532	(1)	105,269
Bronze powder and powdered foil	587,927	173,948	250,055	96,598	277,979	99,300
Foil less than 0.006 inch thick	609,930	185,554	504,415	167,952	944,330	293,094
Powder in leaf (5½ by 5½ inches)	(2)	1,536	(2)	602	(2)	2,824
Table, kitchen, and hospital utensils, and other similar hollow ware	101,755	44,959	96,688	56,910	81,549	51,226
Other manufactures	(3)	36,596	(3)	34,247	(3)	32,963
	(3)	467,516	(3)	413,841	(3)	584,676
Grand total	(3)	3,213,954	(3)	4,038,374	(3)	4,279,014

[1] 1933: 14,446,166 leaves; 1934: 24,905,941 leaves; 1935: 41,298,561 leaves; equivalent in pounds not recorded.
[2] 1933: 430,750 leaves; 1934: 117,066 leaves; 1935: 644,025 leaves; equivalent in pounds not recorded.
[3] Quantity not recorded.

Aluminum imported for consumption in the United States, 1931–35

Year	Crude and semicrude [1]		Manufactures of [2]	Total value	Year	Crude and semicrude [1]		Manufactures of [2]	Total value
	Pounds	Value				Pounds	Value		
1931	14,832,807	$2,539,756	$670,989	$3,210,745	1934	18,591,591	$3,624,533	$413,841	$4,038,374
1932	8,184,713	1,339,455	482,747	1,822,202	1935	21,291,235	3,694,338	584,676	4,279,014
1933	15,246,696	2,746,438	467,516	3,213,954					

[1] Includes crude aluminum, plates, sheets, wire, etc.
[2] Includes aluminum leaf, kitchen utensils, and all other manufactures of aluminum.

Domestic aluminum exported from the United States, 1934–35, by classes

Class	1934		1935	
	Pounds	Value	Pounds	Value
Crude and semicrude:				
Ingots, scrap, and alloys	8,052,548	$1,141,808	3,361,097	$485,940
Plates, sheets, bars, strips, and rods	313,009	107,256	609,250	208,432
	8,365,557	1,249,064	3,970,347	694,372
Manufactures:				
Tubes, moldings, castings, and other shapes	513,847	208,397	949,329	349,884
Table, kitchen, and hospital utensils	(1)	297,056	(1)	302,152
Other manufactures of aluminum	(1)	624,808	(1)	720,822
	(1)	1,130,261	(1)	1,372,858
Grand total	(1)	2,379,325	(1)	2,067,230

[1] Quantity not recorded for table, kitchen, and hospital utensils and other manufactures.

Aluminum and manufactures of aluminum exported from the United States, 1931–35

Year	Crude and semicrude [1]		Manufactures	Total value
	Pounds	Value		
1931	4,700,878	$985,870	[2] $1,868,875	$2,854,745
1932	4,436,690	468,792	[2] 983,583	1,452,375
1933	5,707,661	599,961	[2] 729,066	1,329,027
1934	8,365,557	$1,249,064	[2] $1,130,261	$2,379,325
1935	3,970,347	694,372	[2] 1,372,858	2,067,230

[1] Includes ingots, metal and alloys, plates and sheets, etc.
[2] Tubes, moldings, castings, and other shapes exported amounted to 1,292,400 pounds in 1931, 839,043 pounds in 1932, 454,200 pounds in 1933, 513,847 pounds in 1934, and 949,329 pounds in 1935; figures for quantity of table, kitchen, or hospital utensils and other manufactures exported are not recorded.

The preceding tables of imports and exports in 1935 show that the total imports for which weights are recorded were 11,298 short tons and the exports 2,460 short tons. The excess of imports over exports is approximately 8,838 tons, which, together with the United States production of new aluminum, indicates an approximate total supply of 68,486 short tons exclusive of stock available for domestic consumption. This is 62 percent above a comparable figure (42,369 short tons) for 1934.

WORLD BAUXITE AND ALUMINUM INDUSTRIES

World production of bauxite.—World production of bauxite in 1935 is estimated at 1,600,000 metric tons compared with 1,315,000 metric tons in 1934. Of the bauxite produced in 1934, France contributed 40 percent, Hungary 14 percent, United States 12 percent, Italy 10 percent, Surinam 8 percent, and Yugoslavia 6 percent.

World production of bauxite, 1931–35, by countries, in metric tons

[Compiled by M. T. Latus]

Country	1931	1932	1933	1934	1935
Australia:					
New South Wales	199		333	161	(1)
Victoria	1,406	1,147	681	970	(1)
British Guiana [2]	127,103	63,510	36,663	51,417	113,290
France	403,550	401,430	490,500	528,400	512,800
Germany		1,638	(3)	6,560	(1)
Greece	1,150	590		(1)	(1)
Hungary	89,556	111,558	72,425	184,991	(1)
India, British	4,367	4,539	1,092	18	(1)
Italy	67,369	86,553	94,818	131,266	170,000
Rumania	381	612	1,156	1,458	(1)
Spain		1,300	2,500		(1)
Surinam (Dutch Guiana)	173,154	126,513	103,977	103,338	(1)
U. S. S. R. (Russia)	11,600	37,400	50,600	61,000	(1)
United Kingdom: Northern Ireland	3,394	1,497	709	58	(1)
United States	199,039	97,895	156,651	160,371	237,666
Yugoslavia	64,842	67,086	80,855	84,828	(1)
	1,147,000	1,003,000	1,098,000	1,315,000	(1)

[1] Data not available.
[2] Exports.
[3] Estimate included in total.

World production of aluminum, 1931–35, by countries, in metric tons

[Compiled by R. B. Miller]

Country	1931	1932	1933	1934	1935
Austria	4,000	2,100	2,000	2,100	1,000
Belgium				100	(1)
Canada	28,450	17,800	16,200	15,800	20,556
France	18,152	14,400	14,500	16,300	21,847
Germany	27,200	19,300	18,900	37,200	62,838
Hungary					600
Italy	11,106	13,400	12,100	12,900	13,085
Japan					4,000
Norway	21,420	17,800	15,400	15,300	15,387
Spain	1,153	1,200	1,200	1,200	1,200
Sweden				300	1,817
Switzerland	13,209	8,500	7,500	8,100	19,432
U. S. S. R. (Russia)	[2] 300	1,000	4,400	14,400	25,000
United Kingdom	14,225	10,200	11,000	12,900	16,033
United States	80,532	47,600	38,600	33,600	54,112
	219,700	153,300	141,800	170,200	257,000

[1] Data not available.
[2] May include production of minor producing countries of Europe.

World production of aluminum.—The world output of aluminum in 1935 was approximately 257,000 metric tons compared with 170,200 metric tons in 1934. Of this, Germany produced 24 percent, United States 21 percent, U. S. S. R. (Russia) 10 percent, France 9 percent, Canada 8 percent, Great Britain 6 percent, Norway 6 percent, and Italy 5 percent. North America manufactured 29 percent and Europe 69 percent of the total.

NORTH AMERICA

Canada.—At the Arvida plant of the Aluminum Co. of Canada, British Guiana bauxite will be converted into aluminum by the Bayer process, which will be used in combination with the present Hall-Hoopes system.

United States.—R. E. S. Heineman has described[12] the Sugarloaf Butte alunite located near Quartzsite, Yuma County, in western Arizona. The deposit is similar to the Marysvale (Utah) deposit, in that the alunite is found in branching veins in a butte composed of dacite. The veins comprise about 10 percent of total volume of the rock. Heineman gives the results of an analysis of a large sample of high-grade vein material, as follows: Al_2O_3, 36.5 percent; SO_3, 38.1 percent; K_2O, 4.85 percent; Na_2O, 4.3 percent; SiO_2, 1.2 percent.

Arkansas bauxite deposits.[13]—In 1934 the Public Works Administration allotted funds to the United States Geological Survey to investigate the bauxite deposits in Arkansas. The known commercial deposits are in two areas about 12 miles apart; the more important is near the town of Bauxite, in Saline County; the other is southeast of Little Rock, in Pulaski County. The program of work was limited largely to prospecting with a light drilling rig, as the surface geology is well known through earlier work and geophysical investigations of underground conditions would require more funds than were available and could not establish definite results unless accom-

[12] Heineman, R. E. S., Sugarloaf Butte Alunite: Eng. and Min. Jour., vol. 136, no. 3, New York, March 1935, pp. 138–139.
[13] By M. N. Bramlette, U. S. Geological Survey. Published by permission of the Director, U. S. Geological Survey.

panied by some drilling. This work was supplemented by some remapping of the surface geology on the new topographic base prepared by the United States Geological Survey (which was available for part of the region) and an examination of the natural outcrops and mine exposures of bauxite. It was hoped that drilling would provide first-hand data on underground conditions of bauxite deposits and possibly reveal more extensive reserves in undiscovered underground deposits.

Both bauxite districts are on and around two corresponding areas of nepheline syenite, locally called "granite." These syenite areas lie near the northwest border of nearly flat lying Gulf Coastal Plain deposits of Tertiary age, including the Midway and Wilcox formations, while to the northwest are highly folded Paleozoic rocks. Only features that aid in the interpretation of reserves of bauxite in Arkansas will be considered here. In 1915 W. J. Mead [14] presented evidence of complete gradation from igneous masses of nepheline syenite up through kaolinized syenite to the bauxite, which, in part, retains the original granitic texture of the syenite. Chemical analyses and other data supported his view that syenite was altered to bauxite by very thorough weathering. Mead and others have considered the beds of bauxite not immediately underlain by syenite as reworked sedimentary bauxite in the Tertiary sediments derived from erosion of the residual bauxite formed over the syenite.

Results of the present investigation, which, in addition to surface examinations, included the drilling of 55 test holes to an average depth of 167 feet (minimum 27 feet, maximum 464 feet), gave data substantiating the view that most commercial-grade bauxite grades down into syenite and was formed from it through surface alteration or weathering. Evidence was also obtained indicating that the thinner deposits of bauxite in the Tertiary beds are residual deposits in situ and not reworked, as formerly supposed, and that all of the bauxite was formed at a particular time in the Eocene on an old land surface that represents an unconformity between the marine Midway and the lignitic deposits of the Wilcox, which may correlate with deposits at a similar Eocene horizon in Mississippi.[15]

Where the Midway deposits thin out against a hill of syenite, the bauxite-kaolin zone at the top of the Midway extends up and over the syenite mass; and where the syenite thus extended above the horizon of the top of the blue clay and was never covered by the Midway deposits, the bauxite grades down through a number of feet of thoroughly altered or kaolinized syenite into the hard syenite. These relationships were found to be general. Nineteen test holes encountered the altered syenite with kaolin or bauxite formed from it and were not overlapped by the Midway deposits. Eleven test holes encountered the hard, unaltered syenite where it occurred at lower levels and was covered by the Midway deposits, and 25 holes failed to reach the syenite because of the thickness of Midway limestone but encountered some bauxite or bauxitic clay and kaolin at the Midway-Wilcox contact.

The results obtained in this study indicate large tonnages of nonmerchantable bauxite between the two areas of syenite. Such deposits occur in relatively thin sheets of bauxite with a high content

[14] Mead, W. J., Occurrence and Origin of the Bauxite Deposits of Arkansas: Econ. Geology, vol. 10, 1915.
[15] Burchard, E. F., Bauxite in Northeastern Mississippi: U. S. Geol. Survey Bull. 750, 1925, pp. 101–146.

of silica and iron, which were not formed directly from an underlying syenite but occur at a definite stratigraphic horizon in the sedimentary formations. Evidence is presented that this easily recognizable horizon, at the contact of the Midway and Wilcox groups of the Eocene, represents the restricted period during which all the bauxite was formed through a profound weathering of an old land surface and indicates that prospecting should be carried down only to this horizon. The conclusion is reached that a blanket of bauxite may have formed upon syenite projecting above this horizon, but syenite occurring below this horizon is little altered and no associated bauxite is to be expected. This conclusion eliminates bauxite possibilities in the areas in which Midway occurs at the surface, even though it is underlain by syenite. Subsurface contours on the top of the limestone of Midway age that will be shown on the map accompanying the final report indicate a limiting depth to which prospecting should be carried. This critical depth also bears on potential underground deposits, since any buried hills of syenite that may occur in the large area between the two present mining districts would have to be relatively near the surface to project above the top of the Midway, to have been altered, and possibly to be capped with bauxite. The widely scattered drilling obviously leaves large areas untested in the extensive region around and between the two known bauxite districts, but the results greatly reduce the possible extent of undiscovered deposits. It has been possible, however, to indicate certain areas in which the results seem to suggest the greatest promise of encountering some ore with more intensive drilling.

A comparison of the depths at which syenite was encountered in various wells with the lines of magnetic intensity mapped by Stearn [16] indicates that the relative depth to syenite does not correspond closely with the lines of magnetic intensity, as only the most marked magnetic areas reflect the proximity to syenite and most of these areas are on actual outcrops of the igneous rock. However, the general conclusion from this magnetic survey—that the two large areas of syenite are probably connected at depth—remains probable and was partly substantiated by the drilling.

SOUTH AMERICA

In Surinam the bauxite deposits are 15 to 100 miles from the coast in the Paramaribo region. The deposits are 10 to 50 feet thick. The deposits of British Guiana are similar, though containing less iron oxide.

EUROPE

The Aluminium Cartel, Alliance Aluminium Cie., of Basel, Switzerland, includes the aluminum producers of Europe and Canada but not of the United States. It determines the export quotas and the price of aluminum but permits free competition of aluminum manufacturers. The Japan Aluminum Reduction Co. has decided to cooperate with the Aluminium Cartel.

Austria.—Austria has two aluminum plants, one at Lend in Salzburg and the other at Steg on Hallstätter See, Upper Austria.

[16] Stearn, N. H., A Geomagnetic Survey of the Bauxite Region in Central Arkansas: Arkansas Geol. Survey Bull. 5, 1930.

France.—The French bauxite and aluminum industry is on the east side of the Rhone Valley near the Italian and Swiss boundaries. Most of the bauxite is produced in the Department of Var, followed by Hérault, Ariège, and Bouches-du-Rhone. Two large companies operate in France; these have combined to form still a third company, Aluminum Français, which is their sales organization and also a fabricator of aluminum.

A decree of April 16, 1935, forbade the exportation from France of bauxite, alumina, or aluminum.

Germany.—At one time aluminum was produced from clay at the Bitterfeld plant of the I. G. Farbenindustrie. Aluminum produced in this manner costs twice as much as aluminum produced from bauxite. Today, however, it is probable that lack of necessity and a low price, rather than technology, prevent the use of clay as a raw material for the manufacture of aluminum.[17] The Vereinigte Aluminiumwerke has purchased clay deposits in the vicinity of Bautzen, Saxony, which are large enough to last the company many years to come. Attention is being given to the nitric acid process of alumina extraction due to the overproduction and consequent cheapness of nitric acid in Germany.

Bauxite was imported chiefly from Yugoslavia and Hungary, as on April 16, 1935, France issued a decree prohibiting its export. France was formerly Germany's chief source of supply for bauxite. In Germany, bauxite is produced in Upper Hesse at the Albert mine near Vogelsberg. The monthly production of washed bauxite amounts to about 1,250 tons. The bauxite occurs as nodules in a matrix of red earth.[18]

German consumption of aluminum increased early in May 1934, when the Control Office issued a decree restricting the use of other base metals. This restriction was decreed in the interests of aluminum producers, even if the bauxite had to be imported. At 100 RM. for 4 tons of bauxite required to produce 1 ton of aluminum, this was still only 7 percent of the value of the aluminum produced.[19]

Great as is German production, it could not equal consumption, so that imports of finished goods increased. Scrap and crude aluminum was imported largely from Norway and Sweden. The character of exports did not change, although aluminum wares were exported to about 70 different countries.

Greece.—The principal bauxite deposits of the mainland are along the north shore of the Gulf of Corinth in a very mountainous region. The following companies have concessions and prospecting rights:[20] Bauxites Barlos Frères, Société Bauxite Delphi, and the Bauxite Société Parnasse; the latter company shipped about 7,900 tons of bauxite to Great Britain in 1935.

On the Island of Amorgos in the Aegean Sea the Bauxites S. Papassotiriou has deposits immediately adjacent to the sea. This company shipped 5,250 tons of bauxite to Japan in 1935.

Hungary.—The Hungarian Bauxite A. G., capitalized at about $3,000,000, was organized to acquire bauxite deposits from private

[17] For a description of the reduction plants at Bitterfeld, Lautawerk, and Rheinfelden, see Metall und Erz, vol. 32, no. 11, Halle (Saale), June 1, 1935. (Special light-metals issue.)

[18] Moldenhauer, M., Die hessischen Bauxitlager: Chem. Ztg., vol. 59, no. 12, 1935, pp. 125–127.

[19] Hamburg World, Economic Archives: Bull., vol. 2, no. 5, Jan. 1, 1936, pp. 12–14.

[20] Foreign Metals and Minerals, Bureau of For. and Dom. Commerce, Circ. 3, Apr. 15, 1935, pp. 19–20.

owners and to obtain prospecting rights to extensive reserves controlled by the State.

The Aluminiumwerke Manfred Weiss A. G. (Budapest) was founded with a capital of about $300,000 to manufacture aluminum from Hungarian bauxite. Immediately after operations were begun by this company at Csepel, an import duty of 65 gold kroner was levied on aluminum and aluminum alloys, effective April 28, 1935.

Italy.—The Italian bauxite deposits occur along the west coast of the southern Adriatic Sea, the east coast of the northern Adriatic Sea, and in the Apennine Mountains.[21] Some six bauxite-producing districts are in Istria; indeed, this zone continues into the island fringe of the Dalmatian coast of Yugoslavia. Since 1919, when Istria became an Italian possession, bauxite has been produced here exclusively. The bauxite deposits in the rest of the country are not exploited but probably are maintained as reserves. Since 1928 the export of Istrian bauxite has been controlled.

The Istrian bauxite mines are exploited by three companies—the Società Anonima Mineraria Triestina, the Società Anonima per l'Escavo e la Industria di Minerali d'Alluminio, and the Bauxiti Istriane Società, all at Trieste.

The capacity of the Italian aluminum plants is approximately 36,000 tons of alumina and 15,000 tons of aluminum.

The Società Italiana dell'Aluminio, a partnership of the Montecatini group and the Vereinigte Aluminiumwerke of Lauta, Germany, was dissolved in 1935. A new company, the Società Nazionale dell'Aluminio, has purchased this property and will continue to manage it.

Norway.—In Norway water power is generated by many streams in their courses, relatively near the sea, as they descend precipitously from the high interior plateaus. Bauxite and alumina must be imported and, in turn, most of the crude metal is reexported. Commerce and navigation are carried on easily and cheaply owing to excellent harbors. The total rated capacity of the plants is about 36,000 tons per year.

Spain.—The Aluminio Español, S. A., owns a reduction plant with an annual capacity of 1,200 tons at Sabinanigo, Huesca Province. Alumina is imported from France.

Sweden.—An aluminum-reduction plant has been constructed at Mansbo by the Aluminiumkompaniet. Its capacity is 1,800 tons, and it is believed to be large enough to handle all Swedish requirements.

Switzerland.—The aluminum industry in Switzerland is similar to that of Norway. The principal Swiss company is the L'Aluminium Industrie (the Neuhausen Co.). This company has two plants in Switzerland (at Neuhausen and at Chippis) in addition to plants in Austria, Germany, and Italy. The other Swiss company is the Fabrique d'Aluminium Martigny, S. A., at Martigny-Bourg in the Canton Valais.

U. S. S. R. (Russia).[22]—The Aluminum Research Institute developed a plan for the Svanka plant near Volhov in northwestern Russia. Construction of this plant was begun in 1930, with French

[21] Crema, C., Le risorse in minerali d'alluminio delle due sponde Adriatiche: Atti Soc. Ital. Prog. Sci., 21st meeting, vol. 2, 1934, pp. 120–144

[22] Consular Rept., The Russian Aluminum Industry; 83 pp., Apr. 18, 1935, based largely on Soviet published sources.

technical assistance, and the plant began operating in May 1932.[23] Its annual productive capacity is 12,000 tons of alumina and 6,000 tons of aluminum, produced from the bauxites of Tikhvin. The Zaporozhe plant at Neproges in the Ukraine was begun in 1930, at the same time as the Svanka plant, but work was delayed in order that the experience gained in constructing the Svanka plant might be put to use. The capacity of the Zaporozhe plant was fixed at 32,000 tons of alumina and 20,000 tons of aluminum per year. Production was begun in May 1935 and will amount to 10,000 or 12,000 tons of aluminum for 1935. An alumina plant is now being constructed at Tikhvin. This plant will have a capacity of 50,000 tons of alumina per year.

A new aluminum plant is being erected at Kamensk in the Urals near the bauxite deposit of that region. The plant will have a capacity of 70,000 tons of alumina and 25,000 tons of aluminum per year.[24]

Extensive nepheline deposits occur in the Kola Peninsula of Arctic Russia. A new alumina plant will be constructed at Kandalaksha,[25] in which a new and simplified reduction method for treating the nepheline will be employed. It is proposed to begin operation of the plant by the end of 1937 at a capacity of 20,000 tons of alumina per year. An alumina-reduction plant with an annual capacity of 8,000 tons will be constructed in Karelia on the White Sea-Baltic Canal. Completion of the Second Five-Year Plan in 1937 calls for an annual production rate of 83,000 tons of aluminum per year.

The Tikhvin bauxite deposits contain 44 percent alumina and 12 to 15 percent silica, while commercial bauxites ordinarily contain 50 percent alumina and 5 to 6 percent silica. Exploration of these deposits was begun in 1916. Reserves of bauxite available for immediate industrial use amount to 2,300,000 tons.

Bauxite deposits occur at 18 localities on the eastern slope of the Ural Mountains. The reserves of first-grade ore readily available are estimated at 6,600,000 tons, and of second grade ore at 1,700,000 tons. (The total reserves of readily available ore in the U. S. S. R. are estimated to be 8,900,000 tons.) Mining of the Ural deposits has not begun.[26]

The possibility of producing aluminum from extensive deposits of leucite in Armenia is being considered.[27] Abundant water power may be obtained from nearby sources.

United Kingdom.—The British Aluminium Co., Ltd., is the chief producer of aluminum and owns alumina plants at Larne Harbour, Ireland, and Burnt Island, Scotland, and aluminum-reduction works at Kinlochleven and Foyers, Scotland. The International Aluminium Co., Ltd., owns an alumina plant at Hebburn, Newcastle-on-Tyne, England. The North British Aluminium Co., Ltd., has a plant at Fort William, Scotland. The Aluminium Corporation owns a reduction plant at Dolgarrog Siding near Llanwrst, North Wales.

[23] Beloussov, M. F., and Ostyabrski, B. L., Next Perspectives of the Volkhov Aluminum Plant: Legkie Metally Light Metals, no. 8 (Russian), Moskva, August 1935, pp. 6-13.

[24] Agranovsky, A. A., and others, The Alumina Plant of the Ural Aluminum Combine: Legkie Metally (Light Metals), no. 8, July 1935 (Russian), pp. 3-12.

[25] Sokolov, A. V., Kandalaksha alumina plant: Legkie Metally (Light Metals), no. 3, Moskva, March 1935, pp. 5-10 (Russian).

[26] Fedorov, B. M., Über die mesozoischen Bauxite des Ostabhangs des Mittel-Urals: Soc. Naturalistes de Moscou, Bull., Section Géol., vol. 13 (1), Moskva, 1935, pp. 42-70 (Russian-German summary, pp. 69-70).

[27] Mining Journal, London, vol. 181, no. 5232, Nov. 30, 1935, p. 903.

Yugoslavia.—Yugoslavia produces two grades of bauxite—the Drenis, which contains 53 percent alumina and up to 2.5 percent silica, and the Knez Polje grade, containing about 59 percent alumina and up to 4.5 percent silica. These ores carry 17 to 24 percent Fe_2O_3 and 2.5 to 3.0 percent TiO_2.

Three companies in Yugoslavia are producers of bauxite—the Adria Bauxite Co., the Continental Mining & Bauxite Industrial Co., and the Dalmatia Bauxite Co. These companies exploit deposits near Drenis and Sinj in Dalmatia and Knez Polje and Ygrovac near Mostar in Herzegovina; the ore is largely exported from the Adriatic ports of Split, Sibenik, and Zelenique.[28]

The Fabrika Alumina A. D., of Beograd, has received a 15-year concession to manufacture aluminum from native bauxite. The minimum allowable production should reach 1,000 tons of aluminum and aluminum alloys within 3 or 4 years.[29] Only Yugoslav subjects may hold shares or receive permanent employment in the company.

G. Petunnikov has described [30] bauxites of excellent quality in the five zones in the vicinity of Ulzin. The known reserves are estimated at several million tons.

ASIA

India.—Extensive deposits of high-grade bauxites have been discovered recently at Tungar Hill in the Thana district about 30 miles from Bombay. India consumes large amounts of crude aluminum, which undergo further fabrication into utensils and other products.

Japan.—Japan, lacking bauxite deposits of its own, has sought and considered various projects for the production of alumina—treatment of shales, exploitation of the alunite deposits in Manchuria, and development of bauxite deposits in the East Indies and in the mandated islands of Pelew, Penape and Yap, of the Caroline Island group. Bauxite deposits on these mandated islands will be exploited by the Mitsui Mining Co. The Japan Aluminum Reduction Co., with German aid, has constructed a reduction works at Takao, Formosa.

The Japanese expect to have a plant capacity of 25,000 metric tons by the end of 1936.

The Ministry of Commerce and Industry has reintroduced a bill in the Diet to increase the tariff on aluminum from 75 to 300 to 400 yen per ton.

Netherland India.—It was planned that the Nederlandsch-Indische Bauxiet Exploitatie Maatschappy should begin production of bauxite in 1936 on the Island of Bintan near Singapore. It is expected that about 120,000 to 130,000 metric tons of bauxite will be produced annually, of which about 24,000 tons will go to Taiwan and the rest to Germany.

Bauxite deposits on the Island of Banka off the east coast of Sumatra have been described by Junker.[31]

[28] Mining Journal, London, vol. 183, no. 5254, May 2, 1936.

[29] Bureau of Foreign and Domestic Commerce, Foreign Trade Notes, Jan. 5, 1935, p. 27.

[30] Petunnikov, Gr., Die Bauxitvorkommen von Montenegro: Montan. Rundschau, vol. 27, no. 23, Wien (Vienna), Dec. 1, 1935, pp. 1–7.

[31] Junker, H. W., Bauxite und Laterit auf Banka: De Ingenieur in Nederlandsch-Indië, vol. 3, no. 2, Bandoeng, February 1936, pp. IV15–IV23.

MERCURY

By H. M. Meyer

SUMMARY OUTLINE

The domestic mercury industry in 1935 was maintained at about the 1934 level. Increased domestic production was accompanied by a decline in imports of metal for use, and consumption was at virtually the 1934 rate—about 10 percent below the average indicated for the 10-year period 1924–33. The quoted price for mercury was slightly lower in 1935, although the average recorded for December closely approximated the highest monthly quotations for 1934.

The disturbed political situation, which included a war between Italy and Ethiopia, economic sanctions against Italy, and internal disorders in Spain, raised the question of possible difficulty in obtaining supplies of mercury and increased the demand for the metal in the last quarter of 1935. Imports of metal into consuming countries showed substantial gains. For example, while British imports in the first 7 months of 1935 were considerably less than in the corresponding period of 1934, in September they were reported to have been 210,207 pounds compared with 24,708 pounds in September, 1934, and the total for the year was higher than in 1934. Sixty percent of the total imports into the United States were entered in the last quarter of 1935.

The price of mercury rose in Europe as a result of the political developments and the uncertainty as to the availability of mercury supplies. The average quoted price for London was $60.74 per flask in 1935, an increase of $4.59 over that in 1934, while the New York price for the year decreased $1.88 per flask. The price differential in favor of New York, caused by the domestic tariff on mercury, declined sharply in 1935. It was $11.25 per flask in 1935 compared with $17.72 in 1934; the tariff in both years was $19 per flask.

Spain and Italy are the leading mercury-producing countries of the world largely because of the size and grade of their ore deposits.

In the United States, which is the third ranking nation in size of output, the average tenor of mercury ores produced is much lower than that of Spain or Italy. During the past 10 years the average grade of crude ore treated has been 0.50 percent (10 pounds to the ton) or less. The number of producing mines has ranged from 17 in 1926 to 95 in 1932; production has ranged from 7,541 flasks in 1926 to 24,947 in 1931; the New York price has ranged from a low of $47 a flask in August 1932 to a high of nearly $128 for November 1927.

The testimony of the domestic producers, under oath at a public hearing before the Tariff Commission,[1] was to the effect that at $90 per flask they could produce enough mercury to supply the demands of the domestic market. Since 1922 there has been a tariff of 25 cents per pound, equivalent to $19 a flask, on all mercury imported. Since that time the domestic industry has supplied amounts ranging from 23 percent of domestic consumption in 1926 to 97 percent in 1931. Although a small amount of imported mercury was consumed in 1931, the domestic mines produced more than enough metal to supply the depressed domestic market. Owing to the limited demand

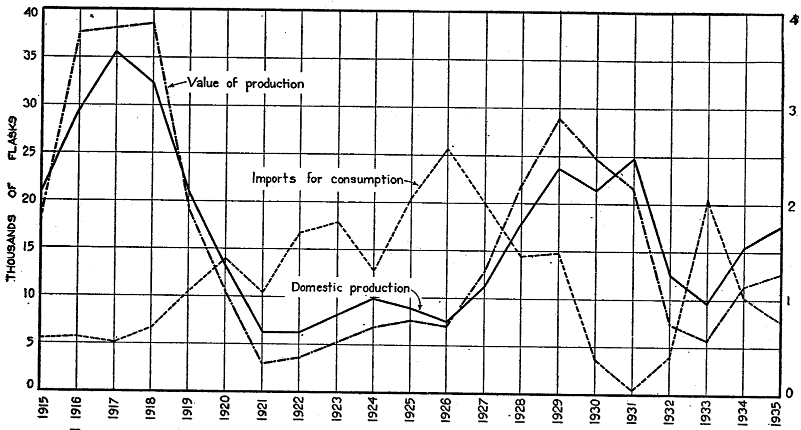

FIGURE 70.—Trends in domestic production, value, and imports of mercury, 1915–35.

in the United States in that year and to a price differential in favor of selling in European markets, a substantial amount of domestic mercury was exported. For the period 1922 to 1935, inclusive, during which the tariff of $19 a flask was in effect, mines in the United States produced about 52 percent of the mercury consumed at home; in 1935 they supplied 69 percent of domestic needs.

The deposits of mercury in the United States are relatively small and scattered. Since the commercial exhaustion of the New Almaden and New Idria mines of California, no single deposit has provided more than 4,000 flasks of mercury in any one year.

The reserves of low-grade ores are of great potential value to the consumers of mercury. This is evidenced by the high prices established by the international cartel from 1927 to 1930, inclusive, and the resulting increase in domestic production. It would seem that this production was influential in breaking the price, with the result that consumers were able to obtain their supplies at a price but little higher than that prevailing in world markets. Just as the manganese deposits of Brazil, operated as they are, give assurance to one of the largest domestic manufacturers of steel of a price in line with its requirements, so do the domestic reserves of mercury safeguard domestic consumers.

[1] U. S. Tariff Commission, Report to the President of the United States; Quicksilver, Mar. 26, 1934.

Salient statistics of the mercury industry in the United States, 1932–35

[Flasks of 76 pounds]

	1932	1933	1934	1935
Production .... flasks..	12,622	9,669	15,445	17,518
Number of producing mines	95	75	93	90
Average price per flask:				
New York	$57.93	$59.23	$73.87	$71.99
London	$48.24	$41.64	$56.15	$60.74
Imports for consumption:				
Pounds	295,348	1,543,935	774,564	593,904
Equivalent flasks	3,886	20,315	10,192	7,815
Apparent supply .... flasks..	16,294	29,700	25,400	25,200
From domestic mines .... percent..	76	32	60	69
Stocks in warehouses (bonded) at end of year..flasks..	[1] 3,840	5,370	4,346	3,582

[1] Probably includes about 3,550 flasks imported late in the year on 1 large contract.

The successful use of mercury in power generation has been responsible, thus far, for the consumption of 10,000 flasks of metal in three boilers and turbines driving generators in the eastern United States. The General Electric Co. states that there is no other known method of generating power from a fuel so efficient as that represented by the mercury and steam cycle. The following article, quoted from Chemical Industries for May 1936, gives recent information regarding the mercury-vapor boilers:

Mercury approximating 750,000 pounds, or 10,000 flasks is at present circulating in three boilers and turbines driving generators in the eastern United States. Two smaller boilers are being installed. Those now in operation are at Schenectady, N. Y., Hartford, Conn., and Kearny, N. J. The first and third mentioned are each of 20,000 kw capacity; that at Hartford is half this capacity. The boiler at Schenectady is an outside installation. It contains 300,000 pounds of foreign-produced mercury (4,000 flasks), equivalent to about half the production of California in 1934 and more than that either of Oregon or of Texas and Arizona combined. The boiler is fired with powdered coal, and the pressure maintained is only 140 pounds per square inch—scarcely one-tenth that of steam at the same temperature. The boiling point of mercury is 675° F. and the boiler temperature is 975° F. A cubic foot of mercury weighs 845 pounds, about 13½ times that of water. A little sodium is added to the mercury to aid heat transfer between the mercury and steel, and some zirconium (or titanium) is added to retard the solution of iron from the boiler by the mercury. A sampling and testing apparatus at the stacks checks mercury loss and is sensitive to minute quantities of mercury. The loss from the boiler and power plant is 1 percent, or 3,000 pounds a year (40 flasks). The mercury vapor flows to the turbo-generators and then to the "condenser-boilers." Here, water is used for condensing the vapor, but the latent heat of the mercury is sufficient to generate steam at 400 pounds pressure, which is piped to a nearby plant. The available energy in the steam so produced exceeds the power obtained from the mercury generators. The mercury circulates in the system seven times an hour. Mercury vapor from the blow-off and safety valve of the mercury boiler is led to the condenser-boilers. The General Electric Co. states that there is no other known method of generating power from fuel so efficient as that represented by the mercury and steam cycle. The Schenectady installation cost around $4,000,000, or $200 per kilowatt capacity; the cost of mercury at present prices would be about 7½ percent of the total. Pioneering difficulties appear now to have been fairly well overcome, and within the next year or two the Emmet boiler may be marketed more aggressively, possibly in relatively small units, even down to 1,000 kw.

The following tables bring out the fact that in only 1 year (1923) since the tariff of $19 a flask was put into effect has the domestic industry enjoyed the full benefit of the tariff.

Average yearly prices of mercury at New York and London, 1922–35

Year	New York		London [3]	Excess of New York quoted price over London price
	Index [1]	Quoted [2]		
1922 [4]	$42.56	$58.95	$51.27	$7.68
1923 [4]	46.15	66.50	46.83	19.67
1924 [4]	49.65	69.76	52.93	16.83
1925 [4]	56.06	83.13	66.90	16.23
1926 [4]	64.13	91.90	76.15	15.75
1927	86.44	118.16	104.01	14.15
1928	89.18	123.51	108.54	14.97
1929	89.49	122.15	108.11	14.04
1930	92.90	115.01	105.91	9.10
1931	83.51	87.35	89.76	[5] 2.41
1932	62.42	57.93	48.24	9.69
1933	62.74	59.23	41.64	17.59
1934	68.84	73.87	56.15	17.72
1935	62.17	71.99	60.74	11.25

[1] The mercury index price has been calculated for each year by dividing the New York quoted price of mercury by the Bureau of Labor Statistics wholesale price index for all commodities (1913=100).
[2] Engineering and Mining Journal, New York.
[3] 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.
[4] Price quoted on 75-pound flask prior to 1927.
[5] London excess.

Average monthly prices of mercury at New York and London and excess of New York price over London price, 1933–35

Month	1933			1934			1935		
	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	$48.50	$36.34	$12.16	$67.54	$48.45	$19.09	$72.76	$58.71	$14.05
February	48.61	36.26	12.35	72.01	53.14	18.87	72.50	58.48	14.02
March	52.68	34.54	18.14	75.47	54.76	20.71	72.50	58.75	13.75
April	54.58	35.57	19.01	75.93	55.40	20.53	72.50	59.86	12.64
May	56.50	37.85	18.65	75.58	55.21	20.37	72.14	59.87	12.27
June	60.04	40.32	19.72	75.00	57.80	17.20	71.46	61.93	9.53
July	62.90	44.81	18.09	75.00	57.19	17.81	70.54	61.60	8.94
August	63.50	41.57	21.93	75.00	58.12	16.88	69.00	61.50	7.50
September	64.58	43.03	21.55	74.56	57.93	16.63	69.21	60.40	8.81
October	66.50	45.38	21.12	74.00	58.67	15.33	71.75	62.57	9.18
November	66.00	50.70	15.30	73.28	58.62	14.66	74.35	61.68	12.67
December	66.33	49.79	16.54	73.00	58.11	14.89	75.20	63.58	11.62
Average	59.23	41.64	17.59	73.87	56.15	17.72	71.99	60.74	11.25

[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.—The following table shows the supply of mercury in the United States, 1925 to 1935.

Supply of mercury in the United States, 1925–35

[Flasks of 76 pounds]

Year	Production (flasks)	Imports for consumption (flasks)	Exports (flasks)	Apparent supply		
				Total (flasks)	From domestic mines (percent)	Imported (percent)
1925	9,053	20,580	201	29,432	30.1	69.9
1926	7,541	25,634	114	33,061	22.5	77.5
1927	11,128	19,941	(1)	[2] 30,900	35.5	64.5
1928	17,870	14,562	(1)	[2] 32,300	54.9	45.1
1929	23,682	14,917	(1)	[2] 38,500	61.3	38.7
1930	21,553	3,725	(1)	[2] 25,200	85.2	14.8
1931	24,947	549	[3] 4,984	20,512	97.3	2.7
1932	12,622	3,886	[3] 214	16,294	76.2	23.8
1933	9,669	20,315	(1)	[2] 29,700	31.6	68.4
1934	15,445	10,192	(1)	[2] 25,400	59.9	40.1
1935	17,518	7,815	(1)	[2] 25,200	69.0	31.0

[1] Not separately classified for 1927-30 and 1933-35.
[2] Estimated by Bureau of Mines.
[3] From a special compilation by the customs statistics section, Bureau of Foreign and Domestic Commerce.

REVIEW BY STATES

In 1934 there was a large increase in the average quoted price for mercury and, in consequence, a substantial increase in production. The average price declined slightly in 1935, while domestic production continued to increase. The output in 1935 amounted to 17,518 flasks compared with 15,445 flasks in 1934, an increase of 13 percent.

Following the past record of the domestic mercury industry, the major part of the production in 1935 was made by a relatively small number of the larger mines. Only 9 mines of the 90 active in 1935 produced 77 percent of the total output. Seventy mines and prospects produced 1,359 flasks only, an average of 19 flasks per mine. The roster of larger properties in 1935 is almost identical with that in 1934. The principal mines in 1935 were: Arkansas: Pike County—Parker property; California: Lake County—Sulphur Bank, Great Western, Mirabel, and Helen mines; Napa County—Aetna, Oat Hill, and Oat Hill Extension mines; San Benito County—New Idria mine (dumps); San Luis Obispo County—Oceanic and Klau mines; Santa Barbara County—Los Prietos and Red Rock mines; and Trinity County—Altoona mine; Oregon: Jefferson County—Horseheaven mine; Lane County—Black Butte mine; and Malheur County—Bretz mine; and Texas: Brewster County—Chisos, Rainbow, and Waldron properties. These properties produced 92 percent of the country's total output of mercury in 1935. No new mine of importance was developed in 1935.

Mercury produced in the United States, 1932–35

	Producing mines	Flasks of 76 pounds	Value [1]
1932:			
California	63	5,172	$299,588
Nevada	15	474	27,456
Oregon	7	2,523	146,145
Washington	3	407	23,575
Texas, Arizona, Arkansas, and Alaska	7	4,046	234,365
	95	12,622	731,129
1933:			
California	49	3,930	232,762
Nevada	12	387	22,921
Oregon	5	1,342	79,483
Texas, Arkansas, Washington, and Utah	9	4,010	237,500
	75	9,669	572,666
1934:			
Arkansas	5	488	$36,046
California	49	7,808	576,738
Nevada	18	300	22,160
Oregon	11	3,460	255,573
Washington	5	330	24,375
Texas and Arizona	5	3,059	225,953
	93	15,445	1,140,845
1935:			
Arkansas	6	304	21,885
California	52	9,271	667,419
Nevada	13	190	13,678
Oregon	10	3,456	248,798
Washington	4	106	7,631
Texas and Arizona	5	4,191	301,710
	90	17,518	1,261,121

[1] Value calculated at average price for quicksilver at New York.

Arizona.—A small quantity of mercury was produced in 1935, as in 1934, at the property of the Mercury Mines of America.

Arkansas.—The output of mercury in Arkansas was lower in 1935 than in 1934. Mercury properties in Pike County and one mine over the borderline in Howard County furnished the output of this State in 1935. A new 50-ton Nichols-Herreshoff furnace was installed at the property of the Mid-Continent Quicksilver Co. and began operations in December.

California.—Increased activity at mercury mines in California resulted in an increase of 19 percent in production. In 1935, 52 mines produced 9,271 flasks of mercury compared with 49 mines and 7,808 flasks of mercury in 1934. Mines that have been producing for years were largely responsible for California's output, and five properties—the Sulphur Bank, Mirabel, Oat Hill, Oceanic, and Klau—accounted for 73 percent of the State total. California as usual, was the most important mercury-producing State, with an output that represented 53 percent of the country's total production.

Mercury production was begun at the Devils Kitchen mine at Coso near Little Lake, Inyo County, in 1935 by F. J. Sanders and A. W. Legge, who used a small Johnson-McKay retort.

Approximately 44 percent of California's output was made in Lake County, where the Sulphur Bank, Great Western, Mirabel, and Helen mines are located. Mines in Napa County, including the Aetna and Oat Hill, produced 14 percent of the State's total output. Working of the dumps at the New Idria mine was the most important mercury operation in San Benito County and caused this property to be one of the large producers in the State. The production of the Oceanic and Klau mines were the chief reasons for output of 2,464 flasks in San Luis Obispo County, 27 percent of the total for California. A screening and concentrating plant, with a capacity of 100 tons every 8 hours, was installed at the Cloverdale mine, Sonoma County, in 1935.

Nevada.—The output of 190 flasks of mercury was from scattered operations in six counties. No mine in Nevada is producing important quantities of mercury at the present time.

Oregon.—Results of mercury mining in this State in 1935 were almost precisely the same as in 1934. Ten properties produced 3,456 flasks in 1935 compared with 11 properties and 3,460 flasks in 1934. Several mines in Crook County were productive, and operations were also carried on in Clackamas, Douglas, and Jackson Counties. The important producing mines in the State, however, were the Horseheaven mine (Jefferson County), Black Butte mine (Lane County), and Bretz mine (Malheur County), which were also among the largest producers in the United States.

Texas.—Production was increased in 1935 at properties of the Chisos Mining Co., Rainbow Mines, Inc., Waldron Quicksilver Properties, Inc., and Brewster Quicksilver Consolidated.

Washington.—Several mines in Lewis County accounted for an output of 106 flasks of mercury in 1935.

EMPLOYMENT, MAN-HOURS, AND PRODUCTIVITY AT MINES AND PLANTS

A careful study of the figures of employment, man-hours, and productivity at mercury mines and plants indicates that there are several characteristics of the domestic mercury industry that should be noted.

As there are relatively few large mines in the United States, the opening up of new deposits, with the high exploratory and labor charge and the greater effort that must be made to combat the gradual exhaustion of old mines, affects this industry much more noticeably than other branches of mining, where operations are large and well established and produce over a period of many years and where an almost fixed amount of development work takes place constantly. Small mercury mines and prospects that produce intermittently, and even then at greatly varying labor costs (utilizing old, inefficient plants and home-made retorts), make the comparison of statistical trends, especially for short periods, extremely hazardous. Over a decade, however, there has been an upward trend in the output of mercury per unit of manpower. As stated in Minerals Yearbook 1935, this upward trend has been due partly to the greater employment of engineers and technical men at the mines and to better-trained mining and metallurgical crews. Also, the low prices for several years brought a demand for lower production costs, shut down some inefficient properties, and brought about the mining of richer veins at others.

Employment at mercury mines and plants in the United States, mercury produced, and average output per man, 1925–34

Year	Employment									Production					
	Average number of men employed			Time employed						Total (flasks of 76 pounds)	Covered by study			Average pounds per man (mines and plants)	
				Man-shifts			Man-hours								
	Mines	Plants	Total	Mines	Plants	Total	Mines	Plants	Total		Flasks	Equivalent pounds	Percent of total	Per shift	Per hour
TOTAL UNITED STATES															
1925	279	43	322	89, 931	11, 113	101, 044	719, 448	88, 904	808, 352	9, 053	8, 513	646, 988	94	6. 40	0. 80
1926	283	30	313	89, 606	8, 175	97, 781	716, 848	65, 400	782, 248	7, 541	6, 559	498, 484	87	5. 10	. 64
1927	364	104	468	120, 570	24, 645	145, 215	964, 560	197, 180	1, 161, 740	11, 128	8, 062	612, 712	72	4. 22	. 53
1928	517	141	658	167, 184	38, 080	205, 264	1, 358, 277	304, 540	1, 662, 817	17, 870	14, 251	1, 083, 076	80	5. 28	. 65
1929	748	222	970	217, 920	58, 467	276, 387	1, 764, 310	470, 549	2, 234, 859	23, 682	20, 114	1, 528, 664	85	5. 53	. 68
1930	665	231	896	201, 695	58, 852	260, 547	1, 778, 830	470, 816	2, 249, 646	21, 533	19, 731	1, 499, 556	92	5. 76	. 67
1931	752	221	973	213, 499	57, 166	270, 665	1, 745, 869	464, 226	2, 210, 095	24, 947	22, 772	1, 730, 672	91	6. 39	. 78
1932	331	137	468	75, 810	26, 761	102, 571	606, 498	214, 087	820, 585	12, 622	10, 580	804, 080	84	7. 84	. 98
1933	286	113	399	70, 406	22, 068	92, 474	562, 682	172, 669	735, 351	9, 669	8, 234	625, 784	85	6. 77	. 85
1934	343	159	502	87, 388	36, 609	123, 997	650, 848	278, 505	929, 353	15, 445	13, 504	1, 026, 304	87	8. 28	1. 10
CALIFORNIA															
1928	254	74	328	83, 225	17, 622	100, 847	665, 800	140, 976	806, 776	6, 977	6, 571	499, 396	94	4. 95	0. 62
1929	419	134	553	116, 413	29, 316	145, 729	931, 304	235, 088	1, 166, 392	10, 139	9, 214	700, 264	91	4. 81	. 60
1930	335	150	485	98, 820	33, 862	132, 682	790, 560	270, 896	1, 061, 456	11, 451	10, 791	820, 116	94	6. 18	. 77
1931	396	136	532	105, 710	31, 420	137, 130	846, 497	256, 105	1, 102, 602	13, 448	12, 547	953, 572	93	6. 95	. 86
1932	144	73	217	23, 766	9, 853	33, 619	190, 082	78, 823	268, 905	5, 172	4, 247	322, 772	82	9. 60	1. 20
1933	116	59	175	22, 988	7, 436	30, 424	183, 332	57, 207	240, 539	3, 930	3, 497	265, 772	89	8. 74	1. 10
1934	166	86	252	37, 144	16, 076	53, 220	297, 144	128, 628	425, 772	7, 808	7, 271	552, 596	93	10. 38	1. 30
OTHER STATES															
1928	263	67	330	83, 959	20, 458	104, 417	692, 477	163, 564	856, 041	10, 893	7, 680	583, 680	71	5. 59	0. 68
1929	329	88	417	101, 507	29, 151	130, 658	833, 006	235, 461	1, 068, 467	13, 543	10, 900	828, 400	80	6. 34	. 78
1930	330	81	411	102, 875	24, 990	127, 865	988, 270	199, 920	1, 188, 190	10, 102	8, 940	679, 440	88	5. 31	. 57
1931	356	85	441	107, 789	25, 746	133, 535	899, 372	208, 121	1, 107, 493	11, 499	10, 225	777, 100	89	5. 82	. 70
1932	187	64	251	52, 044	16, 908	68, 952	416, 416	135, 264	551, 680	7, 450	6, 333	481, 308	85	6. 98	. 87
1933	170	54	224	47, 418	14, 632	62, 050	379, 350	115, 462	494, 812	5, 739	4, 737	360, 012	83	5. 80	. 73
1934	177	73	250	50, 244	20, 533	70, 777	353, 704	149, 877	503, 581	7, 637	6, 233	473, 708	82	6. 69	. 94

FOREIGN TRADE[2]

Imports of mercury into the United States in 1935 were from only three countries—Spain, Italy, and Mexico—and were 23 percent lower than in 1934. Statistics for 1931 to 1935, inclusive, are shown in the following table.

Mercury imported into the United States, 1931–35, by countries

Country	1931		1932		1933		1934		1935	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Belgium			7,606	$3,100						
Canada					30	$7				
Italy			261,972	98,907	244,076	109,729	49,285	$33,339	68,705	$30,735
Mexico	445	$622	221	199	156,056	74,464	188,494	120,914	4,182	2,975
Spain	26,609	32,027	346,090	128,637	1,292,553	584,769	536,025	326,635	521,017	347,806
Sweden							760	600		
United Kingdom			760	571	21,449	9,038				
	27,054	32,649	616,649	231,414	1,714,164	778,007	774,564	481,488	593,904	381,516

Mercury compounds imported for consumption in the United States, 1934–35

Compound	1934		1935	
	Pounds	Value	Pounds	Value
Chloride (mercuric) (corrosive sublimate)			10	$11
Chloride (mercurous) (calomel)	1,112	$1,243	998	1,187
Mercury preparations (not specifically provided for)	427	866	79	190
Vermilion reds (containing quicksilver)	27,435	26,159	51,697	49,230
		28,268		50,618

WORLD PRODUCTION

The following table shows the world production of mercury, by countries, from 1931 to 1935.

World production of mercury, 1931–35, by countries

[Compiled by R. B. Miller]

[1 metric ton=29.008 flasks of 76 pounds]

Country[1]	1931		1932		1933		1934		1935	
	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons
Algeria	1,073	37.0	1,184	40.8					(2)	(2)
Australia: Queensland	11	.4	26	.9			3	0.1	(2)	(2)
Austria	72	2.5	23	.8	5	0.2			18	0.6
Bolivia[3]	1,021	35.2	505	17.4			664	22.9	577	19.9
Chile	20	.7	8	.3					(2)	(2)
China[3]	[4] 638	[4] 22.0	580	20.0	435	15.0	[5] 450	[5] 15.0	1,314	45.3
Chosen	41	1.4	26	.9					(2)	(2)
Czechoslovakia	2,222	76.6	1,305	45.0	194	6.7	763	26.3	2,004	69.1
Italy	37,652	1,298.0	29,480	1,016.3	17,605	606.9	12,804	441.4	25,469	878.0
Japan	101	3.5	69	2.4	234	8.1	196	6.8	(2)	(2)
Mexico	7,292	251.4	7,330	252.7	4,478	154.4	4,580	157.9	6,277	216.4
New Zealand	450	15.5	20	.7	99	3.4	49	1.7	(2)	(2)
Rumania	8	.3	2	.1	8	.3	2	.1	(2)	(2)
Spain	19,786	682.1	23,656	815.5	19,626	676.6	31,799	1,096.2	(2)	(2)
Turkey	235	8.1			23	.8	41	1.4	(2)	(2)
United States	24,947	860.0	12,622	435.1	9,669	333.3	15,445	532.4	17,518	603.9
Yugoslavia			8	.3					(2)	(2)
	[6] 95,569	[6] 3,294.7	[6] 76,844	[6] 2,649.2	[6] 52,376	[6] 1,805.7	[6] 66,796	[6] 2,302.2	(2)	(2)

[1] In addition to countries listed, Taiwan reported production of 488 kilograms of cinnabar in 1931; mercury content not stated. The U. S. S. R. (Russia) is reported to produce mercury, but no statistics of production are available.
[2] Data not available. [3] Exports. [4] Approximate production. [5] Estimated. [6] Exclusive of U. S. S. R.

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

In the past issues of Minerals Yearbook attention has been called to the fact that the industrial world is supplied with its requirements of mercury by only a few localities. During the 15 years ended December 31, 1934, approximately 79 percent of the world's production came from Italy and Spain, 43 percent from Italy, and 36 percent from Spain. Prior to 1928 the mercury market of the world might have been considered highly competitive. By the forming of the Consorzio Mercurio Europeo, the larger part of the mercury sold in the world market came under the control of this so-called International Cartel. The signatories to the original agreement, made in 1928, were the Italian and Spanish Governments. In 1932 there was a threatened withdrawal of the Italian producers from the cartel. In 1933 the agreement was renewed for a period ended December 1934, at which time it was prolonged for another 2 years. Meetings are held annually, and world quotas and markets are allocated. Broadly, up to January 1936 the European market was supplied from the product of Italy. The balance of the world's requirements came principally from Spain. The headquarters of the Consorzio Mercurio Europeo are at Lucerne, Switzerland, and all purchases of Italian and Spanish mercury must be made through this office.

The recovery of mercury per ton of ore from the Almaden mine of Spain is five times greater than that from the Italian mines. The indicated losses per ton are more than the average tenor of the ores produced in Italy. It seems evident that the success of the Italian mercury-mining industry depends upon the present international agreement, which enables Italy to obtain a price at which the mining of mercury is commercially profitable.

Australia.—The opening of a mercury deposit has been reported in the Kilkivan field, in the Wide Bay District, Queensland. A Government geologist is reported as affirming that a vigorous prospecting campaign is warranted. The lode formation is exposed intermittently for 700 feet, the hanging wall of andesite carrying numerous calcite veinlets, while immediately below the andesite a highly decomposed clay seam 3 feet wide shows appreciable values in cinnabar.

Germany.—According to Report 51923 by Sydney B. Redecker, American consul, Frankfurt-am-Main, Germany, dated October 26, 1935 and entitled "German Metal and Mineral Notes", the mining of mercury there was resumed in 1935 after many years of idleness. This doubtless was due to the effort of the German Government to relieve, in every conceivable way, the pressure of foreign-exchange shortage by the curtailment and elimination of imports wherever possible. The demand of general industry as well as military requirements also contributed to the desire for domestic production.

Imports of mercury into Germany in the first 11 months of 1935 were reported to have been 21,900 flasks compared with 15,600 flasks during the corresponding period in 1934.

Mercury deposits of Germany are situated in the neighborhood of Obermoschel in the Rhine Palatinate (Pfalz). The mines of this district were productive from 1762 to 1780. The annual output during this period has been estimated to have averaged slightly over 1,000 flasks. After 1842, owing to the low tenor of the ore, Germany was unable to compete with the Spanish, Italian, and Austrian output.

In 1933 the German Government, carrying out its desire to decrease mercury imports and to provide employment, determined that it was justified in resuming operations on these mines. During 1934 and

1935 an entirely new plant was built on the property. The reduction works were capable of treating 200 tons of ore per day, and the entire project employed about 300 persons. It has been reported that the ore reserves are abundant but that the grade is exceedingly poor, and the average tenor of the ore is approximately 0.2 percent.

The company responsible for the operation of the present mine is the Deutsche Montangesellschaft, with headquarters at Wiesbaden. According to the consular report cited, it is unofficially reported that the Reich Government has undertaken to grant subsidies or to make other guarantees against financial losses to the operating company, indicating the importance placed upon developing the mines from a foreign-exchange and employment point of view.

Italy.—According to Vice Consul Charles W. Wright,[3] mining of mercury in Italy was at a low ebb during the 5 years prior to 1935. From 1927 to 1930 the annual production was nearly 58,000 flasks, with a value of approximately lire 100,000,000. In 1934 the production was 12,804 flasks, with a value of lire 7,846,249. Most of the mines, particularly those in Tuscany, were closed. The depressed condition of this industry was due partly to the decrease in exports as well as to the large unsold stocks under the jurisdiction of the International Cartel. Production in 1935, while much below the level of years prior to 1933, nearly doubled that of 1934.

The increase in the average price in the United States from $59.23 per flask of 76 pounds in 1933 to $71.99 in 1935 did not help the situation in Italy, owing to devaluation of the dollar. The mercury output is controlled almost entirely by the Societa Anonima Mineraria Monte Amiata, with mines in Tuscany, and by the Government, which operates the Idria mine near Udine. The average tenor of the ore from the Tuscany mines has been approximately 1 percent mercury. More than 75 percent of the total Italian production in the past has been obtained from this source. The average tenor of the ore from the Idria mine is approximately 0.7 percent. The reserves of the Tuscany area have been estimated as being of sufficient magnitude to produce 43,500 flasks per year for several decades.

Mercury produced in Italy, 1932–33

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
1932											
Cagliari (Iglesias)[2]	------	------	------	------	------	------	(2)	(2)	63	$3,123	(2)
Gorizia (Trieste)	1	624	59,739	0.660	$217,082	96	1	97	9,758	363,978	101
Grosseto (Firenze)	4	260	26,280	.370	20,204	101	4	164	2,480	110,198	15
Siena (Firenze)	4	960	41,741	1.300	579,764	43	3	341	17,179	763,014	50
	9	1,844	127,760	.810	817,050	69	8	602	29,480	1,240,313	[3] 49
1933											
Cagliari (Iglesias)[2]	------	------	------	------	------	------	(2)	(2)	45	3,573	(2)
Gorizia (Trieste)	1	594	45,007	.726	190,785	76	1	92	8,734	360,043	95
Grosseto (Firenze)	3	97	9,539	.96	78,018	98	3	43	2,882	135,220	67
Siena (Firenze)	1	179	14,000	1.05	130,469	78	2	48	5,944	278,856	124
	5	870	68,546	.826	399,272	79	6	183	17,605	777,692	96

[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.

[3] Wright, Charles W., Vice Consul, Rome, Italy, The Italian Metal Industries: No. 51524, Oct. 17, 1935.

The present production of the Idria district is from a single deposit. It is said that the mine has been bottomed at 350 meters. The reserves have been estimated to be capable of supporting a production of 14,500 flasks of mercury per year for about 10 years. It has been estimated that the cost of producing mercury in Italy is approximately $65 a flask. The average tenor of the crude ore produced in Italy has been about 0.87 percent.

Spain.—The long history of production and the known and probable reserves of the Almaden mine of Spain place it today in the position of the greatest mercury mine now known. The indicated reserves have been estimated many times as being of sufficient magnitude to supply for more than 100 years the world's normal annual consumption of approximately 100,000 flasks.

The average tenor of the crude ore is said to be 8 percent, of which approximately 6 percent is recovered.

Mercury produced in Spain, 1933–34

Province	Ore mined					Metal produced				
	Number of mines	Number of workmen	Metric tons	Value [1]	Tons per man	Number of plants	Number of workmen	Flasks (76 pounds)	Value [1]	Flasks per man
1933										
Ciudad Real	1	1,505	9,297	$167,530	6.18	1	445	19,626	$1,051,568	44.10
Granada	1	30	47	191	1.57					
Oviedo	1	33	950	2,380	28.78					
	3	1,568	[2] 10,294	170,101	6.57	1	445	19,626	1,051,568	44.10
1934										
Ciudad Real	1	1,522	17,821	519,479	11.71	1	551	31,713	1,567,708	57.55
Granada	1	39	344	1,647	8.82	1	11	86	8,806	7.73
Oviedo	1	49	2,070	12,332	42.24					
	3	1,610	[3] 20,235	533,458	12.57	2	562	31,799	1,576,514	56.58

[1] Pesetas converted to dollars at the average annual rate of exchange, as published by the U. S. Federal Reserve Board.
[2] Production at mine mouth.
[3] Merchantable ore.

For many years the mine has been operated by the Spanish Government, and prior to the agreement with Italy the product was marketed through an arrangement with the House of Rothschild of England (Pickering & Co., agents). Since entering the agreement with Italy, the mine has been operated sporadically, production for 2 or 3 months of the year sufficing to meet the Spanish quota. The cost of production per flask has been estimated as not exceeding $45.

According to a report from Commercial Attaché Nufer, Madrid, exports of mercury from Spain increased from 33,600 flasks in 1934 to 66,400 flasks in 1935.

U. S. S. R. (Russia).—During the last few years, according to reports, about 20 mercury deposits have been discovered in different parts of the Union, and this year it is said that an important deposit was found in the Altai district (central Asia). At Nikitovka, says the secretary of the Lomonosov Institute of the Academy of Science, who has just returned from the Altai Mountains, ore with a mercury content of 0.25 percent is worked; the new central Asia deposits are reported to contain ore with as much as 5 percent mercury. Free mercury has also been found there for the first time.

MANGANESE AND MANGANIFEROUS ORES [1]

By Robert H. Ridgway

SUMMARY OUTLINE

The continued rise in the world output of steel to over 96,000,000 long tons in 1935 was reflected in the world production and consumption of manganese ore. Price quotations, which held at the level reached in 1934, reflected the better demand; and the increased domestic consumption in the U. S. S. R. (Russia), the principal world producer, tended to relieve the pressure of price competition. Figures for the world production of manganese ore in 1935 are not yet available, but preliminary returns indicate that they not only exceeded those of 1934 but reached a new all-time record and may have amounted to 3,500,000 tons. Production in Brazil and Egypt was revived during the year, while Russian production surpassed the record figure of 1934 by 30 percent. A large increase was noted in the output of the Union of South Africa, while that of Cuba declined.

In the United States 1935 was characterized by increases in domestic consumption and imports, while domestic production and prices held steady. The following table outlines the principal statistics for the manganese industry for the past 5 years compared with the annual average 1925 to 1929, inclusive.

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

Salient statistics of the manganese industry in the United States, 1925–29 and 1931–35, in long tons

	1925–29 average	1931	1932	1933	1934	1935
Manganese ore:						
Total shipments containing 35 percent or more manganese	59,312	39,242	17,777	19,146	26,514	26,428
Shipments of metallurgical ore	[1] 41,892	29,874	9,963	9,527	14,978	16,679
Shipments of battery ore	17,420	7,952	7,012	7,904	8,889	7,264
Imports for consumption	600,000	293,137	90,782	288,187	341,339	383,501
Stocks in bonded warehouses at end of year	304,000	613,814	622,489	490,819	430,714	418,302
Indicated consumption (35 percent or more manganese)	659,000	334,753	110,861	308,971	369,564	413,287
Ferro-alloys:						
Production of ferromanganese	306,360	166,937	56,350	136,267	139,171	214,290
Imports of ferromanganese [2] [3]	[4] 50,590	19,836	14,779	31,759	18,702	21,829
Production of spiegeleisen	95,463	67,800	37,317	26,683	(5)	60,018
Imports of spiegeleisen [2]	7,298	9,482	8,364	26,277	21,184	32,384
Exports of spiegeleisen and ferromanganese	3,769	1,306	33	47	222	131
Stocks of ferromanganese in bonded warehouses	[3] [4] 7,765	6,745	6,173	6,424	7,124	5,796

[1] Includes small quantity of miscellaneous ore.
[2] Imports for consumption.
[3] Manganese content.
[4] Includes small quantity of other manganese alloys.
[5] Not at liberty to publish.

The trend in imports and domestic production of manganese ore from 1900 to 1935 is shown graphically in figure 71.

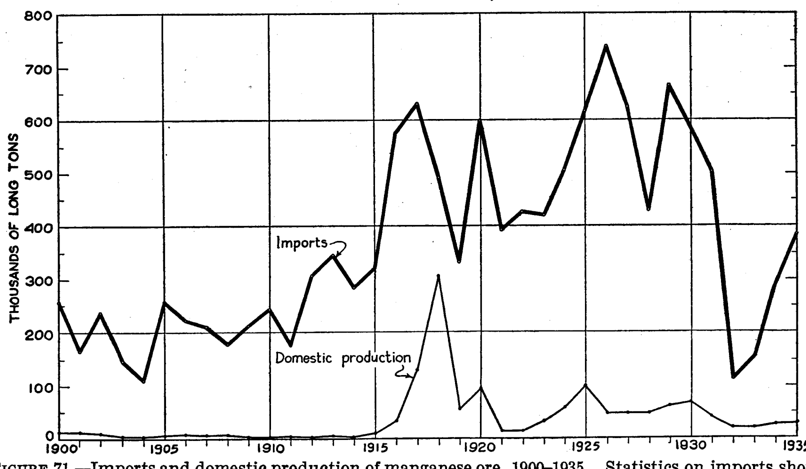

FIGURE 71.—Imports and domestic production of manganese ore, 1900–1935. Statistics on imports shown in the graph represent "general imports" for the period 1900–1933; beginning with 1934 data classified as "general imports" were not available, and the figures plotted for 1934 and 1935 represent imports for consumption adjusted for changes in stocks in bonded warehouses, and are closely comparable with the record for earlier years.

Tariff reductions.—Effective January 1, 1936, the duty on manganese ore containing more than 10 percent manganese was reduced from 1 to ½ cent per pound of contained manganese. This reduction in duty was provided for in the trade agreement with Brazil.

For an ore containing 50 percent manganese the cost to the consumer will be reduced $5.60 per long ton; roughly, the cost of manganese ore necessary to make 1 long ton of standard ferromanganese will be decreased $10 to $11.

The Union of Soviet Socialist Republics is now the principal source of imports into the United States.

The trade agreement between the United States and Canada signed on November 15, 1935, and proclaimed by the President on December 2, 1935, provided for reduction of the duty on ferromanganese containing not less than 4 percent carbon imported into the United States. According to the agreement that went into effect January 1, 1936, the new duty will be as follows on the manganese content:

> * * * 3/8 cent per pound plus 1 1/4 times the lowest rate of ordinary customs duty provided for manganese ore containing in excess of 10 percentum of metallic manganese the product of any foreign country except Cuba, at the time such ferromanganese is entered or withdrawn from warehouse, for consumption; but not more than 1 5/8 cents per pound.

With the duty on manganese in ore reduced to 1/2 cent per pound by virtue of the Brazilian agreement, the new duty on ferromanganese will be 1 cent per pound of contained manganese in lieu of 1 7/8 cents under the Tariff Act of 1930. As with other trade agreements, the reduction in duty will apply to all countries except as noted above.

In addition to reducing the compensatory duty on ferromanganese, the Canadian agreement at least halves the protective increment on the smelting operation. Assuming that foreign ferromanganese contains an average of 1,780 pounds of manganese per long ton, the new rate will amount to $17.80 per ton instead of around $33.40 on a commodity recently selling at $85 a ton f. o. b. seaboard points in the United States and at the equivalent of $50 or less in Europe. Norway is now the principal source of imported ferromanganese.

DOMESTIC PRODUCTION

The domestic production of manganese ore in 1935 was 26,428 long tons or about the same as in 1934. Expanded activity in the domestic iron and steel industry resulted in increased demand for manganese ore, but the increase was met by increased imports. Large increases, however, were recorded in the figures for the production of domestic ferruginous manganese ores and domestic manganiferous iron ores. This also reflects the increased activity in the iron and steel industry. Shipments of battery-grade ores (concentrates) decreased from 8,889 tons in 1934 to 7,264 in 1935. The following table covers shipments of manganese-bearing ores for the last 5 years.

Manganiferous raw materials shipped in the United States, 1931–35, in long tons

Year	Metallurgical ore [1]				Battery ore [2]	Miscellaneous manganese ore
	Manganese ore (35 percent or more manganese)	Ferruginous manganese ore (10 to 35 percent manganese)	Manganiferous iron ore (5 to 10 percent manganese)	Manganiferous zinc residuum		
1931	29,874	64,062	217,352	96,990	7,952	1,416
1932	9,963	15,635	9,799	25,320	7,012	802
1933	9,527	12,779	178,852	----------	7,904	1,715
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

[1] Ferrous metallurgy only.
[2] Recorded as "chemical manganese ore" in reports of this series prior to 1930.

Shipments of the various grades during the last 5 years are given by States in the following tables.[2]

Metallurgical manganese ore shipped from mines in the United States, 1931–35, by States, in long tons

State	1931	1932	1933	1934	1935	State	1931	1932	1933	1934	1935
Alabama	------	267	806	------	59	Tennessee	70	------	------	------	1,418
Arkansas	4,028	1,306	1,890	5,842	3,809	Texas	155	------	------	------	------
California	40	------	------	158	306	Virginia	901	------	4,184	1,040	1,972
Georgia	6,491	200	1,565	6,281	6,960	West Virginia	29	------	95	------	------
Montana	17,088	8,190	987	1,657	2,155						
New Mexico	1,072	------	------	------	------		29,874	9,963	9,527	14,978	16,679

Ferruginous manganese ore shipped from mines in the United States, 1931–35, by States, in long tons

State	1931	1932	1933	1934	1935	State	1931	1932	1933	1934	1935
Alabama	1,321	4,328	2,810	1,404	647	Minnesota	26,567	1,399	------	------	77,931
Arkansas	2,230	208	1,060	1,374	145	Montana	14,311	------	------	11,247	6,818
Colorado	3,685	------	------	------	2,625	Utah	1,501	------	------	------	190
Georgia	11,652	9,700	8,505	9,166	3,735	Virginia	------	------	404	40	645
Idaho	578	------	------	------	------						
Michigan	2,217	------	------	------	555		64,062	15,635	12,779	23,231	93,291

Manganiferous iron ore shipped from mines in the United States, 1931–35, by States, in long tons

State	1931	1932	1933	1934	1935
Alabama	------------	217	685	------------	------------
Colorado	------------	------------	------------	------------	56
Georgia	------------	------------	------------	31	------------
Michigan	------------	9,582	6,445	595	4,847
Minnesota	217,352	------------	171,722	197,622	419,373
Wisconsin	------------	------------	------------	343	6,617
	217,352	9,799	178,852	198,591	430,893

Battery ore [1] shipped from mines in the United States, 1931–35, by States

Year	Montana (long tons)	Virginia (long tons)	Total		Year	Montana (long tons)	Virginia (long tons)	Total	
			Long tons	Value				Long tons	Value
1931	7,802	150	7,952	$281,523	1934	8,889	---------	8,889	$295,649
1932	7,012	---------	7,012	239,267	1935	7,264	---------	7,264	254,635
1933	7,904	---------	7,904	265,766					

[1] Recorded as "chemical manganese ore" in reports of this series prior to 1930.

IMPORTS OF MANGANESE ORE

Imports for consumption of manganese ore into the United States in 1935 totaled 383,501 long tons containing 189,256 tons of manganese. Of the imports for consumption in 1935, 40 percent was from the U. S. S. R., 25 percent from Gold Coast, 15 percent from India, and 11 percent from Cuba.

[2] In addition, manganiferous zinc residuum was produced in New Jersey; miscellaneous ores came from Alabama, Montana, Tennessee, and Virginia.

Manganese ore imported into the United States, 1933–35, by countries

Country	Manganese ore (long tons)			Manganese content (long tons)			Value		
	1933	1934	1935	1933	1934	1935	1933	1934	1935
Brazil	--------	55,834	29,528	--------	24,483	13,484	--------	$418,342	$205,571
Canada	(1)	1,520	917	(1)	840	471	$20	32,442	29,302
Chile	445	1,133	3,442	211	567	1,702	3,116	7,103	28,367
China	2	--------	--------	1	--------	--------	43	--------	--------
Cuba	28,257	63,743	43,955	14,573	31,431	22,220	430,906	965,610	700,493
Czechoslovakia	--------	--------	3	--------	--------	1	--------	--------	1,124
Egypt	--------	50	--------	--------	28	--------	--------	2,452	--------
France	--------	(1)	2	--------	(1)	1	--------	9	521
Germany	14	17	158	8	9	82	988	1,334	14,650
Gold Coast	43,768	73,656	95,134	22,391	36,913	48,916	429,515	982,953	1,285,483
Hong Kong	1	--------	--------	1	--------	--------	32	--------	--------
India (British)	--------	20,550	56,570	--------	10,493	28,876	--------	216,381	603,723
Netherland East Indies	526	--------	29	291	--------	16	11,317	--------	1,189
Philippine Islands	--------	--------	500	--------	--------	240	--------	--------	6,500
U. S. S. R. (Russia)	83,780	124,836	153,200	41,890	61,076	73,213	499,406	902,556	1,327,876
United Kingdom	43	--------	63	24	--------	34	2,979	--------	3,970
	156,836	341,339	383,501	79,390	165,840	189,256	1,378,322	3,529,182	4,208,769

1 Less than 1 ton.

Stocks.—For the third consecutive year, stocks of manganese ore in bonded warehouses decreased and at the end of 1935 totaled 418,302 long tons containing 211,812 tons of manganese metal, compared with 430,714 tons containing 213,250 tons metal at the close of 1934. The figure for 1935 is the lowest reported since 1930.

Tariff.—Under the tariff bill of 1930, the duty on manganese ores or concentrates containing more than 10 percent manganese was dutiable at the rate of 1 cent per pound on the metallic manganese contained therein. The Brazilian Trade Agreement, signed on February 2, 1935, and proclaimed by the President on December 2, 1935, reduced the duty on imports into the United States from 1 to ½ cent per pound of contained manganese. The new duties became effective January 1, 1936. Approval of the treaty by the United States Senate is not required under the authority conferred on the President in the Trade Agreements Act approved June 12, 1934. All concessions under the act may be extended to all countries unless the President finds that any country discriminates against American commerce or pursues policies that tend to defeat the purpose of the act.

Prices of manganese ore.—Quoted domestic prices of manganese ore in 1935 were maintained at the level reached at the close of 1934. Prices of manganese ore according to grade and origin, as quoted by the various trade journals, are for imported ore and (except for battery ore) are on a unit basis, the unit being 1 percent of a long ton (22.4 pounds of metallic manganese). Prices of battery-grade ore are quoted on a per-ton basis, with a minimum requirement of manganese dioxide.

The prices quoted in the following table are from the Engineering and Mining Journal:

Domestic prices of metallurgical manganese ore, 1935, in cents per long-ton unit

[C. i. f. North Atlantic ports, cargo lots, exclusive of duty]

Brazilian, 46–48 percent manganese	24
Chilean, 47 percent manganese	24–26
Indian, 48–50 percent manganese	25
Caucasian, 52–55 percent manganese	26
South African:	
49–51 percent manganese	26
44–48 percent manganese	24

According to the Engineering and Mining Journal the prices for chemical (battery) ores during 1935 were as follows: Domestic chemical ores containing 70 to 72 percent manganese dioxide were quoted at $40 to $45 a ton in carload lots during the year. Imported chemical ores containing a minimum of 85 percent manganese dioxide were quoted at $45 to $60 a ton throughout the year.

CONSUMPTION OF MANGANIFEROUS RAW MATERIALS

The manufacturing industries in the United States that consume manganese ore fall into three main groups: The metallurgical industry, the battery industry, and miscellaneous industries. The first group consumes by far the largest quantity, whereas the third group has little importance when the total consumption of manganese ore is considered but has significance to the small producers of specialty ores.

Expanded activity in steel production, the principal use of manganese ore, was accompanied by increase in the consumption of manganese and manganiferous ores in 1935 compared with 1934.

The following table shows the indicated consumption of manganiferous raw materials in the United States in 1934 and 1935. 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, 1934–35

	Ore containing 35 percent or more manganese		Ore and residuum containing 10 to 35 percent manganese		Ore containing 5 to 10 percent manganese	
	Long tons	Manganese content (percent)	Long tons	Manganese content (percent)	Long tons	Manganese content (percent)
1934						
Domestic shipments	[1] 28,225	[2] 43	88,467	16	198,591	7.7
Imports for consumption	341,339	49	[3] 614	21	[3] 104,587	8.0
Total available for consumption	369,564	48	89,081	16	303,178	7.8
1935						
Domestic shipments	[1] 29,786	[2] 45	207,288	14	430,893	7.4
Imports for consumption	383,501	49	[3] 1,927	21	[3] 86,815	7.4
Total available for consumption	413,287	49	209,215	14	517,708	7.4

[1] Includes shipments from Puerto Rico. [2] Partly estimated. [3] Estimated.

Besides the material shown in the foregoing table, 575,402 long tons of iron ore containing 2 to 5 percent manganese presumably were used in the manufacture of manganiferous pig iron in 1935 compared with 635,254 tons in 1934. Figures for imports of this class of ore are not available.

METALLURGICAL INDUSTRY

Although manganese ore is used in both the ferrous and nonferrous metallurgical industries, the bulk is consumed in the manufacture of iron and steel. Most of the ore entering this industry is used in the manufacture of ferromanganese and spiegeleisen, the forms in which manganese usually is added to steel.

Chief manganese alloys imported into and made from domestic and imported ores in the United States, 1934–35, in long tons

	1934		1935	
	Alloy	Manganese	Alloy	Manganese
Ferromanganese:				
Imported	23,349	18,702	27,240	21,829
Domestic production	139,171	109,491	214,290	170,168
From domestic ore [1]	354	283	1,916	1,532
From imported ore [1]	138,817	109,208	212,374	168,636
Total	162,520	128,193	241,530	191,997
Ratio (percent) of manganese in ferromanganese of domestic origin to total manganese in ferromanganese made and imported		0.22		0.80
Number of plants making ferromanganese	6		7	
Spiegeleisen:				
Imported	21,184	[1] 4,237	32,384	[1] 6,477
Domestic production	(2)	(2)	60,018	12,310
From domestic ore [1]	(2)	(2)	41,215	8,487
From imported ore [1]	(2)	(2)	18,803	3,823
Total	(2)	(2)	92,402	18,787
Ratio (percent) of manganese in spiegeleisen of domestic origin to total manganese in spiegeleisen made and imported		(2)		45.17
Number of plants making spiegeleisen	3		4	
Total available supply of metallic manganese as alloys		(2)		210,784
Percentage of available supply of manganese in—				
Ferromanganese and spiegeleisen imported		(2)		13.43
Ferromanganese made from imported ore		(2)		80.01
Spiegeleisen made from imported ore		(2)		1.81
Ferromanganese made from domestic ore		(2)		.73
Spiegeleisen made from domestic ore		(2)		4.02
Ferromanganese and spiegeleisen made from domestic ore		(2)		4.75
Spiegeleisen made and imported		(2)		8.91
Total open-hearth and Bessemer steel	25,693,462		33,550,460	

[1] Estimated. [2] Not at liberty to publish.

Ferromanganese.—Production of ferromanganese in 1935 totaled 214,290 long tons compared with 139,171 tons in 1934 and was made at seven plants by seven different operators. A large part of the output came from blast-furnace plants. The following plants manufactured ferromanganese in 1935:

Pittsburgh Metallurgical Co., Niagara Falls, N. Y.
Bethlehem Steel Co., Johnstown, Pa.
Lavino Furnace Co., Reusens, Va.
Jones & Laughlin Steel Corporation, Aliquippa, Pa.
Electro Metallurgical Co., Alloy, W. Va.
Tennessee Coal, Iron & Railroad Co., Ensley, Ala.
Carnegie Steel Co., Etna, Pa.

In addition to the above plants shipments from stock were made by—

Lavino Furnace Co., Sheridan, Pa.
Republic Steel Corporation, Birmingham, Ala.
Colorado Fuel & Iron Co., Pueblo, Colo.

The domestic production of ferromanganese in 1935 used 401,846 long tons of foreign manganese ore, 4,286 tons of domestic manganese ore, 9,195 tons of domestic iron ore, and 8,921 tons of cinder, scale, and scrap.

Ferromanganese produced in the United States and metalliferous materials consumed in its manufacture, 1931–35

Year	Ferromanganese produced			Materials consumed (long tons)				Manganese ore used per ton of ferromanganese made (long tons)
	Long tons	Manganese contained		Manganese ore		Iron and manganiferous iron ores	Cinder, scale, and scrap	
		Percent	Long tons	Foreign	Domestic			
1931	166, 937	78. 59	131, 200	287, 973	12, 277	19, 214	3, 405	1. 799
1932	56, 350	77. 66	43, 760	90, 677	10, 666	5, 270	1, 499	1. 798
1933	136, 267	79. 30	108, 059	233, 607	10, 695	10, 795	1, 655	1. 793
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

The following table shows, by sources, the foreign manganese ore consumed in the manufacture of ferromanganese from 1931 to 1935. The undistributed ore reported in 1935 is believed to have originated mainly in Gold Coast and Cuba.

Foreign manganese ore used in manufacture of ferromanganese in the United States, 1931–35, in long tons

Source of ore	1931	1932	1933	1934	1935
Africa	26, 133	5, 135	30, 427	18, 076	21, 917
Brazil	62, 630	25, 279	42, 805	55, 778	47, 663
Chile	4, 363		1, 046	451	2, 941
Cuba		2, 126	28, 275	16, 242	56, 411
India	26, 267	11, 541	22, 499	21, 460	76, 983
Philippine Islands					520
U. S. S. R. (Russia)	168, 580	46, 596	108, 555	116, 953	147, 471
Undistributed				28, 020	47, 940
Total	287, 973	90, 677	233, 607	256, 980	401, 846

Shipments of ferromanganese in 1935 were 194,627 long tons valued at $16,374,328, an increase of 32 percent over 1934. The trend of shipments during the last 5 years has been as follows:

Ferromanganese shipped from furnaces in the United States, 1931–35

Year	Long tons	Value	Year	Long tons	Value
1931	159, 168	$12, 999, 329	1934	147, 947	$12, 345, 697
1932	70, 417	5, 061, 029	1935	194, 627	16, 374, 328
1933	127, 453	9, 384, 611			

Although there is a slight export trade in ferromanganese the quantity manufactured in the United States is supplemented by imports. Ferromanganese imported for consumption in 1935 included 547 tons containing not over 1 percent carbon, virtually all of which came from Norway.

Ferromanganese imported into and exported from the United States, 1931–35

Year	Imports for consumption			Exports [1]	
	Gross weight (long tons)	Manganese content (long tons)	Value	Gross weight (long tons)	Value
1931	24,664	19,836	$1,751,646	1,306	$38,506
1932	18,470	14,779	1,091,026	33	2,369
1933	39,693	31,759	2,548,068	47	3,393
1934	23,349	18,702	1,441,360	222	12,580
1935	27,240	21,829	1,731,411	131	10,389

[1] Include spiegeleisen; not separately classified.

Norway, United Kingdom, and France furnished the bulk of the imports into the United States in 1935; Norway alone furnished 66 percent. The following table shows the distribution of imports by countries for the last 2 years.

Ferromanganese imported for consumption in the United States, 1934–35, by countries

Country	1934		1935	
	Manganese content (long tons)	Value	Manganese content (long tons)	Value
Belgium	21	$1,100		
Canada	2,226	250,443	40	$4,500
France	440	43,814	2,091	193,006
Germany	79	4,105	1,025	64,694
Italy	516	69,704	709	97,523
Netherlands	258	11,855	1,095	61,166
Norway	12,387	884,760	14,365	1,156,488
Poland and Danzig	734	41,043	157	9,889
United Kingdom	2,041	134,536	2,347	144,145
	18,702	1,441,360	21,829	1,731,411

Ports into which imported ferromanganese entered in 1934 and 1935 were as follows:

Manganese content of ferromanganese imported for consumption in the United States, 1934–35, by ports of entry, in long tons

Port of entry	1934	1935	Port of entry	1934	1935
Buffalo	2,449	1,417	New York	697	1,509
Chicago	516	594	Ohio	393	
Galveston	43	19	Oregon	75	20
Los Angeles	266	304	Philadelphia	3,508	1,347
Maryland	7,642	14,122	Pittsburgh		20
Massachusetts		120	San Francisco	288	363
Michigan	372		Washington (State)	249	253
New Orleans	2,204	1,741		18,702	21,829

Stocks of ferromanganese in bonded warehouses at the end of 1935 amounted to 5,796 long tons containing 4,769 tons of manganese metal. Of the above total, 5,556 tons contained more than 1 percent carbon and 240 tons contained 1 percent or less carbon.

Tariff on ferromanganese.—The tariff on ferromanganese in the Tariff Bill of 1930 was as follows:

PAR. 302: (*d*) Ferromanganese containing more than 1 per centum of carbon, 1⅞ cents per pound on the metallic manganese contained therein: Provided, that ferromanganese for the purpose of this act shall be such iron manganese alloys as contain 30 per centum or more of manganese.

(*e*) Manganese metal, manganese silicon, manganese boron, and ferromanganese and spiegeleisen containing not more than 1 per centum of carbon, 1⅞ cents per pound on the manganese contained therein and 15 per centum ad valorem.

The rate was not changed in 1935, but on November 15, 1935, a trade agreement was signed between the United States and Canada which provided for a reduction in the duty on ferromanganese containing not less than 4 percent of carbon imported into the United States. According to the agreement which was proclaimed by the President on December 2, 1935, and went into effect January 1, 1936, the new duty on the manganese content will be as follows:

* * * three-eighths cent per pound plus one and one-fourth time the lowest rate of ordinary customs duty provided for manganese ore containing more than 10 per centum of metallic manganese the product of any foreign country except Cuba, at the time such ferromanganese is entered or withdrawn from warehouse, for consumption; but not more than 1⅞ cents per pound.

With the duty on manganese in ore reduced to one-half cent per pound by virtue of the Brazilian agreement, the new duty on ferromanganese is 1 cent per pound of contained manganese in lieu of 1⅞ cents under the Tariff Act of 1930. Under the Trade Agreements Act, the new duty will be extended to all countries unless the President finds that any country is discriminating against American commerce or is pursuing policies that tend to defeat the purpose of the act.

The price of ferromanganese was maintained nearly constant during 1935 and at the end of the year was quoted at $90.13 per long ton of 80 percent alloy delivered at Pittsburgh. Effective January 1, 1936, the price of ferromanganese was reduced $10 per gross ton as a result of the tariff agreements with Canada and Brazil. The quotations for the last 3 years have been as follows:

Prices per long ton of ferromanganese in the United States, 1933–35 [1]

[80 percent—delivered at Pittsburgh]

Month	1933	1934	1935	Month	1933	1934	1935
January	$73.24	$90.24	$89.79	July	$84.44	$89.79	$90.13
February	73.24	90.24	89.79	August	87.24	89.79	90.13
March	73.24	90.24	89.79	September	87.24	89.79	90.13
April	73.24	90.24	89.85	October	87.24	89.79	90.13
May	73.24	90.24	90.13	November	87.24	89.79	90.13
June	73.24	90.00	90.13	December	87.24	89.79	90.13

[1] Steel, vol. 98, Jan. 6, 1936.

Spiegeleisen.—Shipments of spiegeleisen increased from 45,769 tons in 1934 to 54,793 in 1935, as shown in the following table:

Spiegeleisen produced and shipped in the United States, 1931–35

Year	Produced (long tons)	Shipped from furnaces		Year	Produced (long tons)	Shipped from furnaces	
		Long tons	Value			Long tons	Value
1931	[1] 67,800	55,327	$1,313,068	1934	(2)	45,769	$1,099,922
1932	37,317	31,071	745,966	1935	60,018	54,793	1,303,574
1933	26,683	50,218	1,144,642				

[1] Steel, Manganese Ore and Alloy Statistics: Vol. 90, no. 1, Jan. 4, 1932, p. 198.
[2] Not at liberty to publish.

Spiegeleisen was manufactured at the following plants in 1935:

Carnegie Steel Co., North Braddock, Pa.
Lavino Furnace Co., Reusens, Va.
New Jersey Zinc Co., Palmerton, Pa.
Tennessee Coal, Iron & Railroad Co., Ensley, Ala.

In addition to the above plants, spiegeleisen was also shipped from the Lavino Furnace Co. plant at Sheridan, Pa.

Most of the spiegeleisen produced in the United States is made from domestic raw materials, but 8,290 long tons of foreign manganese ore were consumed in the manufacture of spiegeleisen in 1935.

Imports of spiegeleisen for consumption were 32,384 long tons valued at $915,134 in 1935 compared with 21,184 tons valued at $595,017 in 1934. Canada, with 30,908 tons, furnished 96 percent of the total in 1935, the remainder coming from Norway (1,149 tons), United Kingdom (226 tons), Union of Soviet Socialist Republics (51 tons), and Germany (50 tons).

Spiegeleisen imported for consumption in the United States, 1931–35

Year	Long tons	Value	Year	Long tons	Value
1931	9,482	$247,788	1934	21,184	$595,017
1932	8,364	192,037	1935	32,384	915,134
1933	26,277	640,613			

The price of spiegeleisen containing 20 percent manganese at producers' furnaces has been quoted by the trade journals at $26 per ton for 1934 and 1935.

Manganiferous pig iron.—Precise data on the consumption of manganiferous ores in the production of manganiferous pig iron are not available; however, 430,900 long tons of domestic ore containing 5 to 10 percent manganese and 575,402 tons of domestic ore containing 2 to 5 percent were shipped in 1935. Foreign manganiferous iron ore (86,815 long tons) also was consumed in the manufacture of pig iron. The sources of the foreign ores for the last 3 years appear in the following table. Import figures on ore containing 2 to 5 percent manganese are not available.

Foreign ferruginous manganese ore and manganiferous iron ore consumed in the United States, 1933–35, in long tons

Source of ore	Ferruginous manganese ore			Manganiferous iron ore		
	1933	1934	1935	1933	1934	1935
Africa					9,836	2,912
Australia		263		51,399	54,390	66,879
Brazil		351	97			
Canada	260		1,830			
Spain					32,888	9,638
Sweden					7,473	7,386
Total	260	614	1,927	51,399	104,587	86,815

BATTERY INDUSTRY

Shipments of manganese ore by domestic producers to battery makers in 1935 totaled 7,264 long tons and shipments from Puerto Rico amounted to 3,358 tons. These figures indicate a consumption of 10,622 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

Manganese ore is also consumed in the chemical, ceramic, and glass industries. Certain ores with peculiar physical or chemical properties are required for the manufacture of special articles in these industries.

REVIEW BY STATES

The following table shows shipments of manganese-bearing ore in 1934 and 1935, by States:

Manganese and manganiferous ore shipped by mines in the United States, 1934–35, by States

	Ore containing 35 percent or more manganese			Ore containing 10 to 35 percent manganese			Ore containing 5 to 10 percent manganese		
	Shippers	Long tons	Value	Shippers	Long tons	Value	Shippers	Long tons	Value
1934									
Metallurgical:									
Alabama				7	1,404	$7,878			
Arkansas	3	5,842	(1)	1	1,374	(1)			
California	4	158	$1,500						
Georgia	6	6,281	(1)	11	9,166	(1)	1	31	$41
Michigan							1	595	(1)
Minnesota							3	197,622	510,017
Montana	[2] 2	1,657	(1)	2	11,247	43,484			
Virginia	[2] 3	1,040	14,922	1	40	300			
Wisconsin							1	343	(1)
Undistributed			203,003			56,610			2,760
Total metallurgical	18	14,978	219,425	22	23,231	108,272	6	198,591	512,818
Battery: Montana	[2] [3] 2	8,889	295,649						
Total battery	2	8,889	295,649						
Miscellaneous:									
Montana	[2] 2	1,002	56,674 (Montana, Tennessee, Virginia)						
Tennessee	1	1,088							
Virginia	[2] 4	557							
Total miscellaneous	7	2,647	56,674						
	24	26,514	571,748	22	23,231	108,272	6	198,591	512,818
1935									
Metallurgical:									
Alabama	[4] 1	59	624	3	647	6,226			
Arkansas	3	3,809	(1)	1	145	(1)			
California	2	306	(1)						
Colorado				1	2,625	(1)	1	56	(1)
Georgia	4	6,960	95,683	6	3,735	23,722			
Michigan				1	555	1,582	1	4,847	(1)
Minnesota				1	77,931	241,734	2	419,373	957,624
Montana	1	2,155	(1)	2	6,818	32,077			
Tennessee	[4] 1	1,418	(1)						
Utah				1	190	(1)			
Virginia	[4] 9	1,972	27,241	3	645	4,110			
Wisconsin							1	6,617	(1)
Undistributed			128,742			16,961			38,575
Total metallurgical	21	16,679	252,290	19	93,291	326,412	5	430,893	996,199
Battery: Montana	[3] [4] 2	7,264	254,635						
Total battery	2	7,264	254,635						
Miscellaneous:									
Alabama	[4] 1	126	3,971						
Montana	[4] 2	1,404	37,690 (Montana, Tennessee)						
Tennessee	[4] 2	475							
Virginia	[4] 4	480	8,754						
Total miscellaneous	9	2,485	50,415						
	25	26,428	557,340	19	93,291	326,412	5	430,893	996,199

[1] Included under "Undistributed."
[2] 1 producer in Montana and 1 in Virginia shipped both metallurgical and miscellaneous ore, and 1 producer in Montana shipped both battery and miscellaneous ore.
[3] Mills through which all ore was shipped; producers not counted.
[4] 1 producer in Alabama, 1 in Tennessee, and 4 in Virginia shipped both metallurgical and miscellaneous ore, and 1 in Montana shipped both battery and miscellaneous ore.

Alabama.—Shipments of manganese ore from Alabama amounted to 185 long tons in 1935, of which 59 tons were metallurgical ore and 126 tons for miscellaneous uses. All the output came from Etowah County. Shipments of ferruginous manganese ore in 1935 were 647 tons; the ore came from Cherokee and Etowah Counties.

Arkansas.—Shipments of manganese ore from Arkansas in 1935 amounted to 3,809 long tons, all of which, except 20 tons from Montgomery County, came from Independence County. In addition, 145 tons of ferruginous manganese ore were shipped from Independence County.

California.—Three hundred and six long tons of manganese ore were shipped from California in 1935, all from Riverside County.

Colorado.—Ferruginous manganese ore amounting to 2,625 long tons was shipped from Saguache County, Colo., and 56 tons of manganiferous iron ore were shipped from Custer County in 1935.

Georgia.—All shipments of manganese ore from Georgia in 1935 came from the Cartersville district in Bartow County. Shipments were 6,960 long tons, the bulk of which came from the operations of the White Manganese Corporation.

Shipments of ferruginous manganese ore were 3,735 long tons, all of which came from the Cartersville district.

Michigan.—Michigan shipped 555 long tons of ferruginous manganese ore and 4,847 tons of manganiferous iron ore in 1935.

Minnesota.—In 1935, 77,931 long tons of ferruginous manganese ore and 419,373 tons of manganiferous iron ore were shipped from the Cuyuna range.

Montana.—Shipments of manganese ore from Montana were 10,823 long tons in 1935, of which 2,155 tons were metallurgical ore, 7,264 tons battery-grade concentrates, and 1,404 tons for miscellaneous uses.

Shipments of ferruginous manganese ore from Montana were 6,818 long tons in 1935.

Tennessee.—Shipments of manganese ore from Tennessee in 1935 were 1,893 long tons—1,418 tons metallurgical ore and 475 tons for miscellaneous uses.

Utah.—One hundred and ninety long tons of ferruginous manganese ore were shipped from Utah in 1935.

Virginia.—Shipments of manganese ore from Virginia in 1935 amounted to 2,452 long tons—1,972 tons metallurgical ore and 480 tons for miscellaneous uses. In addition, 645 tons of ferruginous manganese ore were shipped during 1935.

Wisconsin.—Wisconsin shipped 6,617 long tons of manganiferous iron ore in 1935.

Puerto Rico.—Shipments of manganese ore from Puerto Rico in 1935 were 3,358 long tons compared with 1,711 tons in 1934. The entire output of the island comes from the mine of the Atlantic Ore Co., about 3 miles from Juana Diaz.

WORLD PRODUCTION

The following table shows, so far as statistics are available, the world production of manganese ores from 1931 to 1935 and their average manganese content. Most figures are from official statistics of the countries concerned, supplemented by data from semiofficial and other sources.

Manganese ore produced in the principal countries, 1931–35, in metric tons

[Compiled by R. B. Miller]

Country [1]	Percentage of manganese	1931	1932	1933	1934	1935
North America:						
Canada (shipments)	----------	176	----------	----------	----------	----------
Cuba	36–50+	96	9,800	28,000	68,000	35,269
Mexico	40+	731	[2] 700	573	664	3,217
United States:						
Continental (exclusive of fluxing ore)	35+	39,872	18,062	19,453	26,940	26,852
Puerto Rico [3]	48–58	2,412	2,339	1,664	1,738	3,412
South America:						
Argentina [4]	----------	221	252	410	583	(5)
Brazil	38–50	147,349	20,300	25,000	7,527	41,767
Chile [3]	40–50	383	448	765	4,065	(5)
Europe:						
Germany	30+	----------	12	563	515	(5)
Greece	30+	356	745	1,628	[3] 1,800	[3] 436
Hungary	30	1,132	1,497	6,232	10	(5)
Italy	30–50	6,421	378	4,524	6,941	8,100
Portugal	40+	----------	----------	26	295	(5)
Rumania	42	18,787	5,051	2,774	12,057	18,095
Spain	29+	17,916	2,591	2,834	3,796	1,260
Sweden	35–45+	4,140	3,014	5,895	5,832	(5)
U. S. S. R. (Russia)	41–48	876,000	915,300	998,000	1,821,000	2,377,000
Yugoslavia	42–45	2,454	160	535	1,103	(5)
Asia:						
China [3]	50–55	22,051	20,733	9,574	870	827
India:						
British	47–52	546,476	216,016	221,811	412,827	(5)
Netherland (East Indies)	45–56	14,541	8,287	10,463	11,635	(5)
Portuguese	42–50+	3,547	3,573	1,600	3,800	(5)
Japan	50+	12,849	26,242	43,535	57,165	(5)
Turkey	40	1,000	2,800	7,700	2,687	15,600
Africa:						
Egypt	30+	101,781	327	187	959	87,303
Gold Coast [3]	50+	226,889	51,502	269,395	344,832	(5)
Morocco (French)	40–50+	11,502	3,980	4,800	3,407	7,553
Northern Rhodesia	41–50	1,491	----------	5,453	2,074	4,041
Union of South Africa	40–60	101,899	----------	21,229	57,730	95,450
Oceania:						
Australia:						
New South Wales	----------	----------	108	131	105	150
South Australia	----------	13	20	2	2	(5)
	----------	2,162,000	1,314,000	1,695,000	2,861,000	(5)

[1] In addition to the countries listed Belgium is reported to produce a small quantity of manganese ore, but statistics of output are not available. Czechoslovakia reports a production of "manganese ore", but as it has been ascertained that the product so reported averages less than 30 percent manganese 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] Approximate production.

[3] Exports.

[4] Shipments by rail and river.

[5] Data not available.

Brazil.—The manganese industry in Brazil has as yet recovered little from the depression of the last few years. However, during 1935 there was renewed interest in the purchase of Brazilian ores by American, German, and Japanese firms. Although production increased from 7,527 metric tons in 1934 to 41,767 in 1935, output was still far below predepression levels. Exports in 1935 increased over 1934 but, as in the case of production, were low compared to the normal movement. Shipments of manganese by countries were as follows:

Exports of manganese ore from Rio de Janeiro, 1935, in metric tons

Destination	Over 45 percent Mn	Under 45 percent Mn	Destination	Over 45 percent Mn	Under 45 percent Mn
United States	26,695	6,056	Great Britain	----------	7,957
France	19,138	----------	Germany	----------	7,400
Belgium	14,602	594			
Netherlands	211	22,609		60,646	54,268
Canada	----------	9,652			

Virtually all of the production of manganese ore in Brazil has come from the State of Minas Geraes, where several firms are operating. Cia. Meridional de Mineracao, a subsidiary of the United States Steel Corporation, has the largest mine in Brazil. Operation is by open pit, and production in 1935 was 16,580 metric tons. A. Thun & Co., Ltd., which is believed to be controlled by Danes, operates two open-pit and two underground mines. Production capacity of the open-pit mines is reported at 72,000 tons and of the underground mines 18,000 tons. Cia. Brasileira de Minas Santa Mathilde, a Swiss-Brazilian company, owns the Santa Mathilda properties, consisting of five deposits near Santa Mathilda. The widow of Carlos Wigg owns a British-Brazilian firm that has a producing property in the same area.

Late in 1935 organized operation was begun on a large mineral property known as the Rola Moca mine situated about 3 kilometers from Ibirete. The property is reported to contain important manganese deposits, but the principal shipments will be manganiferous iron ore (4 tons manganiferous iron ore to 1 ton of manganese ore) containing 7 to 32 percent manganese and enough iron to bring the metal content up to 60 percent. Rail charges from Ibirete to Rio de Janeiro, some 300 kilometers, are 16.66 milreis (about $0.95 at rate of exchange on Jan. 2, 1936).

Cuba.—Cuban production in 1935 was 35,269 metric tons, of which 17,236 tons were sintered concentrates and 18,033 tons sorted ore. Virtually all of the output was made by the Cuban-American Manganese Corporation near El Caney in Oriente Province. Work at the company concentration plant was discontinued on May 1, but high-grade ore was sorted and shipped. Research and experimental work were conducted during the year with a view to lowering costs.

All Cuban manganese ores are shipped to the United States, where they are admitted duty free. The 50-percent reduction in the American tariff on this commodity from all other countries lowered the price of Cuban ores to such an extent that production was no longer profitable. Costs of producing Cuban sinter are high, due to high charges for concentrating the ore and sintering the concentrates.

A new company with Cuban capital initiated production in 1935 at its concession 6 miles from Pines del Rio. The ore, which is of chemical grade, is reported to run 82 to 85 percent manganese dioxide and 1½ percent iron.

Egypt.—Production was resumed in Egypt in 1935 by the Sinai Mining Co. after a shut-down since 1931. Output was 87,303 metric tons in 1935 compared with only 959 tons in 1934. Egyptian ores are low-grade, averaging 28 to 32 percent but occasionally running as high as 35 percent.

Gold Coast.—Production of manganese ore in Gold Coast, as measured by exports, has been given at 400,000 metric tons an increase of 16 percent. The only producing mine in Gold Coast is the Nsuta mine of the African Manganese Co., Ltd.

India.—Manganese mining in India, normally the world's second largest producer, improved considerably in 1935 over 1934. Shipments from India in 1935 have been estimated at 860,000 metric tons, making India the principal exporting nation. Most of the movement was through the new port of Vizagapatam on the Bay of Bengal, where the lower freight rate was determinative. The shorter haul to Vizagapatam has also helped develop the trade in second-grade ore. About 160,000 tons of the total moved through the Portugese port of Mormugao, but this was mostly low-grade ore which finds its market chiefly in France, where it is used in blast furnaces as a desulphurizer.[3]

U. S. S. R. (Russia).—Preliminary figures indicate that the production of manganese ore in the U. S. S. R. reached the record figure of 2,377,000 metric tons in 1935, a large increase over 1934. Exports were 644,874 metric tons in 1935 compared with 736,877 tons in 1934. The decline in exports coupled with the large increase in production indicated a larger domestic consumption. The difference between production and exports in 1935 is 1,732,126 tons, four times the apparent consumption in the United States, where steel production was nearly three times that of the U. S. S. R. From the above figures it appears that either Russian production is raw ore before concentration or that large stocks are being accumulated in the country.

Germany was the principal market for Russian manganese ore in 1935, taking 235,880 metric tons (37 percent); the United States was second with 138,179 tons (21 percent); France was third with 97,767 tons (15 percent).

The principal production in the U. S. S. R. comes from Nikopol and Chiaturi. The Nikopol region has been connected with the Dnieprostroy hydroelectric power works.[4]

Late in the year the new concentrating plant at Chiaturi began operating. During the first runs metal losses were reduced from 35 to 15 percent or less. In 1936 a second plant will be built, which will complete the reconstruction of the milling facilities.

New manganese deposits are reported [5] to have been discovered in the Matveev Kurgan district near Taganrog on the Sea of Azov. Analysis shows that the ore runs 57 percent manganese, but no data are available on the extent of the deposit. In the neighborhood of Labino and Maikop, Russian geologists claim to have discovered a deposit of manganese ore estimated to contain some 33,000,000 [6] tons of ore.

Union of South Africa.—The production of manganese ore in the Union of South Africa was 95,450 metric tons in 1935, an increase over the 57,730 tons produced in 1934. Exports in 1935 were 81,501 metric tons as against 66,224 short tons in 1934. Netherlands, Belgium, and France took a large part of South African manganese ore in 1935.

Except for a small tonnage of friable ore with a high manganese dioxide content mined for use in the Krugersdorp district of Transvaal, the production in the Union comes from the Postmasburg deposits in Cape Province. These deposits extend north about 40 miles from Postmasburg and are believed to contain very large reserves of ore.

The ore, which is quarried, is hard and tough. Three grades are available for shipping:

High grade: 50 + percent manganese; 7–9 percent iron.
Medium grade: 46–48 percent manganese; 11–14 percent iron.
Low grade: 43–45 percent manganese; 13–17 percent iron.

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[3] Mining Journal (London), Manganese in 1935: Vol. 192, no. 5245, Feb. 29, 1936, p. 181.
[4] Metal Bulletin (London), Power for Nikopol: No. 1980, Apr. 15, 1935, p. 15.
[5] Metallborse, Neue Manganerzfunde in der U. S. S. R.: Jahrg. 25, no. 67, Aug. 2, 1935, p. 1061.
[6] Metal Bulletin (London), New Russian Deposit: No. 2051, Dec. 24, 1935, p. 15.

Phosphorus and silica are within the limits demanded for metallurgical use.

Two producers furnish the output—South African Manganese, Ltd., and the Associated Manganese Mines of South Africa, Ltd. The latter concern was formed in 1935 under the auspices of the Anglo-Transvaal Investment Co., Ltd., and took over the operations of Manganese Corporation, Ltd., and the Cape Manganese Corporation. To meet the program of developing the manganese industry in the most efficient manner, the Union Government agreed in 1935 to extend the existing railway to the Gloucester deposits, a distance of about 21 miles. The line will be in operation about April 1936. Postmasburg ore must be hauled long distances to the port of Durban, and rail charges are heavy.

Other countries.—There was some improvement in the manganese-ore trade in Netherland India during the year, primarily because of shipments to Germany. Production in Morocco has benefited by a reduction in transportation costs, and during 1935 low-grade ores (37 to 40 percent manganese) were shipped to France. Continued prospecting in the Imini district by the Maroc Mines is reported to have proved an ore reserve totaling 2 million tons. The discovery of a deposit said to contain 10 million tons of ore with 30 to 40 percent manganese was reported from Poland in 1935.

Activities in manganese mining were reported from China, Hungary, Bulgaria, Philippine Islands, Germany, and Italy.

MOLYBDENUM

By J. W. Furness

SUMMARY OUTLINE

During the last 30 years the expanding demand for high-duty, high-speed machinery, as well as for increased tolerance in steels, has increased greatly the manufacture of special grades. The production of these steels calls for a steadily rising tonnage of the alloying metals. The demands of industry for steel to meet the present-day rigid specifications have also led to an ever-increasing consumption of the so-called ferrometals.

The United States is the world's largest producer of tonnage steel, as well as special steels, and like other industrial countries depends largely upon sea-borne trade to supply its demands for such deficiency metals as manganese, nickel, chromium, etc., used in the manufacture of alloy steels.

Prior to 1914 the consumption of molybdenum by the manufacturers of steel was negligible. The indicated increased demand has been met from domestic production with ease. The United States cannot only supply present demands but seems likely to be able to produce the domestic requirements for many years. During 1935 the estimated exports of molybdenite concentrates were approximately 15,000,000 pounds valued at $5,500,000.

Prior to 1914 a great deal of research work was carried on concerning the use of molybdenum in steel; but the metallurgists of those days found no material improvement in the steels manufactured by the introduction of molybdenum as an alloying metal because of the large quantities used. Since then it has been discovered that the use of molybdenum in minute quantities imparts to steel the characteristics that are desirable in meeting the demands mentioned.

Considered from the standpoint of national security, the alloying metals are in the category of defense minerals. The importance of developing adequate substitutes for these minerals was well illustrated by the experience of Germany during the World War. As stated by Gillett and Mack,[1] "The development of a domestic alloying element which can in whole or in part replace or supplement these foreign elements is of obvious importance to American steel makers and users. Molybdenum is such an element."

[1] Gillett, H. W., and Mack, E. L., Molybdenum, Cerium, and Related Alloy Steels: 1925, p. 54.

During the last few years it has been indicated more and more clearly that continued research may develop the uses of molybdenum in steel to such an extent as greatly to modify the dependence of the United States upon foreign sources for some of the essential deficiency minerals.

Salient statistics of the molybdenum industry in the United States, 1933–35 [1]

	1933	1934	1935
Production:			
Ore ... short tons	705,000	1,339,000	1,384,000
Concentrates ... do	5,348	9,119	11,786
Molybdenum contained:			
Average ... percent	53.12	51.33	48.84
Total ... pounds	5,682,000	9,362,000	11,512,000
Shipments (molybdenum contained):			
Pounds	5,761,000	9,377,000	11,503,000
Value [2]	$4,316,000	$6,502,000	$8,032,000
Imports (molybdenum contained):			
Pounds	670	213,928	68,758
Value	$601	$124,156	$40,721

[1] Figures for molybdenum exported not separately recorded.
[2] Estimated by Bureau of Mines.

Prices.—The price of molybdenite concentrates carrying 75 to 85 percent MoS_2 was quoted by the Engineering and Mining Journal of New York at 42 cents per pound of contained MoS_2 throughout 1935. The Mining Journal of London quoted molybdenite concentrates at the beginning and end of 1935 at 34s. 6d. to 35s. 6d. per long-ton unit (22.4 pounds of MoS_2); the price, which fell to 33s. 6d. by the end of July, recovered by the end of the year, equivalent to 38 to 39 cents and 37 cents.

Imports.[2]—The Tariff Act of 1930 as applied to molybdenum and molybdenum products has to all intents and purposes converted the market into a strictly domestic one.

The imports for the past 10 years are shown in the following table:

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, 1926–35

Year	Molybdenum content (pounds)	Value	Year	Molybdenum content (pounds)	Value
1926	14,001	$12,162	1931	210,766	$213,660
1927	14,198	16,184	1932	44	89
1928	576	1,385	1933	670	601
1929	1,627	2,384	1934	213,928	124,156
1930	144,963	283,846	1935	68,758	40,721

DOMESTIC PRODUCTION

Arizona.—There was a production throughout 1935 by the Molybdenum Gold Mining Co., a subsidiary of the Molybdenum Corporation of America. The operations were confined largely to the New

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

Year and Mohawk claims. The ore produced contains chiefly wulfenite and as a byproduct some gold, silver, and vanadinite. The production of metals other than molybdenum reduces materially the cost of the production of the primary product.

The Arizona Molybdenum Corporation (433 South Spring Street, Los Angeles, Calif.) treated from its property on Copper Creek a few miles east of Mammoth, Pinal County, 55,142 tons of crude ore which yielded 773 short tons of concentrates, carrying 94.41 percent MoS_2 or 875,634 pounds of the element—a material increase over the previous year when 356,054 pounds were produced.

The Mammoth-St. Anthony, Ltd., of Pinal County came into production in 1935 and produced and treated a complex ore from which lead, molybdenum, vanadium, gold, and silver were recovered.

Hugo W. Miller, Santa Cruz County, treated a small quantity of wulfenite during 1935.

Colorado.—The Climax Molybdenum Co., with its mine at Climax, Lake County, Colo., maintained its lead as the largest producer of molybdenum in the world. During the year the company mined 1,267,459 tons, from which 9,526 tons of concentrates were produced. These concentrates yielded 10,168,635 pounds of the metal.

Molybdenum (element) contained in concentrates produced from the Climax deposit, Colorado, 1918–35 [1]

	Pounds		Pounds
1918	342, 200	1929	3, 529, 295
1919	152, 648	1930	3, 083, 000
1924	156, 935	1931	2, 644, 399
1925	821, 757	1932	1, 913, 395
1926	1, 057, 367	1933	5, 028, 695
1927	1, 858, 228	1934	8, 378, 683
1928	2, 957, 845	1935	10, 168, 635

[1] None produced, 1920–23, inclusive.

Nevada.—The Shenandoah mine at Goodsprings, Clark County, Nev., was acquired by the Molybdenum Corporation of America during 1935. Enlargement of mill and development comprised most of the work; consequently, production during 1935 was small.

New Mexico.—The Molybdenum Corporation of America with a property in Sulphur Gulch 7 miles east of Questa, Taos County, mined comparatively high-grade molybdenum ore.

The report of the Molybdenum Corporation of America to the stockholders for the year 1935 contains the following statement: "During the year we added a new material to our production; namely, vanadium; and we also became a producer of gold."

USES

The 1934 chapter of Minerals Yearbook contains a very full account of the uses of molybdenum. Reference is also made to the chapter on this subject by W. H. Phillips, vice president, Molybdenum Corporation of America, Pittsburgh, Pa., in Modern Uses of Nonferrous Metals, American Institute of Mining and Metallurgical Engineers, series, 1935, pages 217 to 228.

WORLD PRODUCTION

Notwithstanding the considerable amount of prospecting work in various countries, no important new discoveries or developments of molybdenum during the year are noted.

World production of molybdenum ores, metallic molybdenum content, in metric tons, 1931–35

[Compiled by M. T. Latus]

Country	Average grade [1]	1931	1932	1933	1934	1935
Australia:						
New South Wales	85	(2)	2	3	2	(3)
Queensland	85	(2)	1	3	1	(3)
Chosen	80	11	21	50	50	(3)
Mexico	90	3	3	40	467	687
Morocco, French [4]	85	2	(2)	59	76	(3)
Norway	90	103	158	248	146	(3)
Peru	85	5	5	6	5	6
United States [5]	87	1,421	1,103	2,574	4,225	5,165

[1] Percent MoS_2 in product (partly estimated).
[2] Less than 1 ton.
[3] Data not available.
[4] Exports.
[5] Molybdenite only. In addition, metallic molybdenum content of wulfenite (carrying 9 to 15 percent MoO_3) was reported as follows: 1933, 3 tons; 1934, 22 tons; 1935, 57 tons.

9,972

TUNGSTEN

By Robert H. Ridgway and J. B. Umhau

SUMMARY OUTLINE

Tungsten, among other metals of the ferro-alloy group, reacted to the improvement in the world iron and steel industries in 1935. Data on world production of tungsten concentrates are rather meager, but supplies both to Europe and the United States increased during the year. A large part of the world output continues to come from China, where exports in 1935 increased 57 percent over 1934. The recent attempts in China at control by monopoly appear to be fairly effective, especially so when administered by the military authorities. Higher prices for tungsten concentrates during 1934 and 1935 stimulated activities in the search for and development of new sources throughout the world.

Although prices of concentrates, which had increased markedly during 1933 and 1934, eased off in 1935, they were still at a very satisfactory level. The 1934 prices of tungsten concentrates were the highest known in peace times.

The United States is the only large steel-producing country in the world that supplies an appreciable amount of its own requirements from domestic sources. Apparent consumption in this country during 1935 showed an increase over 1934, and the increased demand was met by larger domestic production, as imports for consumption registered a small decline. The quoted prices for domestic scheelite in 1935 dropped at midyear but recovered most of the loss during the closing months. Tungsten concentrate of a higher purity than that currently obtainable in China is being produced in the United States, and a leading consumer has discontinued purchases of foreign ore.

Salient statistics of the tungsten industry in the United States, 1934–35

	1934		1935	
	Short tons	Value	Short tons	Value
Concentrates shipped (60 percent WO_3)	2,049	$1,791,316	2,395	$1,921,017
Imported for consumption (W content)	477	411,819	445	449,950
Stocks in bonded warehouses, Dec. 31:				
Ore (W content)	660	634,829	654	497,730
Metal (W content)	14	26,549	20	34,205

The following graph, figure 72, shows the domestic industry in the world setting since 1921.

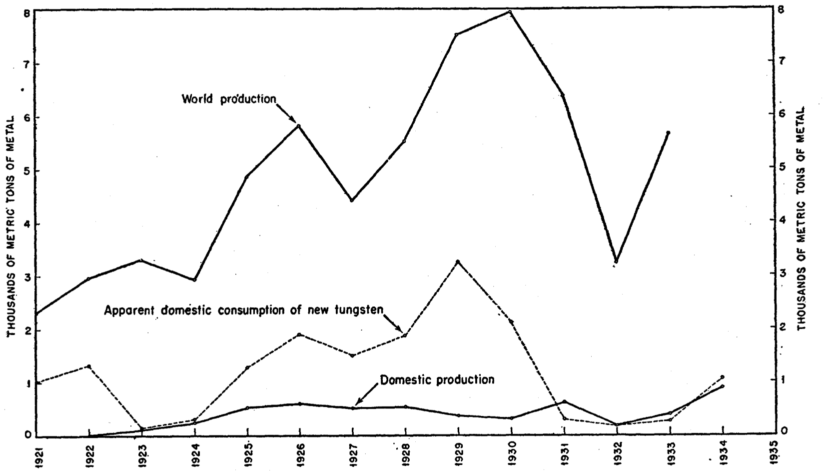

FIGURE 72.—World production, domestic production, and apparent consumption of tungsten, 1921–34.

DOMESTIC PRODUCTION

Production of tungsten concentrates in the United States in 1935 (reduced to equivalent of 60 percent WO_3) amounted to 2,395 short tons, an increase of 17 percent over 1934. Production during the last 10 years is shown in the following table.

Concentrated tungsten ores (reduced to equivalent of 60 percent WO_3) produced in the United States, sold in 1926–35, and average price per unit

Year	Short tons	Value	Average price per unit	Year	Short tons	Value	Average price per unit
1926	1,382	$920,400	$11.10	1931	1,404	$928,000	$11.02
1927	1,164	724,000	10.37	1932	396	218,394	9.20
1928	1,208	753,900	10.40	1933	895	514,234	9.58
1929	830	654,000	13.13	1934	2,049	1,791,316	14.57
1930	702	509,000	12.09	1935	2,395	1,921,017	13.37

Output in 1935 was recorded from five States—Arizona, California, Colorado, Nevada, and Washington; Nevada was the largest producer.

Arizona.—Shipments of tungsten concentrates in Arizona in 1935 were 339 short tons containing 69.78 percent WO_3. A large part of the shipments was wolframite, but there was some movement of huebnerite and scheelite.

The principal producer in Arizona in 1935 was the Boriana Mining Co., which operates a number of claims in the Hualpai Mountains, 15 miles northeast of Yucca. A good grade of wolframite concentrate was shipped; much smaller amounts of wolframite were also produced by Lawler & Wood from the Black Pearl group in Yavapai County and by Frank Samsel in Gila County.

The Southwest Ore Corporation shipped 28 short tons of huebnerite concentrates from the Las Guigas mine in Pima County near

Arivaca. This property now owned by the General Electric Co. was formerly worked by the Ore, Metal & Engineering Co. but was taken over in February 1935 by the Southwest Ore Corporation which continued underground development and increased mill capacity. Considerable tailings from the old mill operations were rerun in 1935. Huebnerite was also shipped from the placer operation north of Dragoon by A. H. Yeagley.

Fourteen tons of scheelite were shipped in Arizona in 1935, the largest amount coming from the Tungsten Reef mine operated by J. J. Seeman near Hereford in Cochise County. Scheelite was also produced by the Gold, Silver & Tungsten, Inc., from two properties, both in Cochise County. The new 40-ton concentration and flotation mill on the Huachuca group completed in 1935 is similar to the company plant in Boulder County, Colo.

California.—Scheelite was the only tungsten mineral produced in California in 1935. Two producers, the Atolia Mining Co. and the Atolia Rand Placers, Inc., made the total output. The former company, whose claims are at Atolia in the western part of San Bernardino County, some 40 miles east of Mohave, continued development work on the lower levels in an effort to extend reserves. This was once the richest known tungsten property in the world. While its production in 1935 was entirely from underground operations, in the past there has been considerable placer output. Vanderburg gives placer-mining costs as 10 cents per ton of material and also describes the milling operations.[1]

The largest producer in California in 1935 was the Atolia Mining Co. The Atolia Rand Placers, Inc., operates in the same region; its output is entirely from placer operations, which yield gold in addition to scheelite. A new mill was completed early in 1935, and extensive work was done checking values and bedrock contours.

Colorado.—Shipments of tungsten concentrates from Colorado in 1935 amounted to 519 short tons, all of which was ferberite. One of the largest producers, the Wolf Tongue Mining Co., operates the Cold Spring mine 3 miles east of Nederland in Boulder County. The ore is mined by the cut-and-fill system from lenses along vein fissures. The mining methods have been outlined by Vanderburg,[2] who also describes the concentrator, which has a capacity of 1 ton of ore per hour when treating ferberite ores containing 4 percent WO_3. In addition to its own production, this company bought ores and concentrates from other properties.

Gold, Silver & Tungsten, Inc. (formerly Tungsten Production Co., Inc.), did not mine tungsten ores in 1935 but purchased and milled ore from various leasers and miners in Boulder County. Lessees in the same district shipped considerable ferberite to other concerns or brokers.

Idaho.—Although no production was recorded from Idaho during 1935, the Ima Mines Corporation at May was doing development work and installing additional flotation equipment. The mill will be ready to treat 60 to 100 tons daily after midyear 1936. The ore is said to carry molybdenum and silver as well as tungsten.

[1] Vanderburg, Wm. O., Mining and Milling of Tungsten Ores.: Inf. Circ. 6852, Bureau of Mines, September 1935, pp. 10, 28–30.
[2] Vanderburg, Wm. O., work cited, pp. 11–14, 31–34.

Montana.—The Jardine Mining Co., one of the larger gold producers in Montana, has treated some tungsten ores, but no concentrates were shipped in 1935.

Nevada.—The mines of the Nevada-Massachusetts Co., 8 miles west of Mill City in Pershing County are the largest producers of tungsten in this country. The ore is scheelite found in tactite. The two mines, the Humboldt and the Stank, operated by the company, produce about 200 tons of scheelite ore per day, averaging 1.1 percent scheelite.[3] The ore is mined by the shrinkage-stoping method, each stope being 75 to 80 feet long. The concentrator has a capacity of 200 tons a day of scheelite ore containing an average of 1 percent scheelite. The method of concentration has been described by Vanderburg.

The old mill on the company Silver Dyke mine in Mineral County has been remodeled and enlarged, and a 10-mile pipe line assures an adequate water supply. Shipments from this 100-ton plant are expected to start early in 1936.

Gold, Silver & Tungsten, Inc., produced some scheelite from its tactite deposit on the east side of the Nightingale Mountains.

Washington.—Tungsten Producers, Inc., mining the wolframite-bearing quartz veins long ago worked by the Germania Mining Co. at Deer Trail just north of the Spokane Indian Reservation, made the largest shipments ever recorded for the mine in 1 year—162 tons carrying 71 percent WO_3. This company's output was the only recorded production in the State of Washington in 1935. During the year a 150-foot shaft was sunk from the main adit, from which drifting was instituted to tap veins at this level.

FOREIGN TRADE[4]

Domestic supplies of tungsten are inadequate to supply the demand, and the United States imports both tungsten concentrates and products. Imports of tungsten ore and concentrates by countries for 1934 and 1935 are shown in the following table:

Imports of tungsten ore and concentrates, by countries, 1934–35

	1934			1935		
	Gross weight, pounds	Tungsten content, pounds	Value	Gross weight, pounds	Tungsten content, pounds	Value
Argentina	95,378	49,801	$16,517	23,565	12,080	$4,944
British Malaya	56,077	33,085	14,644	163,871	90,020	45,692
China	1,321,456	709,055	268,568	1,237,840	669,143	317,381
Hong Kong				220	45	13
Mexico	58,300	34,980	31,482	50,777	34,470	11,412
Netherland India				11,040	6,864	4,214
Peru	39,000	19,638	8,423			
Total	1,570,211	846,559	339,634	1,487,313	812,622	383,656

[3] Vanderburg, Wm. O., work cited, pp. 17–21.

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

In addition, considerable tungsten is imported in the form of tungsten metal and tungsten carbide, as well as in tungstic acid and other compounds, as follows:

Imports of tungsten metal and compounds, by countries, 1934–35

Country	Tungsten metal and tungsten carbide				Tungstic acid and other compounds of tungsten			
	Tungsten content, pounds		Value		Tungsten content, pounds		Value	
	1934	1935	1934	1935	1934	1935	1934	1935
Germany	17,010	127	$10,438	$863	663	537	$2,191	$1,874
United Kingdom	89,483	77,038	59,440	63,557				
Canada	11		15					
Switzerland					42		115	
Total	106,504	77,165	69,893	64,420	705	537	2,306	1,874

Although the United States does not export tungsten ores or concentrates, there is a considerable export of tungsten in manufactured forms. Exports of ferrotungsten, tungsten metal, and wire amounted to 996,974 pounds valued at $743,592 in 1935 compared with 704,230 pounds valued at $453,813 in 1934. This export business is in large measure a result of smelting in bond; ore and concentrates containing 815,038 pounds of tungsten were shipped to this country for smelting and refining in bonded works and were exported during 1935 compared with 361,445 pounds in 1934. The remainder of this outward movement consists principally of exports with benefit of drawback or refund of 99 percent of the duties collected on exported raw material, although under the Tariff Act of 1930 it is possible also to substitute domestic for foreign raw materials and still obtain a refund from the Treasury on articles manufactured for foreign consumption.

PRICES

London prices of concentrates containing 65 percent WO_3, according to The Mining Journal (London), opened the year at 40s. per long-ton unit, declined to 29s. 6d. during June and July, and subsequently recovered to 35s. at the close of the year. American trade journals quoted domestic scheelite at $16.50–$17 per short ton unit, New York, at the beginning of the year. Quotations dropped to $14.50 during June but recovered to $15.50–$16 in December.

CONSUMPTION AND USES

Apparent consumption.—The trend in the apparent consumption of new tungsten during the last decade is shown in the following table:

Apparent consumption of new tungsten in the United States, 1926–35, as shown by imports and production less exports

Year	Supply (contained tungsten—pounds of metal)			Exports of ferrotungsten, tungsten metal, and wire (contained tungsten—pounds of metal, estimated)	Apparent consumption of new tungsten	
	In ore and alloys imported	In domestic ore shipped	Total		Pounds of metal	Equivalent (short tons of 60-percent WO_3 concentrates)
1926	2,883,867	1,315,000	4,198,867	23,504	4,175,000	4,387
1927	2,198,051	1,108,000	3,306,051	16,114	3,290,000	3,457
1928	2,968,839	1,150,000	4,118,839	13,313	4,105,000	4,314
1929	6,446,096	790,000	7,236,096	82,257	7,154,000	7,517
1930	3,998,150	668,000	4,666,150	23,983	4,642,000	4,878
1931	189,276	1,336,215	1,525,491	[1] 846,200	679,291	714
1932	106,202	376,881	483,083	[1] 112,626	370,457	389
1933	379,335	851,789	1,231,124	683,130	547,994	576
1934	953,766	1,950,074	2,903,840	563,384	2,340,456	2,459
1935	890,324	2,279,369	3,169,693	797,579	2,372,114	2,492

[1] Of these quantities, in 1931, 802,609 pounds and, in 1932, 90,000 pounds were shipped to U. S. S. R. (Russia) as ferrotungsten.

Uses.—Most of the tungsten produced is used in the steel industry, where its principal application is in the manufacture of high-speed tool steels. During recent years tungsten has also found its way into a number of complex alloy steels. Some tungsten is also consumed in nonferrous alloys, such as the well-known stellite group. Cemented tungsten carbide continued to grow in favor, and cemented-carbide consumption in the United States in 1935 was the largest for any year and about three times that for 1932. Machine tools with enough rigidity and power to utilize the inherent qualities of cemented carbides have been developed. Although tungsten carbide cemented with cobalt is still used more than all other types of cemented carbides combined, the year has witnessed new development of several special grades, principally (1) variations in tungsten carbide cemented with cobalt; (2) combinations of tungsten carbide and tantalum carbide cemented with cobalt or nickel, or both; (3) combinations of tungsten carbide and titanium carbide cemented with cobalt; and (4) tantalum carbide cemented with nickel or cobalt. Aside from uses as cutting tools, cemented carbides have recently been employed for wearing surfaces of machines, the life in some instances being 100 times that of steel. During the past year a cemented-carbide die weighing 5½ pounds was made—the largest piece so far made, at least in this country. A thick coating of tungsten can be plated electrolytically, but so far as is known no commercial use has been made of the process. Tungsten plate has a bright, silvery luster and is not attacked by any of the common mineral acids, although it can be dissolved in a mixture of nitric and hydrofluoric acids. Lamp filaments, radio-tube filaments, and contact points in electrical apparatus, while important uses, consume only minor amounts of metal. Although the bulk of the tungsten is used in the metallurgical industry, there are important uses in the chemical field, particularly in the production of certain types of dyes (lakes), and mordants. Consumption of tungsten raw materials in chemical outlets is increasing.

WORLD PRODUCTION

The following table shows the world production of tungsten for 1931 to 1935, inclusive:

World production of tungsten ore, 1931–35, in metric tons of concentrates containing 60 percent WO_3

[Compiled by M. T. Latus]

Country [1]	1931	1932	1933	1934	1935
North America:					
Mexico				80	53
United States	1,274	359	812	1,859	2,173
	1,274	359	812	1,939	2,226
South America:					
Argentina	20	6		392	(2)
Bolivia [3]	410	686	240	475	(2)
Peru				12	(2)
	430	692	240	879	(2)
Europe:					
Czechoslovakia	17				(2)
Germany (Saxony)	5			1	(2)
Great Britain (Cornwall)	121	2	12	223	(2)
Portugal	274	272	358	610	880
Spain	135	43	46	49	(2)
	552	317	416	883	(2)
Asia:					
China [3]	7,492	2,249	6,000	5,099	7,998
Chosen	17	62	144	399	(2)
India (Burma)	2,474	2,226	3,056	3,913	(2)
Indochina (Tonkin)	248	247	250	300	(2)
Japan	56	22	31	70	(2)
Malay States:					
Federated Malay States	462	378	1,188	1,695	(2)
Unfederated Malay States	241	175	91	90	(2)
Netherland India	1			1	(2)
Siam	12			36	(2)
	11,003	5,359	10,760	11,603	(2)
Africa:					
Nigeria				5	(2)
Southern Rhodesia	24	14	33	117	26
South-West Africa			3	18	(2)
Union of South Africa	2				6
	26	14	36	140	(2)
Oceania:					
Australia:					
New South Wales	62	27	(4)	59	(2)
Northern territory:					
Central Australia } North Australia }	29	15	13	89	(2)
Queensland	3	8	14	41	(2)
Tasmania	(4)		123	230	271
New Zealand [3]	6	9	19	39	(2)
	100	59	169	458	(2)
	13,400	6,800	12,400	15,900	(2)

[1] In addition to the countries listed, tungsten ore is produced in the U. S. S. R. (Russia), but no data of production are available for the period under discussion.
[2] Data not available.
[3] Exports.
[4] Less than 1 ton.

British India.—Although there are other known tungsten ore deposits in India, the output now is coming entirely from Burma, where in recent years there has been a revival of tungsten mining. Exports of concentrates (including mixed tin and wolfram concentrates) were 7,600 metric tons in 1935, of which 6,626 tons went to the United Kingdom. The bulk of the output came from Tavoy and from Karenni State. All of the production in the latter district was from one property, the Mawchi, where the product is a mixed concentrate of cassiterite, wolframite, and scheelite. The concentrates are shipped to England for magnetic separation. In Tavoy the output comes from a number of operations, and much of the tungsten is won incident to the mining of tin. The mixed concentrates from Lower Burma (Tavoy and Mergui) are separated at Tavoy, where the Consolidated Tin Mines of Burma, Ltd., has an electromagnetic separation plant which raises the tungsten concentrates to about 69 percent WO_3. Except for surface deposits, quartz veins either in granite or sedimentaries at the granite contact furnish the great bulk of the concentrates from Burma.[5] The veins vary widely in size, from great veins down to mere stringers.

China.—China has been the principal producer of tungsten ores since the World War. Production figures are not available, but exports in 1935 were 7,383 metric tons compared with 4,707 tons in 1934. The following table gives the distribution of exports during 1934 and 1935:

Destination of tungsten ore shipped from China, 1934–35, in metric tons

Destination	1934	1935	Destination	1934	1935
Belgium	490	552	Sweden	102	684
France	574	553	United States	1,186	1,072
Germany	1,486	2,333	Other countries	2	51
Great Britain	641	878			
Hong Kong	201	1,260	Total	4,707	7,383
Italy	25				

The bulk of the output in China comes from the Provinces of Kiangsi and Kwangtung and is exported from Hong Kong, Canton, and Shanghai; Changsha is becoming more important as a tungsten marketing and export center. Hunan is also listed as a tungsten-producing province, and in 1935 discoveries were made in Kwangsi Province near Kweilin.

For a number of years the various provincial and national governments have tried to gain control of the tungsten-mining industry. Late in 1933 the Canton Government succeeded in establishing a strong monopoly regulating both price and production of tungsten ores from Chinese mines. The operation of the monopoly, however, was not satisfactory to the miners who smuggled their ores to Shanghai and Hong Kong and by so doing realized better returns from their product. During the latter part of April 1935 the military authorities of the First Army Group took over the management of the tungsten trade from the civil authorities in Canton. The situation in China is complicated further by the Kiangsi Wolfram Ore Monopoly, local dealers, smuggling, the Kwangsi Provincial Government, low stocks, Japanese interests, silver prices, and financial troubles.

[5] Clegg, E. L. G., Tungsten: Geol. Survey of India Records, vol. 70, 1935, p. 332.

Malay States.—The production from the Malay States is largely high-grade scheelite, apparently from the Kramat Pulai mine in the village bearing the same name 7 miles east of Ipoh, Perak. Exports in 1935 amounted to 1,395 metric tons, of which 1,387 tons were scheelite and 8 tons wolframite. It was reported [6] during the year that Kramat Pulai, Ltd., had located an extension of the scheelite ore body.

Portugal.—The production in Portugal in 1935 was 849 metric tons. Tungsten deposits in Portugal are now attracting considerable attention, and several mines which have been idle since the war are being reopened. The largest producer in Portugal is the Beralt Tin & Wolfram, Ltd., which operates a group of mines in Fundao, Province of Beira Baixa.

Other countries.—Production of scheelite concentrates from Yxsjo deposits at Ljusnarsberg, Sweden, may be resumed in 1936. The Yxsjo deposits are said to be the most important in Europe and were worked during the World War. The exploitation of what are said to be the richest wolfram-ore deposits in Soviet Russia has been begun near Dshidin in the Mongolian republic of Buryato.[7] Exploration work at the Tshontonda mine, Wankie district, southern Rhodesia, during 1934 and 1935 has indicated additional bodies of tungsten ore. Activities have also been reported from England, France, Germany, Tanganyika (discovery reported), South-West Africa, Australia, and Belgian Congo.

[6] Metal Bulletin (London) no. 2048, Dec. 31, 1935, p. 15.
[7] Metal Bulletin (London), no. 2054, Jan. 7, 1936, p. 15.

TIN

By Charles White Merrill

SUMMARY OUTLINE

Tin is one of the few commodities that the United States must obtain almost exclusively by importation; the value of tin imports for consumption exceeds that for any other raw metallic material. Imports in 1935 were worth almost $70,000,000, but domestic mine output was valued at less than $50,000. The importance of maintaining an uninterrupted flow of this metal into the United States is apparent when it is realized that tin is indispensable to many of the larger domestic industries.

United States production.—The domestic output of tin in 1935 was 40.5 long tons valued at $45,900; most of it was mined in Alaska. However, recovery of secondary tin—that is, production of tin from sources other than ore—provided over one-fourth of the United States supply.

Salient statistics for tin in the United States, 1926–35

	1926–30 (average)	1931	1932	1933	1934	1935
Production—						
From domestic mines ... long tons	25	3.7	0.4	[1] 2.7	8.2	[1] 40.5
From secondary sources ... do	29,750	17,679	13,170	19,732	22,232	24,911
Imports for consumption ... do	78,826	66,064	34,819	63,718	39,986	64,258
Exports (domestic and foreign) ... do	2,000	[2] 1,661	[2] 1,116	[2] 1,041	[2] 1,216	[2] 2,292
Monthly price of Straits tin at New York:						
Highest ... cents per pound	70.67	27.07	24.76	53.07	55.60	52.29
Lowest ... do	25.27	21.35	19.24	22.70	50.87	46.91
Average ... do	51.40	24.46	22.01	39.12	52.16	50.39

[1] Subject to revision.
[2] Foreign only. Domestic not separately recorded.

United States consumption.—The bulk of the tin consumption in the United States depends upon relatively few industries, notably food packing, automobile manufacture, and building. Food packing is relatively stable from year to year and may be counted upon to absorb a fairly constant quantity of tin plate and solder. The automobile industry continued to improve and reached the level enjoyed before the depression though still well below the peak established in 1929; further advance has been predicted for 1936. The general depression was still felt acutely in the building trades, which are large users of terneplate, tin plate, solder, and a variety of other tin-bearing articles employed in equipping new buildings.

World output, price, and stocks.—The world production of tin (tin content of ores) in 1935 was 140,000 long tons, an increase of 16 percent from the 121,000 tons produced in 1934, but 27 percent below the 193,000 tons produced in the record year 1929. The production of the five leading tin-mining countries was 109,566 tons (80 percent of the world total), as follows: Federated Malay States, 40,749 tons (30 percent); Bolivia, 25,003 (18 percent); Netherland India, 25,000 (18 percent); Siam, 9,779 (7 percent); and China, 9,035 (7 percent). The smelter production of tin was even more localized than the mine output, as the four leading tin-smelting countries—the Straits Settlements, the United Kingdom, Netherland India, and the Netherlands—produced approximately nine-tenths of the world total.

The principal supply to consumers in the United States is imported into the domestic market as refined pig tin, and most of it comes from two countries; the Straits Settlements furnished 54 percent and the United Kingdom 24 percent of the 1935 total. Imports of tin for consumption in 1935 were 64,258 long tons, an increase of 61 percent over the 1934 imports.

The average price of Straits tin at New York was 50.39 cents a pound for 1935 compared with 52.16 cents for 1934. Thus the production-control scheme succeeded in holding the price well above its 1929 level of 45.19 for a second year.

This year, according to a new policy, world "visible" stocks include the carry-overs in the Straits Settlements and at Arnhem. Despite these additions, however, visible stocks at the end of 1935 were near the level reported last year for December 1934. Visible stocks in the United States were also low at the close of the year.

The accompanying graph (see fig. 73) illustrates some of the salient features of the tin industry since 1900. During most of this period world mine production follows an upward slope of lower inclination than that of many other metals. The effects of the post World War depression and the boom of the late twenties are clearly seen. The most significant feature of the graph, however, is the parallelism between the price curve and the United States tin-imports curve. Bearing in mind the general industrial trend over the period, the importance to tin miners of industrial activity in the United States can be seen at a glance. The curve for prices shows a strong tendency to fall as world visible stocks increase and vice versa; United States visible stocks, although so small as to be almost insignificant, parallel the course of world visible stocks to some extent.

International production control.—The high tin prices of 1926–27 caused a boom in the development of tin mines that led to overproduction of tin as early as 1928. Stocks began to rise and prices to fall. During the summer of 1928 the Tin Producers' Association was formed to regulate the output of tin mines, but the general industrial depression caused a decline in consumption that nullified all benefits from controlled production. In 1930 a move was started to effect a legally enforceable curtailment program.

The Governments of British Malaya, Bolivia, Netherland India, and Nigeria finally agreed to a production-control plan that went into effect March 1, 1931, and set up the International Tin Committee with headquarters at The Hague to carry out the scheme. The 1929 output was adopted as a standard, and the committee regulated production by permitting the signatories to produce varying percentages of the standard. When curtailment was most severe, production was reduced to one-third of the standard. The committee later prevailed on Siam, Belgian Congo, Indochina, the United Kingdom, and Portugal to join the plan, but its quotas have been much more liberal than those set for the original signatories. The

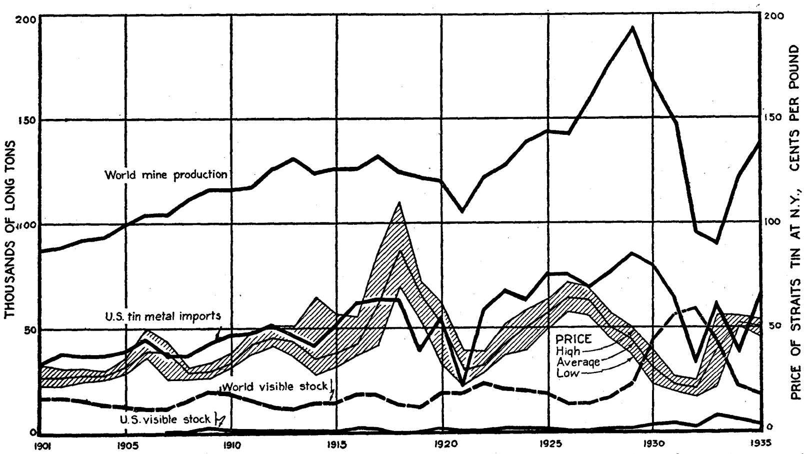

FIGURE 73.—Trends in production, imports, stocks, and prices of tin, 1901-35. (For change in reporting world visible stock beginning with 1930, see table — on p. 470.)

original agreement was extended before its expiration and will continue in force until December 31, 1936. The table on page 470 summarizes the quota data.

During 1935 negotiations were already in progress to extend the production-control scheme still farther. The consensus seemed to be that production control would be continued under an agreement like the present one. Many experts, however, expressed the opinion that the ratio of production among the participants would be altered considerably, and some thought that tin consumers might be given some consideration. C. V. Thomas, a prominent operator in the Malayan tin fields, commented:[1]

I hear rumors of efforts on the part of some to get the control agreement renewed for 5 years from the end of this year, but I hardly think Malaya could view such a proposal with favor. Even a renewal for 3 years, with no opportunity of reconsidering it, is, I think, opposed to the interests of Malaya, whatever might be the advantages to other countries.

I am emphatically of the opinion, even assuming a new agreement can be arrived at with equality of sacrifice and without deterioration of the present position of Malayan producers vis-a-vis those of all other participating countries, that under the terms of any new agreement the constitution of the International Tin Committee should be radically altered and that it should be more representative than at present.

All interested parties should be represented on the delegation. * * *.

Therefore, if the Tin Control Scheme is to be prolonged the British delegation should include representatives of British tin mining, smelting (but not so largely

[1] American Metal Market, Suggest Modification in Tin-Control Agreement: vol. 43, no. 22, Jan. 31, 1936, p. 3.

represented as mining), and consuming interests, and possibly, of the London Metal Exchange.

I agree with the view that another serious defect in the present scheme is that all changes in quotas must represent the unanimous decision of the various delegations. As the interests of the signatories differ enormously such a regulation is highly artificial, unreasonable, and dangerous and amounts to a sort of dictatorship by the weakest.

One interesting suggestion called for an entirely reconstituted control committee with delegates from producing countries, consuming countries, and the London Metal Exchange. It seems much more likely, however, that consumer recognition will continue in the form of advisory committees, such as the one on which John Hughes now represents the United States.

The Buffer Pool was started in 1934 with the object of placing a supply of metal, with which it could protect consumers from temporary shortages, in the hands of the International Tin Committee. The pool's manipulation during 1935 did not confirm the optimistic claims made for its usefulness, and it was liquidated by the end of the year without provision for renewal. Further discussion was heard regarding plans for allowing mining companies or smelters to keep a limited supply of concentrates on hand at all times so that market shortages could be quickly overcome.

One of the original objectives of the Tin Producers' Association was to provide the tin industry as a whole with better statistics and with a research organization. During 1933 this program, which, meanwhile, had become a part of the production control scheme under the International Tin Research and Development Council, began to yield results. The council's statistical office at The Hague has continued to publish comprehensive data on the tin industry. It also is cooperating with the United States Tin Research and Development Committee of the American Tin Trade Association and has placed the actual research work with the Battelle Memorial Institute, Columbus, Ohio. The committee proposes to expand the present uses of tin, develop new uses, and preserve and strengthen existing markets where tin meets competition.

Congressional Tin-Investigation Committee.—Many of those interested in an unrestricted flow of tin in international trade have urged for a long time that some agency of the United States Government investigate all possible means of protecting the country against extortionate prices in peacetime and shortage of this strategic metal in wartime. Their efforts bore fruit during 1934, when the House of Representatives started hearings [2] on the tin situation. The hearings were opened by the Tin Investigation Committee of the Committee on Foreign Affairs. Congressman Sam D. McReynolds, chairman of the committee, and H. H. Buckman, its investigator, directed the proceedings.

The testimony brought out a great many possible courses which could be taken by the United States to improve its present position with respect to tin. The possibility of establishing a domestic tin-mining industry was investigated at some length, and suggestions were advanced that a Nation-wide geological survey aimed at the discovery of tin deposits be conducted and that direct Government aid be granted to develop particular properties. Protection to the

[2] Of the Subcommittee of the House Committee on Foriegn Affairs, Tin Investigation; Report: Parts 1-3, 1935, 1111 pp.

secondary tin industry was considered in the form of embargoes on the exportation of scrap from which it derives its tin. A great deal of testimony centered about the possibility of reestablishing a domestic tin-smelting industry. Sources of ore and concentrates and their control were suggested for intensive study; United States smelting costs were compared with those of the United Kingdom; and the effectiveness of a tariff on tin metal with tin ore and concentrates remaining on the free list was discussed. The military and naval requirements were considered at some length, and this led to considerable testimony with respect to the effects of a large Government-owned stock pile of the metal. Another line of defense suggested for domestic consumers was the use of substitutes. Testimony was taken regarding the possibilities of developing substitutes, and subsidy of research for such work was proposed.

Witnesses were called to testify as to the interests of various tin-consuming industries, metal brokers, smelters, American owners of foreign tin mines, promoters of domestic tin properties, detinners, and scrap-metal dealers. The Bureau of Mines, the Bureau of Foreign and Domestic Commerce, the Geological Survey, the Bureau of Standards, the State Department, the War Department, and the Navy Department all sent specialists for questioning before the committee.

Shortly after the investigation was completed the McReynolds bill (H. R. 7675) was introduced in the House of Representatives on April 23, 1935, but favorable action was not taken on the measure. With the opening of the 1936 session of the Seventy-fourth Congress, the Faddis bill was introduced and was signed by the President on February 15, 1936, as the Faddis-Barbour tin bill (S. 3381). It provided that tin-plate scrap may be exported only under Federal license, and its principal object is the protection of the domestic detinning industry. Other features of the original McReynolds bill have been incorporated in proposed bills, and it seems likely that further legislation will result from the tin investigation.

Meanwhile, the high price for tin and the monopolistic manipulation of its output have increased research for substitutes in tin-consuming countries and prospecting for new mines in countries having stanniferous areas. Although substitutes and new production apparently have not affected the tin market very greatly, there are many signs of anxiety being felt by producers bound by law to restrict their output. On the other hand, tin consumers realize that present conditions are very likely to lead to cheap tin or cheap substitutes in the future.

DOMESTIC PRODUCTION AND RESOURCES

Primary tin.—Although the United States has never been an important producer of tin, it does not lack producing deposits entirely; nevertheless, careful studies of areas where tin has been produced or where it has been found, particularly during the World War period, indicate that this country cannot expect to supply even an appreciable part of its requirements. The following table gives the domestic mine production for the past 10 years; no smelter production has been reported since 1924, but increased imports of tin concentrates lent credence to rumors that experimentation was going on during the year looking to reestablishment of a domestic tin-smelting industry.

Mine production of recoverable tin in the United States (including Alaska), 1926–35

Year	Long tons	Value	Year	Long tons	Value
1926–30 (average)	24.6	$27,660	1933	2.7	$2,400
1931	3.7	2,050	1934	8.2	9,600
1932	.4	220	1935	[1] 40.5	[1] 45,800

[1] Subject to revision.

Alaska has been the chief source of tin for many years and is reported to have produced 40.1 long tons in 1935. South Dakota produced the remaining 0.4 ton. No other output was reported, but areas in North Carolina, California, Virginia, South Carolina, and Texas have produced small quantities in the past, and tin minerals are known to occur in many other States.

Secondary tin.—During 1935, 24,911 long tons of secondary tin were recovered in the United States, an increase of 12 percent from that recovered in 1934 and equivalent to 39 percent of the virgin tin imported in 1935. If the recovery of secondary tin were included with primary production the United States would rank fourth among tin-producing countries.

Tin content and value of secondary tin recovered in the United States, 1926–35 [1]

Year	Recovered at detinning plants			Recovered from all sources			
	As metal (long tons)	As chemicals (long tons)	Total (long tons)	As metal (long tons)	As alloys and chemicals (long tons)	Total: Long tons	Total: Value
1926–30 (average)	925	2,102	3,027	7,098	22,652	29,750	$34,246,700
1931	985	1,912	2,897	4,911	12,768	17,679	9,428,800
1932	628	1,579	2,207	4,152	9,018	13,170	6,248,100
1933	838	1,792	2,630	6,473	13,259	19,732	16,508,700
1934	940	1,761	2,701	7,366	14,866	22,232	25,487,600
1935	1,077	2,182	3,259	8,572	16,339	24,911	27,498,200

[1] Figures compiled by J. P. Dunlop, of the Bureau of Mines.

The principal uses of tin are in conjunction with steel as in tin plate, with lead as in solder and babbitt, and with copper as in bronze. Consequently the recovery of tin from scrap and junk depends on the market for these metals as well as that for the reclaimed tin itself. Industrial activity also affects secondary tin output by determining the quantity of scrap available. Most tin recovered from alloys does not pass through a refined-tin stage but is used in making alloys which are brought to required specifications by adding virgin metals.

The most important single source of secondary tin is tin-plate scrap, which is detinned for its steel as well as its tin. During the last 3 years domestic detinners have met increasing competition from Japanese buyers for tin-plate clippings produced at seaboard points. The Japanese detinners had an advantage over domestic buyers because Japan's tin import duty did not apply to the tin content of tin-plate scrap. As a result, the Japanese detinners enjoy a premium on the tin they reclaim equal to their country's import duty on pig tin. On February 15, 1936, however, the President approved the Faddis bill, section 2 of which reads:

There shall not be exported from the United States after the expiration of sixty days from the enactment of this Act any tin-plate scrap, except upon license issued by the President of the United States. The President is authorized to grant licenses upon such conditions and regulations as he may find necessary to assure in the public interest fair and equitable consideration to all producers of this commodity.

On February 16, 1936, the President issued an Executive order which delegated—

to the Secretary of State as Chairman of the National Munitions Control Board the power to grant licenses for the exportation of tin-plate scrap upon such conditions and under such regulations as he may find necessary to assure in the public interest fair and equitable consideration to all producers of this commodity, and as he may prescribe by and with the advice and consent of the Board.

On April 4, 1936, the Secretary of State prescribed regulations for the administration of the act that defined tin-plate scrap and outlined the form of application for export. Hereafter, it is expected that no tin-plate scrap that can be utilized by domestic detinning plants will leave the country.

IMPORTS AND EXPORTS [3]

Metal and ore.—Imported tin concentrates first were smelted in the United States in 1916, following the original imports in 1915. These imports reached the high point in both quantity and value (30,489 long tons, $18,795,162) in 1920 but have been negligible since 1923.

Foreign trade of the United States in tin and tin concentrates, 1926–35

Year	Imports				Exports of metallic tin (long tons)	
	Metallic tin		Tin concentrates			
	Long tons	Value	Tin content (long tons)	Value	Domestic [1]	Foreign [2]
1926–30 (average)	78,826	$88,942,840	194	$115,888	582	1,418
1931	66,064	36,723,656	30	7,117	(3)	1,661
1932	34,819	16,473,998	17	4,364	(3)	1,116
1933	63,718	51,240,829	24	10,630	(3)	1,041
1934	39,986	44,800,650	2	859	(3)	1,216
1935	64,258	69,815,287	178	106,078	(3)	2,292

[1] Imported as ore and exported as pigs, bars, etc.
[2] Imported as pigs, bars, etc., and exported as such.
[3] Not separately recorded.

The imports of 64,258 long tons of tin (bars, pigs, blocks, grains, and granulated) for consumption in 1935 represented a 61-percent increase over 1934, but was far below the average for the 5-year period ended in 1930. The Straits Settlements supplied 54 percent of the tin imported in 1935, the United Kingdom 24 percent, and all others 22 percent; in 1934 the Straits Settlements furnished 62 percent and the United Kingdom 21 percent.

[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.

Metallic tin (bars, pigs, blocks, grains, and granualated) imported for consumption in the United States, 1934–35, by countries

Country	1934		1935	
	Long tons	Value	Long tons	Value
Australia	48	$51,418	121	$129,197
Belgian Congo	277	322,042	350	384,558
Belgium	------	------	100	114,360
Canada	29	10,074	56	38,149
China	1,459	1,559,917	2,387	2,548,361
Germany	945	591,992	890	510,186
Honduras	------	------	(1)	175
Hong Kong	1,394	1,541,640	3,037	3,182,696
India (British)	------	------	2,290	2,499,035
Japan	------	------	10	11,288
Malaya (British) (Straits Settlements)	24,829	28,031,345	34,954	38,619,747
Mexico	------	------	18	13,130
Netherlands	815	978,641	1,973	1,939,417
Netherland India	1,722	1,965,742	2,493	2,713,222
Panama	1	382	1	864
United Kingdom	8,467	9,747,457	15,578	17,110,902
	39,986	44,800,650	64,258	69,815,287

1 Less than 1 ton.

During 1935 the exports of metallic tin in the form in which it had been imported amounted to 2,292 long tons. Although this was almost twice the exports of 1934, the quantity was very small compared with the imports of tin.

Tin manufactures.—Imports of tin plate, terneplate, and taggers tin were 187 long tons valued at $48,867 in 1935 compared with 126 tons valued at $31,821 in 1934. In 1935 the United Kingdom furnished nine-tenths of these imports.

The export in 1935 of 134,499 long tons of tin plate, terneplate, and taggers tin valued at $13,021,779 represented a decline of 27 percent in quantity and 23 percent in value from 1934. The world export market for tin plate declined approximately 15 percent during 1935. The United Kingdom continued to be the largest exporter, with the United States, Germany, France, and Italy sharing the export market in the order named.

Tin plate, terneplate, and taggers tin exported from the United States, 1926–35

Year	Long tons	Value	Year	Long tons	Value
1926–30 (average)	245,958	$27,388,512	1933	95,239	$7,650,419
1931	84,433	7,841,193	1934	184,651	16,872,564
1932	39,603	3,272,566	1935	134,499	13,021,779

During 1935 over one-third of the United States tin-plate exports went to the Orient, where Japan, China, and the Philippine Islands were the principal customers; South American countries accounted for over a quarter of the exports, with Brazil, Argentina, and Uruguay the largest customers. The volume of domestic tin-plate exports to almost all countries declined in 1935 compared with 1934, but the great increase to Russia was a notable exception. Most of the tin plate was exported through the Maryland and New York port districts; the former port led in quantity and the latter in value.

Exports of tin plate, terneplate, and taggers tin from the United States, by principal countries and districts, 1934–35

	1934		1935	
	Long tons	Value	Long tons	Value
Country				
Argentina	20,095	$1,870,581	10,590	$1,081,003
Brazil	11,428	1,086,751	10,683	1,019,756
British Malaya	3,420	301,354	1,434	137,800
Canada	2,784	272,214	3,872	355,728
Chile	3,381	327,452	4,599	447,534
China	24,162	2,212,438	8,758	888,107
Colombia	2,886	283,677	2,514	262,531
Cuba	5,840	570,226	6,984	705,680
Greece	3,400	295,051	472	42,475
Hong Kong	5,471	484,764	4,913	464,688
Japan	40,215	3,628,315	21,549	1,874,099
Kwantung	5,471	477,570	1,897	185,408
Mexico	9,939	929,006	7,853	827,189
Netherland India	3,645	327,267	2,259	218,724
Peru	4,055	364,855	3,681	342,058
Philippine Islands	8,684	776,112	7,356	698,108
Sweden	4,158	337,760	2,573	231,662
Syria	3,404	290,189	989	88,465
Turkey in Asia and in Europe	3,176	276,485	449	42,315
U. S. S. R. (Russia)	759	109,327	8,455	913,499
Uruguay	7,401	686,563	6,664	664,746
Others [1]	10,877	964,607	15,955	1,530,204
Total	184,651	16,872,564	134,499	13,021,779
District				
Maryland	112,065	10,186,970	64,474	5,995,818
New York	65,291	5,990,984	60,234	6,080,463
Philadelphia	2,259	207,138	4,273	413,006
Others [1]	5,036	487,472	5,518	532,492
Total	184,651	16,872,564	134,499	13,021,779

[1] Includes all exports not exceeding $250,000 in 1934 or 1935.

Much tin also is exported from the United States in manufactures, little of whose value is derived from the tin they have consumed incident to production. The most important of such exports are products of the automotive and food-packing industries. There are no statistics on the quantity of tin thus exported, but estimates based on the total exports of these products indicate that it is considerable.

CONSUMPTION AND USES

The United States is the world's leading consumer of tin, due largely to its supremacy in the canning and motor-vehicle industries. Canvasses by the Bureau of Mines in 1925,[4] 1927, 1928, and 1930 [5] show that tin plate is the largest use of virgin tin, followed in order of importance by solder and babbitt; bronze, foil, collapsible tubes, tin chemicals, tinning of brass and bronze products, white metal, and type metal are other uses.

Virgin-tin consumption can be estimated from the figures for mine production, imports, exports, and stocks; the result is termed "apparent" consumption. Apparent consumption is only an approximation of actual consumption, because it does not take full account of "invisible" stocks and because secondary tin may be included in the

[4] Furness, J. W., Consumption of Tin in the United States, 1925: Inf. Circ. 6019, Bureau of Mines, 1927, 3 pp.

[5] Umhau, J. B., Consumption of Primary Tin in the United States during 1930: Inf. Circ. 6564, Bureau of Mines, 1932, 7 pp.

figures used for "visible" stocks. The domestic apparent consumption of 62,470 long tons for 1935 was a 43-percent increase over 1934 but was far below the average for the 5 years ended in 1930. The scarcity of spot tin during 1935 would have tended to reduce invisible stocks, therefore it is probable that true consumption was somewhat higher than the figure for apparent consumption. Invisible stocks, however, have always proved to be small when disclosed, so it is reasonable to presume that their reduction during 1935 did not add greatly to consumption.

Apparent consumption of virgin tin in the United States, 1926–35, in long tons

	1926–30 (average)	1931	1932	1933	1934	1935
Supply:						
Domestic production	25	4		3	8	[1] 41
Imports of tin as metal	78,826	66,064	34,819	63,718	39,986	64,258
Imports of tin in concentrates	194	30	17	24	2	178
Visible stocks, Jan. 1	[2] 2,654	4,693	6,254	4,496	7,504	2,638
Total available	81,699	70,791	41,090	68,241	47,500	67,115
Withdrawals:						
Exports of tin as metal	2,000	[3] 1,661	[3] 1,116	[3] 1,041	[3] 1,216	[3] 2,292
Exports of tin in concentrates	25	4		3	8	41
Visible stocks, Dec. 31	[2] 4,693	6,254	4,496	7,504	2,638	2,312
Total withdrawn	6,718	7,919	5,612	8,548	3,862	4,645
Apparent consumption	74,981	62,872	35,478	59,693	43,638	62,470

[1] Subject to revision.
[2] Stocks for Jan. 1 and Dec. 31 are taken at the beginning and end of the 5-year period and are not averages taken on Jan. 1 and Dec. 31 of each year.
[3] Foreign exports only for 1931–35.

The consumption of secondary tin cannot be segregated by uses as completely as can virgin tin because much of it is reclaimed in an alloyed or chemical form for which the manufacturer frequently does not have an exact analysis. In fact, less than one-third of the total domestic secondary tin supply is recovered as unalloyed metal. The principal use of secondary tin is in the manufacture of alloys, and most of it so used is reclaimed from secondary alloys without first being converted into the pure metallic state. The tin-alloy store of the United States can best be represented as a reservoir containing many metals, into which a stream of virgin tin must constantly flow to replace losses and provide for expansion.

Tin plate and terneplate.—The tin-plate and terneplate industry is the largest user of virgin tin in the United States and has accounted for approximately two-fifths of the domestic consumption during the last few years.

Tin plate is made by coating steel sheets with pure tin, and in present practice standard tin plate contains about 1½ percent of tin by weight; 1 pound of tin will make 220 square feet of tin plate. Terneplate is similar to tin plate, except that a tin-lead alloy is substituted for pure tin in the coating. Taggers tin is extra-thin tin plate. In the United States during the last few years, tin-plate manufacturers have been developing a new technique, which calls for more nearly continuous rolling of the sheet bar to black plate, more dependence on cold rolling for reduction of thickness, more attention to heat treatment in the annealing processes, and the mechanization of many of the former hand processes. These new developments have been so successful that they are now being copied in the long-established plants of Wales.

The improvement of ordinary tin plate by the electrodeposition of an additional light coat of tin from an alkaline bath has been described by Hothersall and Bradshaw.[6] It is said that porosity of the coat is greatly reduced and that the appearance of the plate is improved. A German suggestion calls for electrodeposition on black plate, which would result in reducing tin consumption by making it practicable to coat only one side of the sheet. This method should prove important to a nation suffering a blockade, such as Germany did during the World War.

The larger part of tin plate and taggers tin is used for making tin cans, particularly food containers. Terneplate is used for gasoline tanks on automobiles, and some is substituted for tin plate in non-food-product containers where the toxic effect of the lead is not deleterious.

Most promising of new uses for tin in recent years is the canning of beer. It is estimated[7] that the daily consumption of cans for this purpose had risen by December 1935 to 3,800,000 or 42 percent of the average number used for vegetables throughout the year. Canned beer has not been on the market long enough to test the permanence of public acceptance but many predict that the demand will continue to expand. The bottle manufacturers, however, have started a vigorous campaign to regain their losses and claim that bottles result in considerable economy in local distribution. The flavor of canned beer is naturally a question of opinion, but the can manufacturers hold that they deliver the beverage so that it equals draft beer in taste.

Tin plate and terneplate produced in the United States, 1926–35, in long tons[1]

Year	Tin plate	Terneplate	Total	Year	Tin plate	Terneplate	Total
1926–30 (average)	1,689,849	118,488	1,808,337	1933	1,685,826	83,272	1,769,098
1931	1,392,227	66,716	1,458,943	1934	1,502,918	100,311	1,603,229
1932	986,217	46,290	1,032,507	1935	1,695,159	191,280	1,886,439

[1] From Annual Report of American Iron and Steel Institute.

The 1,695,159 long tons of tin plate produced in 1935 was 13 percent more than the 1934 output and equaled the average attained in the years before 1930. As exports fell off in 1935, this output represents a greatly expanded domestic consumption. Terneplate output in 1935 exceeded that of any previous year.

Automobile manufacture.—The automobile industry is one of the principal consumers of tin. The chief uses are in solder for radiators, babbitt for engine bearings, and bronzes for bearings and bushings. The increase in the number of cylinders in current models has tended to call for added tin for babbitted engine bearings, but tin-free bear-

[6] Hothersall, A. W., and Bradshaw, W. N., Improvement in the Quality of Tin Plate by Superimposed Electrodeposition of Tin: International Tin Research and Development Council, Tech. Pubs., ser. A, no. 22, 1935, 16 pp.

[7] Wall Street Journal, Beer-Container Market a Major Can Outlet Now: Vol. 13, no. 112, Dec. 10, 1935, p. 1.

ing metals have been displacing tin alloys in some of the most popular makes. In fact, the great revival of the automotive industry has not increased domestic tin consumption as much as might have been expected.

Production, registration, and exports of motor vehicles in the United States, 1926–35

Year	Production [1]			Registration [2] (all classes)	Exports [3] (all classes)
	Passenger cars	Trucks and busses	Total		
1926–30 (average)	3,581,616	573,469	4,155,085	24,649,200	394,100
1931	1,973,090	416,648	2,389,738	25,934,000	130,705
1932	1,135,491	235,187	1,370,678	24,115,000	66,404
1933	1,573,512	346,545	1,920,057	23,844,000	108,027
1934	2,177,919	575,192	2,753,111	24,933,000	237,880
1935	3,252,244	694,690	3,946,934	[4] 26,167,000	272,761

[1] Bureau of the Census.
[2] Bureau of Public Roads.
[3] Bureau of Foreign and Domestic Commerce.
[4] Automobile Manufacturers Association.

In 1935 there was an increase of 43 percent over 1934 in the number of motor vehicles produced, thus recording the third consecutive annual increase. Motor-vehicle output was back to the predepression level, and truck production almost equaled that of the peak year 1929. Moreover, the industry's export business continued to improve. An advance in the date for introducing new models tended to increase output, but sales during the early months of 1936 indicate that the change has not robbed the new year of an advancing sales record. Another favorable feature was the further increase in the number of motor vehicles registered. Their maintenance and repair are substantial items in the consumption of tin.

Other manufactures and new uses.—Returning industrial activity during 1935 has increased the need for tin because the moving parts of so many machines run on tin-alloy bearings. Airplanes, mechanical refrigerators, and Diesel engines require much tin for their manufacture and maintenance.

SUBSTITUTES

Tin returned to its position during 1935 as the highest priced of the common base metals, a position it has continued to hold. This fact, in conjunction with the monopolistic manipulation of its production, turned the attention of many United States consumers toward research for substitutes, because substitution is virtually the only weapon available to consumers with which to combat excessive price. Moreover, substitutes would prove invaluable to national defense should war curtail the flow of tin to the United States.

Most interesting of developments in connection with tin substitutes is the new process for coating black plate with aluminum instead of tin. Colin Fink, its inventor, reports: [8]

> Our process of coating steel with aluminum is being tried out on a commercial scale, and if all goes well we ought to have the product on the market before long. Our product is highly resistant to corrosion not only at ordinary temperatures but also at high temperatures. Furthermore, it withstands fruit and

[8] Mining Journal (London), Tin-Plate Substitute: Vol. 190, no. 5213, July 20, 1935, p. 543.

vegetable acids perfectly. Its outstanding feature is the alloy bond between the outer aluminum and the inner steel. It is this alloy bond which is so highly resistant to acids and high temperatures. As regards solders, we are particularly concerned with eliminating lead entirely, and have been able to get good air-tight seals without the use of lead, so that we can, for the first time, say that no lead gets into contact with the liquids.

Should aluminum-coated steel prove a satisfactory substitute for tin plate, the present market for tin would be almost halved. A German invention is said to have solved the soldering problem. Tin-free bearing metals have already displaced much babbitt in the automotive industry.

PRICES AND STOCKS

Prices.[9]—The price of tin during 1934 and 1935, though very high compared with that of other commodities and particularly with other metals, was much steadier than it had been in years. This stability reflected the manipulation of production and stocks by the International Tin Committee. The break in the price in February 1935, however, revealed the committee's weakness when confronted with major upsets in the London market. Moreover, the ability of the London tin market to withstand shocks is said to be declining because tin price stabilization is causing speculators to transfer their activities to other markets. During the last 2 years much of the dealing in tin was affected as much by the fluctuations in monetary exchange as in tin price.

Monthly price of Straits tin for prompt delivery in New York, 1933–35, in cents per pound [1]

	1933			1934			1935		
	High	Low	Average	High	Low	Average	High	Low	Average
January	23.45	21.80	22.70	53.20	50.60	51.88	51.15	50.50	50.87
February	23.80	23.20	23.50	52.60	50.00	51.62	51.20	47.35	49.96
March	25.50	23.50	24.34	55.20	52.30	53.74	47.75	45.75	46.91
April	30.25	24.70	27.15	56.65	54.87½	55.60	51.25	47.85	50.10
May	40.75	32.37½	35.90	54.65	52.65	53.52	52.20	50.35	51.10
June	46.50	40.62½	44.21	52.50	50.25	51.22	51.80	50.50	51.07
July	48.00	44.62½	46.38	52.37½	51.25	51.92	52.75	51.75	52.29
August	46.12½	43.37½	44.74	52.90	51.40	51.95	52.62½	48.25	50.44
September	48.25	44.75	46.65	51.95	51.15	51.49	50.25	48.25	49.07
October	49.00	46.00	47.92	51.30	50.55	50.93	54.00	49.10	51.21
November	55.80	49.00	53.07	51.37½	51.10	51.22	53.62½	51.00	51.88
December	53.50	52.35	52.87	51.05	50.70	50.87	52.00	48.37½	49.77
Year	55.80	21.80	39.12	56.65	50.00	52.16	54.00	45.75	50.39

[1] Metal Statistics, 1936, pp. 345 and 347.

It was not until April 1933 that the price of tin started its spectacular climb from the depression levels that had prevailed for so many months; by November of that year it had reached the level held throughout 1934 and 1935. The average monthly price per pound for 1935 was 3 percent lower than that for 1934, and the average price for the closing month of 1935 was 2 percent below that for December 1934.

[9] Prices used in the discussion refer to Straits tin at New York, as quoted in the American Metal Market and published in Metal Statistics, 1936, pp. 345–347.

Prices of tin plate and sheet bars at Pittsburgh and pig tin at New York on dates of principal price changes of tin plate, 1929–35 [1]

Date	Tin plate (per base box)	Sheet bars (per long ton)	Pig tin (per pound)	Date	Tin plate (per base box)	Sheet bars (per long ton)	Pig tin (per pound)
			Cents				*Cents*
1929: Dec. 31	$5.25	$34.00	39.75	1932: Nov. 17	$4.25	$26.00	23.35
1930: Oct. 1	5.00	31.00	28.00	1933: Aug. 29	4.65	26.00	46.00
1931: Oct. 1	4.75	29.00	22.12½	Dec. 1	5.25	26.00	53.50

[1] Metal Statistics, 1936, p. 149.

Stocks.—The term "world visible stocks", as used in this series, has never included the carry-over at the Straits Settlements smelters or at the Arnhem smelter in the Netherlands. Recently these stocks have been reported regularly and have become definitely visible. Consequently, they will be included hereafter in figures for world visible stocks. The above table includes the Straits Settlements carry-over since January 1930 and the Arnhem carry-over since July 1933.

Visible stocks both for the world and for the United States continued at the low levels established late in 1934. In fact, tin was so scarce at times that a high premium was quoted for prompt delivery.

Visible stocks of tin in the world and in the United States at end of each month 1926–35, in long tons [1]

Month	1926–30 (average)		1931		1932		1933		1934		1935	
	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	21,074	2,724	49,300	4,904	60,869	5,342	54,626	3,461	28,724	8,209	18,535	2,581
February	22,484	2,963	52,992	5,862	60,423	4,578	52,951	2,741	28,296	7,014	23,426	3,571
March	21,599	2,479	52,437	7,917	60,520	3,841	52,038	2,281	25,010	6,459	22,165	4,531
April	22,596	2,864	54,933	6,212	60,847	3,546	50,198	2,040	22,886	5,649	20,324	4,295
May	23,766	3,456	58,099	5,698	59,424	3,981	49,046	3,036	21,580	5,089	19,074	4,930
June	23,658	3,527	58,828	5,633	58,198	3,759	46,936	3,474	20,587	5,094	16,221	5,467
July	23,531	3,550	58,319	5,838	60,360	4,559	45,209	4,549	20,939	6,461	16,173	3,227
August	23,883	3,228	56,781	6,213	57,392	4,459	40,362	5,788	19,676	4,968	16,306	2,681
September	23,620	3,227	57,249	5,868	57,138	4,191	36,129	6,003	18,833	4,243	14,564	2,849
October	24,257	3,371	58,445	6,773	56,899	4,291	34,109	6,664	20,624	4,998	16,138	1,389
November	24,574	3,066	59,152	7,458	56,913	3,441	31,961	6,769	19,239	4,048	16,804	1,472
December	26,349	2,685	59,606	6,254	56,126	4,496	29,464	7,504	18,172	2,638	15,318	2,312
Average	23,466	3,095	56,345	6,219	58,759	4,207	43,586	4,526	22,046	5,406	17,920	3,275

[1] Metal Statistics, 1936, pp. 337 and 339. Beginning January 1930, world stocks include the carry-over in the Straits Settlements (on lighters and warrants), and since July 1933, the stock carry-over at Arnhem (Netherlands) smelter.

The Buffer Pool of 8,282 long tons, which was accumulated during 1934, was liquidated during 1935. Despite the fact that it had been proposed for the purpose of protecting buyers in case of sudden shortages of stocks, the markets received little relief from this quarter during periods of scarcity. Apparently the Buffer Pool idea has been abandoned.

WORLD PRODUCTION AND RESOURCES

The world mine production of 140,000 long tons of tin was an increase of 16 percent over 1934 but was only 73 percent of the all-time peak output of 193,000 tons in 1929.

World production of tin (content of ore), 1926–35, by countries, in long tons

[Compiled by R. B. Miller]

Country	1926–30 average	1931	1932	1933	1934	1935
Australia	2,517	1,750	2,138	2,810	2,986	3,100
Belgian Congo	884	(1)	(1)	1,576	4,356	6,447
Bolivia [2]	38,356	31,137	20,589	14,721	22,835	25,003
China [2]	6,605	3,478	2,009	9,485	6,340	9,035
India (British)	2,503	2,979	3,168	3,153	4,061	[3] 3,600
Indochina	774	881	1,010	1,038	1,132	1,075
Japan	578	1,577	1,557	1,538	[3] 1,500	[3] 1,500
Malay States:						
Federated [2]	57,834	53,457	28,363	23,922	36,385	40,749
Unfederated	2,159	1,436	1,341	923	1,348	1,527
Mexico	(1)	761	740	(1)	621	621
Netherland India	34,044	27,375	16,789	12,609	19,358	25,000
Nigeria	8,782	7,056	4,320	3,755	4,864	6,949
Portugal	605	(1)	(1)	(1)	524	650
Siam	8,937	12,495	9,276	10,324	10,157	9,779
Union of South Africa	1,131	(1)	540	539	570	616
United Kingdom (England)	2,688	598	1,337	1,542	1,999	2,050
Other countries [4]	1,500	1,900	1,900	1,900	2,000	2,200
	169,000	147,000	95,000	90,000	121,000	140,000

[1] Less than 500 tons; included under "Other countries."
[2] Exports.
[3] Estimated.
[4] Includes countries producing less than 500 tons.

PRODUCTION-CONTROL QUOTAS

The international production-control program has been a leading factor in determining tin output and what countries produced it since March 1, 1931. The following table compares 1935 outputs with those for 1930, the last year of unrestricted production.

Comparison of tin outputs in 1935 with those in 1930 in countries signatory and nonsignatory to the international production-control program

Country	1930	1935	Ratio of outputs 1935 to 1930
Original signatories:	*Long tons*	*Long tons*	*Percent*
British Malaya [1]	63,980	42,276	66
Bolivia	38,161	25,003	66
Netherland India	34,586	25,000	72
Nigeria	8,570	6,949	81
Total	145,297	99,228	68
Subsequent signatories and adherents:			
Siam	11,526	9,779	85
Belgian Congo	652	6,447	989
United Kingdom	2,488	2,050	82
Indochina	992	1,075	108
Portugal	460	650	141
Total	16,118	20,001	124
Nonsignatories and nonadherents:			
China	6,483	9,035	139
India	2,990	3,600	120
Australia	1,451	3,100	214
Japan	1,496	1,500	100
Mexico	363	621	171
Union of South Africa	930	616	66
Others	1,100	2,200	200
Total	14,800	20,672	140
Grand total	176,000	140,000	80

[1] Include Federated Malay States, Unfederated Malay States, and Straits Settlements.

The revision and extension of the output curtailment agreement negotiated late in 1933 continued to run its 3-year course, 1934–36. During 1934 the Belgian Congo, Indochina, the United Kingdom, and Portugal were induced to join the agreement, but on terms so liberal that their outputs and expansion have been affected very little so far. The quotas of the original four signatory countries, British Malaya, Bolivia, Netherland India, and Nigeria, opened 1935 at the 40-percent rate, which was the standard for the last quarter of 1934. On March 15 the rate was raised to 45 percent for the second quarter. On June 12 the International Tin Committee set the rate for the third quarter at 50 percent, but on August 9 increased it to 65 percent, retroactive to July 1, and on October 3, to 70 percent, retroactive for the third quarter. The quota of 65 percent set on August 9 was to have applied to the fourth as well as the third quarter, but on October 22 the rate was increased to 80 percent to apply retroactively for the entire fourth quarter.

On December 6 the rate for the first quarter of 1936 was raised to 90 percent, but on February 19, 1936, the quota for the second quarter was reduced to 85 percent. The net result of all these rulings was the following schedule of quota rates: First quarter 1935, 40 percent; second quarter, 45 percent; third quarter, 75 percent; fourth quarter, 80 percent; first quarter 1936, 90 percent; and second quarter, 85 percent. The following table summarizes the quota data of the production-control scheme since the revised basis was adopted on January 1, 1934.

Tin-production quotas for countries signatory to the tin-output curtailment plan, 1934–36, in long tons [1]

Country	Quota basis 1934–36	Quota (annual rate)								
		1934 [2]			1935				1936	
		Jan. 1	Apr. 1	Oct. 1	Jan. 1	Apr. 1	July 1	Oct. 1	Jan. 1	Apr. 1
British Malaya	71,940	28,776	35,970	28,776	28,776	32,373	50,358	57,552	64,746	61,149
Bolivia	46,490	18,596	23,245	18,596	18,596	20,921	32,543	37,192	41,841	39,517
Netherland India	36,330	14,532	18,165	14,532	14,532	16,349	25,431	29,064	32,697	30,881
Nigeria	10,890	4,356	5,445	4,356	4,356	4,901	7,623	8,712	9,801	9,257
Siam	9,800	9,800	9,800	9,800	9,800	9,800	9,800	9,800	9,800	9,800
Belgian Congo	14,872 (Belgian Congo to Other countries)	4,500	4,500	4,500	6,000	6,000	6,000	6,000	7,000	7,000
Indochina		1,700	1,700	1,700	2,500	2,500	2,500	2,500	3,000	3,000
United Kingdom		1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700
Portugal		650	650	650	650	650	650	650	650	650
Other countries		(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)

[1] For record of plan from its beginning in 1931 through 1932, see Minerals Yearbook 1935, p. 516.
[2] An additional 4-percent quota was distributed among the first 4 countries during 1934.
[3] No restriction of output.

TIN-MINING COUNTRIES

British Malaya.—The southern part of the Malay Peninsula, known as British Malaya, comprises three major political divisions—the Federated Malay States, the Straits Settlements, and the Unfederated Malay States.

The Federated Malay States, the world's leading source of tin ore, produced concentrates containing 40,749 long tons of metallic tin in 1935, an increase of 12 percent over the 1934 production but less than 61 percent of the output for the peak year 1929. The legally enforced curtailment program was the principal factor in the reduction of output during 1931–35, inclusive; of the 119 dredges in use, 49 were idle temporarily at the end of 1935. Employment in the mining industry in the last month of the year has been as follows: 1935, 65,328; 1934, 53,037; and 1929, 104,468. During 1935 the Government rescinded the prospecting-suspension order to the extent that hereafter it will consider applications from lessees or holders of assessments for permission to prospect potential mining land in order to continue operations.

The tin miners evidenced the greatest interest in the problem of regulating tin output. Although there were many rumors of dissatisfaction, it appeared that virtually all producers favored the restriction scheme and were bending their efforts toward getting a larger share of the total world output through quota revision.

The Straits Settlements continued to lead the world in production of smelted tin, and the Unfederated Malay States advanced to eleventh place in point of mine output.

Bolivia.—Bolivia, the second largest producer of tin and the largest producer of lode tin, exported concentrates and ore containing 25,003 long tons of tin in 1935, an increase of 9 percent over 1934 but only 54 percent of that for 1929. The Patiño Mines & Enterprises Consolidated, Inc., the world's greatest tin-mining company, produced over one-third of Bolivia's tin in 1935.

The conclusion of the war against Paraguay in the Gran Chaco area released many of the best workmen from military service and relieved the Government of the necessity for wartime taxation. Peace, however, found Bolivia in an exhausted state financially, and it will probably be some time before many of the fever-ridden war veterans can regain their former efficiency as mine and mill laborers. Meanwhile, it is predicted that Bolivia will find it difficult to fill its tin quotas as long as the present rate of world production is continued.

Netherland India.—Netherland India produced concentrates containing 25,000 long tons of tin during 1935, which represented an increase of 29 percent from the output in 1934. Virtually all the production came from mines operated by the Government and by the Billiton Joint Mining Co. Negotiations continued for the amalgamation of these two organizations, and it appeared probable that they ultimately would be joined because the Government already controls five-eighths of the latter company. The Government continued its policy of mechanization and rationalization, which resulted in a large reduction in labor forces and a concentration of exploitation in fewer areas.

Siam.—Siam continued to remain within its production limit of 9,800 long tons by mining concentrates containing 9,779 tons during 1935. Much development is reported in Siam's tin fields; a promising body of lode ore was opened up in the south by the Siamese Tin Mines, Ltd., a company financed in part by American capital. More disquieting to restrictionists, however, were rumors that Japanese capitalists were considering the construction of a smelter either in Siam or Japan to treat Siamese concentrates now going entirely to the Straits Settlements smelters.

China.—Exports of tin from China in 1935 are reported at 9,035 long tons, an increase of 43 percent over those for 1934. Production in recent years has come principally from the Kotchiu district in southern Yunnan Province.

Nigeria.—Nigeria produced concentrates containing 6,949 long tons of tin in 1935, an increase of 43 percent over 1934; all the concentrates were exported for smelting.

Belgian Congo.—The Belgian Congo continued its amazing development program by producing 6,447 long tons of tin in 1935 compared with 4,356 tons in 1934 and 689 tons in 1932. Although the Belgians finally were prevailed upon to join the production-control plan, the terms to which they agreed were not very restrictive, as they permit an output of 7,000 tons in 1936. The export duty on tin ore was increased 3 to 7 percent ad valorem to protect the growing local tin-smelting industry. Devaluation of the belga proved very stimulating to the tin miners.

India.—India, although outside the restriction scheme, actually decreased its output of tin in 1935.

Australia.—Australia, another country outside the production-control plan, produced 3,100 long tons of tin in 1935, an increase of 4 percent over 1934.

United Kingdom.—The production of tin (content of domestic ores) in the United Kingdom was 2,050 long tons, a negligible increase over 1934. Beginning with 1934 the United Kingdom accepted an annual quota of 1,700 long tons until 1937. The importance of the United Kingdom in tin production, however, is based upon the output of its smelters at Liverpool and Redruth. The principal tin smelters of the United Kingdom were brought under one management through the formation of Consolidated Tin Smelters, Ltd., at the close of 1929. It is reported that the tin smelter being built at Liverpool by the British Tin Smelting & Refining Co., Ltd., a subsidiary of the Straits Trading Co., Ltd., will be in operation by midyear 1936. Thus the virtual monopoly of the Consolidated Tin Smelters, Ltd., in the United Kingdom is about to be challenged.

Other countries.—The countries separately discussed account for 133,000 long tons (95 percent of the total production) in 1935. The remaining 7,000 tons were produced largely by Japan, Indochina, Portugal, Mexico, and the Union of South Africa, but small outputs were reported for a number of other countries. An important discovery was reported in Jujuy Province, Argentina, and a substantial production was predicted from it.

TIN SMELTERS

In recent years the bulk of the tin has been smelted in a very few places; the principal plants were at Singapore and Penang in the Straits Settlements, Liverpool, and Redruth in the United Kingdom, and Batavia, Banka, and Billiton in Netherland India. The rising importance of the Arnhem smelter in the Netherlands and the Hoboken plant in Belgium is tending to decentralize the industry, and this decentralization would be carried much farther should legislation growing out of the recent tin investigation by the House of Representatives result in the reestablishment of a large tin smelting and refining industry in the United States.

Smelter production of tin, 1926–34, in long tons [1]

Country	1926–30 average	1931	1932	1933	1934
Australia	2,623	1,690	1,958	2,360	2,330
Belgium [2]	900	200	800	2,700	3,900
British Malaya [3]	82,433	87,514	49,945	46,942	49,627
China	6,604	5,891	7,890	7,600	8,000
Germany	3,750	3,689	1,871	(4)	(4)
Netherland India [5]	14,724	12,788	8,091	8,792	10,506
Netherlands [2]	1,500	3,000	3,500	5,000	13,411
United Kingdom [2]	48,000	35,600	28,500	18,200	26,500

[1] Adapted from figures as published by Imperial Institute, London.
[2] Estimated.
[3] Exports plus difference between carry-over at end and beginning of year.
[4] Data not available.
[5] Exports.

CHROMITE

By Robert H. Ridgway

SUMMARY OUTLINE

The continued improvement in the international ferrous-metallurgical industries, coupled with armament activities by the military powers during 1935, increased the demand for chromite. Although the production of this commodity dropped more than 50 percent from 1929 to the depression low of 1932, the output and sale of chromium ores have increased considerably during the subsequent 2 years, and by 1934 output was second only to the record figure for 1929. World production in 1935 exceeded 1934 and probably was greater than that in 1929, although complete figures are not available. Production in Turkey continued to expand in 1935 and reached a new high of 150,504 metric tons. The U. S. S. R. (Russia) was probably the leading producer; an output of 180,000 tons was planned for 1935. Southern Rhodesia ranked third in 1935 but was closely followed by the Union of South Africa, where output increased 47 percent over 1934.

The mining of chromite in the United States is unimportant in the light of world production or domestic consumption. The domestic output in 1935 was 440 long tons compared with 341 tons in 1934. The United States, however, ranks first in the consumption of chromite, and like most of the other large consuming nations depends on foreign sources. The supply available for consumption was 35 percent above that in 1934. Africa and New Caledonia were the largest sources of American imports for consumption in 1935. The following table compares 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 and 1931–35

	1925–29 average	1931	1932	1933	1934	1935
Production .... long tons..	262	762	200	966	341	440
Consumption:						
Imports .... do....	224, 357	212, 528	89, 143	116, 511	192, 297	259, 063
Domestic shipments .... do....	276	268	155	843	369	515
Apparent available supply .... do....	224, 633	212, 796	89, 298	117, 354	192, 666	259, 578
Prices per ton at New York, approximate average of all grades	$22. 46	$18. 50	$18. 00	$17. 00	$19. 00	$17. 70
Origin of imports:						
Africa, South [1] .... percent of total..	63	36	20	11	25	36
New Caledonia .... do....	6	19	13	13	10	21
Turkey .... do....	---------	1	20	24	15	6
Greece (includes transshipments from Yugoslavia) .... percent of total..	9	14	18	10	12	8
U. S. S. R. (Russia) .... do....	---------	8	5	11	10	1
Cuba .... do....	15	7	---------	20	26	18
Others .... do....	7	15	24	11	2	10
World production .... long tons..	428, 000	407, 000	301, 000	405, 000	609, 000	(2)

[1] Includes Southern Rhodesia and Union of South Africa.
[2] Data not available.

Figure 74 shows the trend of domestic consumption and prices during the past 11 years.

Trade agreement with Sweden.—The import duties on ferrochromium and chromium metal were reduced in 1935 by virtue of the trade

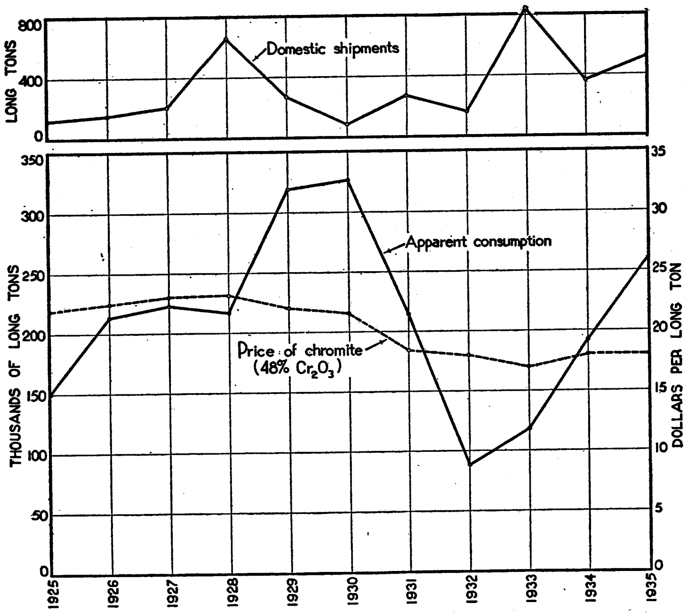

FIGURE 74.—Trends in consumption, price, and domestic shipments of chromite in the United States, 1925–35.

agreement with Sweden. The duty on ferrochromium containing 3 percent or more carbon (high-carbon ferrochromium) was reduced from 2½ cents to 1¼ cents per pound of contained chromium. The rate on ferrochromium containing less than 3 percent carbon (low-carbon ferrochromium) and on chrome metal was reduced from 30 to 25 percent ad valorem. The trade agreement was proclaimed by the

President on July 8, 1935, and became effective August 5. The agreement with Sweden is based upon the principal of unconditional most-favored-nation treatment and upon the consequent assumption that the concessions each country grants to the products of the other, will, as a rule, in the absence of special considerations, be extended to like products of other countries.

DOMESTIC PRODUCTION

In the United States 440 long tons were mined and 515 tons shipped in 1935 compared with 341 tons mined and 369 tons shipped in 1934. All of the output and shipments in 1935 were from California, shipments being reported from Fresno, Napa, Placer, San Luis Obispo, Santa Barbara, Shasta, and Siskiyou Counties.

The following table shows the production and shipments of chromite in the United States from 1931 to 1935.

Crude chromite mined and shipped from mines in the United States (all from California), 1931–35

Year	Ore containing 45 percent or more chromic oxide			Ore containing 35 to 45 percent chromic oxide			Total value
	Mined (long tons)	Shipped (long tons)	Value	Mined (long tons)	Shipped (long tons)	Value	
1931	612	268	$3,509	150			$3,509
1932	200	155	2,160				2,160
1933	879	743	(1)	87	100	(1)	11,585
1934	331	320	(1)	[2] 10	49	(1)	4,653
1935	66	74	(1)	[3] 374	[3] 441	(1)	6,163

[1] Figures included in total value only. Bureau of Mines not at liberty to publish separately.
[2] Produced in Montana.
[3] Includes 52 tons containing less than 35 percent Cr_2O_3.

IMPORTS [1]

Imports of chromite into the United States were 259,063 long tons in 1935 compared with 192,297 tons in 1934, an increase of 35 percent. The chromite imported into the United States in 1935 had a chromic oxide content of 45 percent. Of the larger quantities of imports in 1935 that from French Oceania (New Caledonia) had the highest content of chromic oxide (51 percent), while that from Cuba had the lowest (32 percent).

Although Mozambique is listed by the Bureau of Foreign and Domestic Commerce as the principal source of American imports in 1935, with 28 percent, the ore from this source originates in Southern Rhodesia and the Union of South Africa. New Caledonia was the second largest source, with 21 percent. Imports from both Mozambique and New Caledonia were much larger in 1935 than in 1934. Cuba, which supplies much lower grade ores was third with 18 percent. The following table shows imports of chromite into the United States by countries, from 1931 to 1935.

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

Crude chromite imported into the United States, 1931–35, by countries

Country	1931 (long tons)	1932 (long tons)	1933 (long tons)	1934 (long tons)	1935		
					Long tons		Value
					Gross weight	Chromic oxide content	
Africa, South [1]	75,670	17,702	13,186	48,848	92,682	43,454	$1,501,554
Belgium	482						
Brazil					2	1	26
Canada			49	30	2,888	1,412	62,941
Cuba	14,957		23,772	49,370	47,743	15,504	253,847
Greece	28,893	16,395	11,499	23,301	20,692	9,213	197,430
Guatemala	91		2,061	792			
India (British)	8,664	7,857	4,152	400	14,926	6,852	155,870
Netherlands				259			
Oceania (French)	39,579	11,550	15,150	19,530	55,686	28,313	1,041,957
Other Asia				1,100			
Philippine Islands					787	354	15,047
Turkey in Asia	2,198	17,602	27,854	28,730	16,060	7,580	267,294
U. S. S. R. (Russia)	17,736	4,800	13,261	19,937	3,412	1,627	53,721
United Kingdom	24,258	13,237			4,185	1,967	54,804
Yugoslavia			5,527				
	212,528	89,143	116,511	192,297	259,063	116,277	3,604,491

[1] Includes Southern Rhodesia and Union of South Africa.

The following tables give the imports of chromium alloys and compounds into the United States from 1931 to 1935.

Ferrochrome or ferrochromium and chrome or chromium metal imported for consumption in the United States, 1931–35, in long tons

	1931	1932	1933	1934	1935
Ferrochrome or ferrochromium:					
Containing 3 percent or more carbon (chromium content)					30
Containing less than 3 percent carbon, gross weight	135	159	168	110	
Chrome or chromium metal		20	48	16	49

Chromium compounds imported for consumption in the United States, 1931–35

Year	Chromic acid		Chromate and bichromate of potash		Chromate and bichromate of soda		Chromium chloride and sulphate	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1931	1,525	$427	4,814	$769	63	$16	100	$74
1932	2,020	534	786	172	246	65		
1933	2,040	629	1,892	417				
1934	2,149	1,011	22	5	110	32		
1935	4,281	2,198						

CONSUMPTION

Owing to lack of data concerning consumers' stocks, it is impossible to estimate accurately the actual consumption of chromite in the United States. However, the apparent available supply increased from 192,666 long tons in 1934 to 259,578 tons in 1935 and was greater than in any year since 1930.

The improvement in the consumption of chromite during the last few years reflects the increased activity in the steel industry, the principal consumer. The automobile industry in the United States, one of the principal users of chromium-alloy steels and chromium plating, increased its output 43 percent over 1934, making 3,946,934 cars in 1935. The building-construction industry uses stainless steel for decorative purposes and large quantities of chromium-plated plumbing fixtures. Activity in this field improved considerably over that in 1934.

The following table shows the apparent available supply of chromite in the United States from 1931 to 1935.

Domestic sales, imports, and supply of crude chromite in the United States, 1931–35, in long tons

Year	Sales from domestic mines	Imports (general)	Apparent available supply	Year	Sales from domestic mines	Imports (general)	Apparent available supply
1931	268	212,528	212,796	1934	369	192,297	192,666
1932	155	89,143	89,298	1935	515	259,063	259,578
1933	843	116,511	117,354				

USES

The industrial uses of chromite fall into three groups—metallurgical, refractory, and chemical. With regard to amounts consumed domestically, the metallurgical uses probably rank first, with refractory uses a close second. Chemical uses rank a poor third.

METALLURGICAL

Alloy steels.—The continued increasing application of alloy steels in the automotive and transportation industries advanced the domestic consumption of alloy steels in 1935 over 1934. According to Steel,[2] this advance was 35 percent compared with an increase of 31 percent in the output of all steel ingots.

Chromium in varying quantities, either alone or combined with other alloying elements, enters into the manufacture of a wide variety of alloy steels designed for specific purposes. Perhaps the most widely known are the steels and irons of the chromium and chromium-nickel series, which are extensively used in the automobile, building, dairy, paper, petroleum, and chemical industries, as well as in kitchen equipment for restaurants, hotels, and hospitals. According to Lippert,[3] production of chromium and chromium-nickel alloy-steel ingots and castings in 1935 was 71,198 net tons compared with 46,569 tons in 1934, an increase of 53 percent. These figures do not include steels running lower than 5 percent in nickel or chromium content or alloys containing more than 35 percent chromium or 25 percent nickel. Of the 1935 total, 67,227 tons were ingots and the remainder castings. Of the ingot total of 67,227 tons, 33,114 tons (49 percent) were 18–8 variety. Castings in the 25 chromium-12 nickel group were the most popular with users during 1935. Steels of these two types have many important industrial applications, and a more intelligent understand-

[2] Steel, Emphasis is Shifting in Race for Alloy-Steel Markets: Vol. 98, no. 1, Jan. 6, 1936, p. 209.
[3] Lippert, T. W., Rustless Steels: Iron Age, vol. 137, no. 17, Apr. 23, 1936, p. 24.

ing of their behavior and applications has characterized recent use. Columbium-bearing stainless steels are now used for welded equipment subject to corrosion, without the necessity of annealing after welding. Titanium is also used to minimize grain-boundary corrosion. Solving the problem of welding 18–8 steel was a valuable contribution to the fabrication of this alloy. Stainless steels became more prominent in forgings in 1935. Steel containing 16 percent chromium and 1 to 2 percent nickel is becoming increasingly popular in airplane construction. Steels containing 11 to 12 percent chromium have been adapted to railroad hopper cars and coal-handling equipment. Chrome-molybdenum tool steels that permit machining at quite satisfactory speeds in the heat-treated state have appeared on the market. A new heat-resistant alloy developed in 1935 can be used for resistor elements in heat-treating furnaces at temperatures of 2,300° to 2,400° F. This alloy contains 37.5 percent chromium, 7.5 percent aluminum, and 55 percent iron.

The second edition of The Book of Stainless Steels,[4] edited by Thum, describes the properties, production, fabrication, requirements, and use of such steels.

Ferrochromium, an electric furnace product that usually contains 65 to 72 percent chromium, is the basic alloy used in the manufacture of most chromium-alloy steels. In general, two grades are recognized—high-carbon ferrochromium, containing 4 to 7 percent carbon, and low-carbon ferrochrome, containing 0.06 to 2.0 percent carbon. High-carbon ferrochromium is made with the well-known carbonaceous reducing agents, and its chief use is in alloy steels of the engineering class. Low-carbon ferrochrome is produced by the silicon-reduction process and is required for steels, such as the 18–8 stainless class, where carbon must be kept low. The use of high-nitrogen ferrochromium for reduced grain size was a development of increasing importance. Steels containing over 20 percent chromium, using high-nitrogen ferrochromium in their manufacture, may be forged, rolled, cold-drawn, or welded without losing desirable properties.

Powdered chromium has been used in chromizing steel to impart a corrosion- and heat-resisting surface. Small amounts of chromium added to copper yield useful characteristics. Copper-chromium cylinder heads for internal-combustion engines have been introduced for marine motors. The chromium additions are made in the form of compressed slugs of copper powder and chromium powder. Chromium powder produced by electrolysis contains 99.5 percent plus chromium and a maximum 0.25 percent iron, while that produced by aluminum or silicon reduction contains 98 percent chromium and a maximum of 1 percent iron.

Most of the corrosion- and heat-resisting steels now being manufactured are covered by the Strauss or Haynes patents, which expire during 1936 and 1937. While these are the basic patents, others will exert a definite influence in this field.

Probably the most significant trend in alloy steels in 1935 was the increased application of low-alloy steels with high physical properties and good welding characteristics. The successful economic welding of low-alloy, high-tensile steels was a development of 1935. These steels, which are better adapted to tonnage markets, are becoming more important factors in the alloy-steel business. So far the major

[4] Thum, Ernest F. (editor), The Book of Stainless Steels: 2d ed., Cleveland, Ohio, 1935, 787 pp.

uses for such steels have been found in the railway and transportation industries. Chromium is one of the elements used in low-alloy steels to obtain the desired increase in strength. As in the case of higher-alloy steels, the low-alloy steels continued to grow in favor in forgings, particularly to combat rust.

Chromium plating.—Chromium plating may be divided into two classes—decorative and wear-resisting. The former is encountered more commonly, being used extensively in automobile fittings and hardware, plumbing fixtures, and miscellaneous hardware and cutlery. The bluish white color, hardness, and high resistance to ordinary atmospheric corrosion make chromium plate a desirable finish. The decorative chromium plate is extremely thin (approximately 0.00002–0.00004 inch) and is usually put on a soft steel base, upon which successive layers of copper and nickel have been applied. Black chromium plate having a finish similar to gunmetal can be applied directly to iron or steel or on an intermediate coat of bright chromium plate.

Wear-resisting plate, while not as well known as decorative plate, has many important industrial applications, including use for dies, rolls, and engraving plates. Chromium plating has been used on iron patterns and core boxes for long production. Usually plate of this type is applied to a steel base hard enough to suit the service required. The depth of the plate ranges from 0.0001 inch up to any reasonable amount.[5] A depth of 0.050 inch is not uncommon. Chromium plating for wear resistance has been discussed by McKay.[6]

The mechanism of chromium deposition has been studied by Kasper,[7] who finds that chromium is deposited in the chromic acid bath directly from the sexivalent state. Improvements in the performance of the chromic acid bath are also suggested.

Although chromium plating has become important industrially and has a wide range of applications, the amount of chromite that enters into this outlet is small because of the thinness of the layer of metal deposited.

The metallurgical uses of chromium have been described by Beckett.[8]

REFRACTORIES

The second largest use of chromite in the United States is in the manufacture of refractory materials, such as brick, cement, ground ore, or crude lump ore. The ore used for this purpose is imported largely from Cuba, Greece, and the Union of South Africa.

Chrome refractories are neutral metallurgically and quite resistant to many types of slag. Chrome brick is used most extensively in parts of open-hearth steel furnaces. Improvements in the quality of chrome brick for open-hearth service have resulted in a more satisfactory neutral-basic refractory. In the basic refractory field an unburned chrome brick has been introduced, manufactured by at least two companies.

According to trade journals the price of chrome brick in 1935 was $45 per net ton.

[5] Nemser, D. A., Industrial Chromium Plating: Iron Age, vol. 133, no. 5, Feb. 1, 1934, p. 14.
[6] McKay, N. H., Chromium Plating for Wear Resistance: Bull. Am. Ceram. Soc., vol. 15. no. 3, March 1936, p. 87.
[7] Kasper, Charles, Mechanism of Chromium Deposition from the Chromic Acid Bath: National Bureau of Standards Research Paper 797, June 1935, pp. 693–709.
[8] Beckett, Frederick M., Modern Uses of Nonferrous Metals, Chapter V, Chromium: A. I. M. E. Series, New York, 1935, pp. 65–94.

CHEMICALS

In addition to the chromite used in the manufacture of chromic acid for electroplating, considerable is consumed in the manufacture of chemicals used principally in the dyeing, tanning, and pigment industries. Chromite is also used as a colorant in the ceramic industry.

PRICES

The 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. According to Steel, chromite containing 48 percent chromic oxide was quoted at $18 to $18.50 at the beginning of the year, increased $1 per ton in March, but subsequently eased off slightly, with the figure at $19.25 for the last quarter. Ore with a lower chromic oxide content usually brings a lower price.

WORLD PRODUCTION

Complete data are not yet available on world output in 1935, but increases in exports and preliminary production figures indicate that world production of chromite was at a much higher rate. The U. S. S. R. (Russia) and Turkey were the largest producers in 1935 and together with Southern Rhodesia and Union of South Africa made large increases in output. Production in Southern Rhodesia, however, was still far below capacity. The following table shows the available statistics on world production from 1931 to 1935, inclusive.

Production of crude chromite, 1931–35, by countries, in metric tons

[Compiled by R. B. Miller]

Country [1]	1931	1932	1933	1934	1935
Australia	61	99	905	1,744	605
Brazil [2]					5
Bulgaria				85	(3)
Canada (shipments)		71	27	101	1,038
Cuba [4]	15,197		24,154	50,162	48,509
Cyprus (shipments)	203	1,000		982	1,198
Greece	5,634	1,555	14,784	30,694	[2] 31,984
Guatemala [4]	92		2,094	805	
India (British)	20,233	18,152	15,775	21,922	(3)
Indochina	2,800				(3)
Japan	9,675	12,492	19,897	27,222	(3)
New Caledonia	74,150	69,429	50,072	55,182	(3)
Norway		409	326	42	(3)
Philippine Islands					[2] 1,292
Rumania			29		(3)
Southern Rhodesia	81,623	15,692	35,046	72,099	105,834
Turkey (Asia Minor)	55,216	55,196	75,379	119,844	150,504
Union of South Africa	23,335	19,371	34,078	61,357	90,431
U. S. S. R. (Russia)	[5] 67,000	[5] 68,000	112,728	129,200	(3)
United States (shipments)	272	157	857	375	523
Yugoslavia	58,384	43,925	26,248	47,352	60,000
	414,000	306,000	412,000	619,000	(3)

[1] In addition to the countries listed, Portugal reported a production of 30 kg of chromite in 1931; average content, 38 percent Cr_2O_3.
[2] Exports.
[3] Data not available.
[4] Imports into the United States. The figures for 1934 represent "imports for consumption"; those for prior years "general imports."
[5] Approximate production.

WORLD TRADE

Chromite is an important commodity in world trade. Except for the U. S. S. R. (Russia), the main producing countries consume only small quantities, while the main consuming countries produce only a small fraction of their requirements. World exports in 1935 were over 600,000 metric tons, probably the largest on record, compared with 448,000 tons in 1934 and 287,000 tons in 1933. Turkey was the principal exporting country in 1935, its portion of the total being 25 percent. The Union of South Africa, with a large increase, accounted for 17 percent in 1935. Southern Rhodesia also increased its exports, while shipments out of New Caledonia nearly doubled.

Figures on imports of chromite into the principal consuming countries in 1935 are not yet complete, but data available indicate that the three principal importing countries, in order of their importance, are the United States, Germany, and Sweden.

A brief summary of activities in the principal chromite producing and consuming countries follows.

Canada.—Canadian production of chromite in 1935 was 1,038 metric tons compared with 101 tons in 1934. Output in Quebec amounted to 314 tons and came from the Thetford-Black Lake area of the Eastern Townships. Chromite is now being mined in northwestern Ontario (724 tons in 1935) near Obonga Lake 25 miles south of Collins Station on the Canadian National Railway by the Chromium Mining & Smelting Corporation, which ships to its own smelting plant at Sault Ste. Marie. The plant, which was formerly operated by the Superior Alloys, Ltd., for the production of ferrosilicon in electric furnaces, will now produce both ferrosilicon and ferrochromium. Ore reserves have been estimated at 225,000 tons, averaging 17 percent Cr_2O_3, with possible extension of these reserves in depth. The company is erecting a 100-ton mill at the mine to concentrate the ore to a 45-percent Cr_2O_3 product.

The geology of the area has been described by Kidd.[9]

Cuba.—Chromite deposts occur in a number of places scattered about the island, but are commercially important only in the Province of Camaguey, where two companies, subsidiaries of American manufacturers, are extracting ore in the vicinity of Alta Gracia near the Oriente borderline. As the ore occurs in small pockets it is difficult to estimate reserves, but it is understood that the two companies have at least 2,000,000 metric tons of proven ore. Production in 1935 has been estimated at 94,500 tons. All of the Cuban output moves to the United States; imports into the United States from Cuba in 1935 were 47,743 long tons compared with 49,370 tons in 1934. Cuban ores are low-grade and used principally for refractories.

Cyprus.—Commercial production and exports of chromite from Cyprus are expected to begin in 1936. The Cyprus Chrome Co., Ltd., which has Swedish connections, has obtained a concession near Mount Olympus and plans to construct a Diesel generating station, a concentrating plant, and an aerial tram for hauling the ore to the concentrator. The output in 1935 was 1,179 long tons.

France.—There is no production of chromite in France, and requirements are met by imports—29,809 metric tons in 1935 compared with

[9] Kidd, D. F., Obonga-Kashishibog Area, Thunder Bay District, Ontario: Geol. Survey, Canada Dept. of Mines, Summary Report 1933, Part D, Publication 2351, 1934, pp. 16-37.

27,168 tons in 1934. Exports of ferrochrome from France in 1935 were 1,053 tons while imports were 124 tons.

Germany.—Germany has no chromite deposits, but its industries consume large quantities of ore, which must be supplied by imports. Imports were 95,440 metric tons in 1935 compared with 76,983 tons in 1934, an increase of 24 percent. Eighty-six percent of the German imports in 1935 came from British South Africa and Turkey, each contributing 43 percent to the total.

Greece.—Exports of chromite were 31,984 metric tons in 1935 compared with 22,141 tons in 1934. Nearly half of the 1935 exports were consigned to the United States; the bulk of the remainder went to Great Britain and to the Netherlands. Greek output comes from Thessaly near Pharsala, and the ore (which is low-grade) is used principally in refractories.

Guatemala.—The Vanadium Corporation of America made a small production of chromite in 1935 from the mine near Jalapa, but there were no shipments.

India.—Production figures for 1935 are not available, but waterborne exports declined from 27,744 tons in 1934 to 26,472 tons in 1935. These figures do not include several thousand tons annually of exports through Mormugao. Total exports from India in 1934 were 31,695 tons.

During recent years the output in both Baluchistan and Mysore has dropped sharply, while that in Singhbhum has increased.

New Caledonia.—New Caledonia is one of the important sources of chromite. Although production figures for 1935 are not available, exports were 73,791 metric tons, almost double the 37,226 tons going out in 1934. Of the 1935 shipments, 61,238 tons (83 percent) went to the United States. The largest producers are the Société la Tiebaghi, the Société Chimique du Chrome, and the Talon-Chagrin mine.

Norway.—Figures for imports of chromite into Norway in 1935 are not available, but in 1934 Norway took 37,365 metric tons, more than double the 1933 figure of 18,217 tons. Exports of ferrochrome from Norway in 1935 were 11,859 metric tons compared with 11,887 tons in 1934.

Philippine Islands.—Exports of chromite from the Philippines during 1935 totaled 1,292 metric tons, of which 1,107 tons went to the United States and the rest to Japan. The first commercial shipment of chromite from the Philippines was made in October 1935, when 510 tons were sent to the United States. The ore, which is reported [10] to have contained 53.39 percent Cr_2O_3 and 14.43 percent Fe_2O_3, came from the property of the Florianne Mining Co., 10 kilometers northwest of Lagonoy in Camarines Sur. Reserves have been estimated as in excess of 100,000 tons, but further shipments will be delayed pending completion of a 10-mile aerial tramway for bringing the ore to the coast. Development and production are being carried on by the Benguet Consolidated Mining Co., and negotiations with the Union Carbide Co. for the output of the mine are under way.

The Benguet Co. has also developed a large body (10,000,000 tons) of medium-grade chromite at Masinloc, Province of Zambales, and is making a detailed railroad survey with a view to installing transportation facilities to the coast as soon as possible. The company,

[10] Bureau of Foreign and Domestic Commerce, Foreign Trade Notes, Philippine Islands—First Chrome Shipment: Vol. 4, no. 11, Dec. 5, 1935, p. 21.

however, did not exercise the option granted on chromite claims on the Island of Samar.

Southern Rhodesia.—During the decade 1922 to 1931, inclusive, Southern Rhodesia ranked first in chromite production by a large margin. Subsequently production declined, and in 1932 only 15,692 metric tons were produced. The output in 1935, however, was 105,834 tons, an increase of 47 percent over 1934 and the largest since 1930.

Sweden.—Imports of chromite into Sweden increased from 35,552 metric tons in 1934 to 41,193 tons in 1935.

Turkey.—Production of chromite in Turkey continued to expand in 1935, when 150,504 metric tons were produced compared with 119,844 in 1934, an increase of 26 percent. Virtually all of the Turkish output of chromite is exported, as there is little or no domestic demand. With a view to assisting such exports, the Government on January 1 scheduled a system of premiums on exports, which will be paid out of a fund to which producers contribute by a system of taxation. Premiums will be on a sliding scale depending on an increase in exports.

Union of South Africa.—Production of chromite in the Union of South Africa in 1935 reached a record figure of 90,431 metric tons compared with 61,357 tons in 1934, an increase of 47 percent. Of the 1935 output 89,645 tons were ore and the remaining 786 tons concentrate. The bulk of the output came from Transvaal, only a few hundred tons coming from Natal.

Extensive reserves, which can be mined cheaply, are reported to exist in Transvaal and are being exploited commercially in the Rustenburg and Lydenburg districts. Virtual control of the industry is in the hands of two producers, the African Mining & Trust Co., Ltd., and the Chrome Corporation, Ltd., controlled by the African Chrome Mines, Ltd. A third operator, Buffelsfontein Chrome, Inc., operating in the Rustenburg district, produces much smaller amounts for local consumption only. The African Mining & Trust Co., Ltd., the largest producer, operates in both the Lydenburg and Rustenburg districts and supplies several grades of chromite having the following typical analyses: [11]

Typical analyses of chromite produced by African Mining & Trust Co., percent

	Friable ore			Hard lump ore, grade C
	Grade A	Grade A, washed	Grade B [1]	
Chromic oxide	48.38	49.55	47.60	45.80
Ferrous oxide	24.98	21.75	23.76	28.01
Silica	4.85	1.81	2.08	3.40
Alumina	10.20	13.95	16.54	11.14
Magnesia	11.35	12.65	9.54	11.95
Lime	.09		.46	
Manganese			.02	

[1] Grade B washed-ore analysis approximately same as unwashed Grade B, except that a higher minimum chromic oxide content is specified.

The Chrome Corporation, Ltd., operates in the Lydenburg district and supplies two grades of ore: (1) Friable ore, average assay 44.5 percent Cr_2O_3–3 percent SiO_2 and (2) hard, lumpy ore, average assay 44.5 percent Cr_2O_3–3½ percent SiO_2.

[11] Quarterly Inf. Circ. October-December 1935, Dept. of Mines, Union of South Africa, February 1936, pp. 5–6.

Rail charges per gross ton of chromite from the Lydenburg district to Lorenzo Marques are 13s. 9d.; from Rustenberg they are 16s. Port charges for loading, etc., are 3s. per ton. The open conference rate on chrome ore from Lorenzo Marques to Atlantic ports is 23s. 6d. per ton. Under a policy of gradual elimination, the South African Government subsidy of 7 percent of the value of chromite at the port of shipment was reduced to 5 percent on August 1, 1935. A further reduction to 2½ percent is to take place on August 1, 1936, and the remaining 2½ percent removed a year later.

Virtually all of the South African chromite is exported to foreign markets, where it is used principally for refractories and in the manufacture of bichromate. Exports, which have been increasing, reached a record figure of 100,662 metric tons in 1935—more than double the 46,442 tons exported in 1934. Of the 1935 exports, 49,928 tons went to Germany and 46,313 tons to the United States; these two countries purchased 96 percent of the total. In 1935 a trade agreement [12] was made with Germany which facilitated payment with blocked reichmarks and permitted increased exports to Germany. The agreement has been extended to cover 1936.

U. S. S. R. (Russia).—The U. S. S. R. (Russia) is now one of the two largest producers of chromite, and if the planned output of 180,000 tons for 1935 is realized will be easily the largest producer. The output has been increasing, and in 1934, 129,200 metric tons were produced compared with 112,728 tons in 1933. Production figures for 1935 are not yet available. Exports, however, have declined due to increased domestic demand. In 1935 only 11,480 tons were shipped compared with 36,499 tons in 1934 and 41,037 tons in 1933. The United States and Italy together took 70 percent of the Russian exports in 1935.

Russian reserves are reported to be extensive (15,000,000 tons), but the ores generally are low-grade, and only the higher grades are exported, although some 40-percent ores have been shipped. The region around Khalilovo in Bashkir has recently been the leading Russian source of higher-grade chromite. Khalilovo is about 900 kilometers from the Black Sea port of Novorossisk, the principal port of export of Russian chromite.

United Kingdom.—The United Kingdom consumes considerable chromite. Data on imports for 1935 are not available, but 37,129 metric tons were imported in 1934.

Yugoslavia.—The production of chromite in 1935 was 60,000 [13] metric tons compared with 47,352 tons in 1934.

The bulk of the Yugoslav chromite output comes from the region around Skoplje, where the Allatini Mines, Ltd., is operating. During 1934 this company produced 11,488 tons of shipping ore and 22,416 tons of wash ore. Exports of Yugoslavia in 1934 were 27,634 tons.

Exploitation of chromite deposits at Tschatschak, in western Yugoslavia, has been resumed after they had been idle since 1901 due to high transportation costs. The opening of a railway line to the Adriatic and building of new roads have lowered transportation costs materially. The ore is said [14] to run 45 to 50 percent Cr_2O_3, up to 19 percent Fe_2O_3, and 6 percent silicon.

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[12] Bureau of Foreign and Domestic Commerce, Foreign Metals and Minerals Circ. 2. South Africa. Chrome: Mar. 14, 1936, pp. 16–17.

[13] Die chemische Industrie, Jugoslawien: Jahrg. 59, no. 15, Apr. 11, 1936, p. 307.

[14] Iron and Coal Trades Review, Chromite in Yugoslavia: Vol. 131, no. 3520, Aug. 16, 1935, p. 268.

ANTIMONY

By F. M. Shore and H. M. Meyer

SUMMARY OUTLINE

The antimony trade of 1935 shared in the substantial progress toward recovery made by industry. Both domestic and foreign consumption increased materially, and prices improved in even larger degree. A leading factor in the antimony trade in 1935 was the increase in the demand from Europe, doubtless due largely to expansion in munitions manufacture. The domestic market responded to the general improvement in industrial production, particularly to the large increase in the production of automobiles. Of the supplies of antimony available for domestic consumption, secondary sources accounted for a larger proportion than in 1934, and there was a notable increase in the contributions from Mexico and South American countries at the expense of China.

The largest quantities of antimony are used for storage-battery plates, babbitt and other bearing metals, solder, type metal, cable sheathings, rubber goods, pigments for paints and enamels, and fixtures. The normal market for antimony therefore is governed by the rate of industrial activity, particularly in those industries whose products consume the largest amounts of antimony. Storage batteries and bearing metals are among the products that normally take a large percentage of the domestic consumption. The notable continuation in 1935 of the increased activity in the automobile industry that characterized 1934 carried with it a substantial increase in the demand for antimony. The 1935 production of automobiles, the largest users of storage batteries, was approximately 43 percent higher than in the previous year. The estimated production of babbitt metal increased about 7 percent, and the lead used in storage batteries is estimated to have increased in about the same proportion. The larger part of the antimony required in the manufacture of battery grids, type metal, bearing or antifriction metal, and cable sheathings is recoverable and constitutes a revolving source of supply which is a major component of the annual domestic consumption of this metal; however, the country depends almost wholly upon foreign sources for its primary supplies. Wars or threats of wars invariably increase the consumption of antimony, due to the use of this metal in the manufacture of shrapnel and small-arms munitions.

Supplies of primary antimony from domestic sources decreased materially in 1935, while supplies from foreign sources increased decisively. Due to the larger production of secondary antimony, the total amount available for consumption from domestic sources increased substantially in 1935, although far less than did total supplies from foreign sources.

Data on world production of antimony for 1935 were not available when this discussion was prepared, but returns from sources that accounted for approximately 94 percent of the output in 1934 indicate a very substantial increase in the 1935 production.

The major trends in the domestic trade during the past 5 years will be evident from the figures in the following table of salient statistics for antimony.

Salient statistics for antimony in the United States, 1931–35

	1931	1932	1933	1934	1935
Average price for year of antimony at New York [1] cents per pound	6.72	5.62	6.51	8.92	[2] 14.08
Imports for consumption:					
Antimony in ore short tons	4,863	1,328	2,128	2,891	4,587
Liquated antimony sulphide do	650	435	707	417	1,352
Metal do	3,753	1,508	1,934	1,765	1,247
Oxide do	746	403	651	269	594
Exports of foreign antimony do	697	123	98	402	318
Stocks of antimony in bonded warehouse at end of year do	702	705	523	570	830
Production of antimony ore and concentrates do		900	1,133	897	111
Antimony contained do		419	587	404	44
Antimony contained in antimonial lead produced from domestic and foreign ores short tons	964	1,085	927	1,675	1,136
Recovery of secondary antimony do	7,900	6,450	7,400	7,550	9,600

[1] According to the American Metal Market.
[2] Chinese grade. American grade was quoted at 13.62 cents a pound.

Prices.—Due to the increase in world demand and to continuation of the Government-sponsored control of the Chinese antimony trade, the price of antimony was uniformly higher throughout 1935 than during the previous year. The average price of standard brands of metal in the New York market was 13.616 cents per pound in 1935, an increase of 53 percent over the average price for the previous year and the largest yearly average since 1926. The trend of the price of metal during the year is indicated by the monthly averages which began with 14.111 cents for January (compared with 13.73 cents in the preceding month), rose to 14.25 cents in February, and began a decline with the April average of 14.029 cents that culminated in the June average of 12.5 cents. The same average was maintained in July and August. The rise of prices in September is represented by the month's average of 13.177 cents, which rose to 15.322 cents in October when the year's peak was reached. Prices declined during November and December, as indicated by the respective monthly averages of 14.217 cents and 13.82 cents, the latter representing a fractional increase over the price for December 1934.

The increased market demand that began in May and June culminated in October when the New York spot price for metal advanced to the peak of 16.75 cents per pound and domestic supplier's stocks receded to an exceptionally low level.

The American production of metal assumed increasing importance during the year, and its quoted prices were frequently below those for the Chinese grades. The announced policy of the producers to quote forward delivery under immediate shipment prices should tend to exert a stabilizing influence on the market.

The increased demand for antimony supplies was reflected in increased quotations for the various grades marketed. The price of needle antimony (powdered) opened the year at the level of 7¾ to 8¼ cents per pound, slightly above the figures at the beginning of 1934, according to quotations published by the Oil, Paint and Drug Reporter. Prices remained at this level until early in April, when they advanced to the range of 10½ to 11 cents per pound. At the end of April the price advanced to 11 to 13½ cents per pound, where it remained until early July. Early July witnessed a reduction to 10½ to 12½ cents. In October the price was advanced to 12½ to 13 cents per pound, where it remained for the balance of the year. The ranges of prices indicated apparently reflects purchases prompted by political and social conditions in continental Europe. Needle antimony is used largely in the manufacture of detonators for high explosives.

Oxides in car lots opened the year at 10¼ cents per pound, reached 11¼ cents per pound on April 1, ranged from 11¼ to 12¼ cents on September 2, and attained a price of 14 cents on October 28. It then advanced to 15 cents a pound on December 9, remaining there for the balance of the year.

The London and New York prices of antimony metal followed, in general, the same trends during the year. According to the Metal Bulletin (London) the London price for foreign metal opened the year at £65 ($318.01) per long ton, reached the peak of £75 to £76 ($368.09 to $373) per ton in the middle of October, and ended the year at £65 to £66 ($320.37 to $325.30).

Prices of crude antimony reacted to the same conditions that influenced the prices of antimony metal or regulus and, in particular, to the notable rise in October. The price of crude, c. i. f. London, opened the year at £32½ ($159), trended generally downward from February to mid-September, and rose to the peak of £41 to £42 ($201.22 to $206.13) in October. At the end of the year the price had receded to about £32 10s. ($160.19).

New York prices for recent years are shown in the following table.

Prices of antimony (Chinese brands) per 100 pounds at New York City, 1931–35 [1]

Year	High	Low	Average	Year	High	Low	Average
1931	$7.625	$6.050	$6.720	1934	$13.750	$7.150	$8.901
1932	7.000	5.000	5.592	1935	16.750	12.500	13.616
1933	7.750	5.400	6.528				

[1] Compiled from Engineering and Mining Journal.

Stocks.—Stocks of needle or liquated antimony and regulus in bonded warehouses were 1,660,932 pounds at the end of December 1935, or approximately 46 percent above the stocks at the end of 1934.

DOMESTIC CONSUMPTION

Definite data on domestic consumption of antimony are not available, but the quantity used is indicated approximately by the total supplies made available to consumers annually, subject to possible modifications by changes in industrial stocks and in the use of substitutes. The quantities made available from both foreign and domestic sources for domestic consumption in 1935 increased materially over the previous year. The largest contribution to the increase in domestic supplies came from foreign sources, although secondary supplies from domestic sources also increased substantially over the previous year.

Higher prices for metal stimulated interest in other grades, and in the supplies from foreign sources notable increases occurred in the receipts of "crude" or liquidated antimony sulphide and in oxides and other compounds. The decline in the relative importance of Chinese supplies in the domestic trade and the increased reliance on supplies from Mexico and other American countries are noteworthy features of the foreign supply made available for consumption in 1935.

DOMESTIC PRODUCTION

Antimony ores and concentrates produced in the United States have never in times of peace constituted an important item in the domestic supply. The quantity produced in 1935—most of which came from the operations of the Yellow Pine Co., in Valley County, Idaho—was the smallest output since antimony-ore production in the United States was resumed in 1932. Some ore was also produced in Nye County, Nev. Alaska reported no production of antimony in 1935.

The Bureau of Mines is not at liberty to publish figures showing the domestic production of antimony metal in 1935. The principal producer in the United States is the Texas Smelting & Refining Co., which operates a smelter at Laredo, Tex. The president of the company has stated that the plant operated at a higher average level in 1935 than during any previous year and smelted ores from Mexico, Idaho, and Bolivia.

Primary antimony in byproduct antimonial lead produced in the United States in 1935 was about 32 percent below the output in 1934.

Detailed figures of domestic production of antimony supplies are shown in the following tables.

Mine production of antimony ores and concentrates in the United States, 1931–35, in short tons [1]

Year	Ore and concentrates	Antimony content	Year	Ore and concentrates	Antimony content
1932	900	419	1934	897	404
1933	1,133	587	1935	111	44

[1] No production reported for 1931.

Byproduct antimonial lead produced in the United States from both foreign and domestic ores, 1931–35

Year	Short tons	Antimony content		Year	Short tons	Antimony content	
		Short tons	Value [1]			Short tons	Value [1]
1931	(2)	964	$129,600	1934	(2)	1,675	$299,000
1932	(2)	1,085	122,000	1935	(2)	1,136	320,000
1933	(2)	927	121,000				

[1] Calculated at average yearly price for ordinary brands of antimony as given by American Metal Market.
[2] Figures not available. Total byproduct antimonial lead produced at primary plants from primary and secondary sources in 1931 was 21,842 tons; in 1932, 21,024 tons; in 1933, 17,805 tons; in 1934, 16,607 tons; and in 1935, 16,384 tons.

Secondary antimony and antimony content of secondary alloys recovered from old alloys, scrap, and dross in the United States, 1931–35

Year	Short tons	Value [1]	Year	Short tons	Value [1]
1931	7,900	$1,061,800	1934	7,550	$1,346,900
1932	6,450	725,000	1935	9,600	2,703,400
1933	7,400	963,500			

[1] Values calculated at average yearly price for ordinary brands of antimony as published by the American Metal Market.

IMPORTS AND EXPORTS [1]

The following tables show imports and exports of antimony and antimony products.

Antimony imported for consumption in the United States, 1931–35

Year	Antimony ore			Liquated antimony sulphide		Antimony metal		Antimony oxides and other compounds	
	Short tons	Antimony content		Short tons	Value	Short tons	Value	Short tons	Value
		Short tons	Value						
1931	14,015	4,863	$259,952	650	$30,481	3,753	$357,907	833	$111,500
1932	3,679	1,328	74,397	435	14,452	1,508	108,241	471	42,014
1933	5,445	2,128	106,662	707	42,727	1,934	137,541	704	59,559
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	1,247	250,771	628	94,783

Antimony imported for consumption in the United States, 1934–35

Country	Antimony ore			Antimony metal	
	Gross weight (short tons)	Antimony content		Short tons	Value
		Short tons	Value		
1934					
Argentina	308	173	$12,726		
Belgium				2	$174
Bolivia	235	163	12,349		
Chile [a]	65	39	2,044		
China	17	12	1,130	1,594	135,273
Germany				1	121
Italy	110	44	4,105		
Mexico	7,720	2,460	126,318	122	14,256
United Kingdom				46	8,590
	8,455	2,891	158,672	1,765	158,414
1935					
Argentina	414	253	31,333		
Belgium				1	295
Bolivia	540	350	40,388		
Chile [a]	359	227	27,303		
China				723	117,123
Honduras	12	5	707		
Hong Kong	28	20	1,450		
Mexico	12,483	3,493	402,225	506	127,689
Panama	93	65	12,507		
Peru	276	174	28,695		
United Kingdom				17	5,664
	14,205	4,587	544,608	1,247	250,771

[a] Imports credited to Chile originated mainly in Bolivia.

[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.

Type metal imported for consumption in the United States, 1931–35 [1]

Year	Type metal and antimonial lead		Assumed antimony content		Year	Type metal and antimonial lead		Assumed antimony content	
	Short tons	Value	Short tons	Percent		Short tons	Value	Short tons	Percent
1932	6	$479	1	16.7	1934	[2] 112	$6,784	18	16.1
1933	[3] 371	29,958	301	81.1	1935	[2] 534	36,453	89	16.7

[1] No imports reported for 1931.
[2] In addition, 661 tons of high-antimony-bearing antimony-lead ingots containing 93 tons of lead (568 tons of assumed antimony) were imported in 1934 and 140 tons containing 20 tons of lead (120 tons of assumed antimony) in 1935. These quantities are included by the Bureau of Foreign and Domestic Commerce under "babbitt metal, solder, white metal, and other combinations containing lead."
[3] Of the 1933 imports, 346 tons, containing 49 tons of lead (297 tons of assumed antimony), were high-antimony-bearing antimony-lead ingots.

Foreign antimony (matte, regulus, or metal) exported from the United States, 1931–35

Year	Short tons	Value	Year	Short tons	Value
1931	697	$74,668	1934	402	$42,415
1932	123	11,820	1935	318	62,167
1933	98	9,321			

WORLD SOURCES AND PRODUCTION

Although antimony ores are found in many parts of the world, in numerous instances the deposits are so limited in extent or accessibility or the difficulties of recovery or quality of the ore are such that these sources cannot compete successfully in the world market except in periods of large demand or of interruption to normal output or distribution. The volume of world reserves has not been determined with accuracy, but enough information is available to give assurance that supplies are adequate for a great many years at the rate of use prevalent in the past.

As antimony is a factor in the metal markets of the leading industrial countries its price in each country is related closely to world demand. The relation between world demand, as indicated by world production, and the price of metallic antimony in New York, is shown for 1912–35 in figure 75. The production curve represents the estimated recoverable content of antimony ore, exclusive of antimonial lead ores, while the price curve shows the annual average price per pound, duty paid.

Antimony is produced regularly by about a dozen countries. In most of them the output is relatively small and has but little influence upon the world market. When stimulated by high prices, however, these countries enter the market to a greater extent and not only add to total production but tend to restore world prices to normal levels. The higher prices of 1935 brought out larger supplies from the small producing countries, and the largest source of antimony, China, also increased its output materially but apparently suffered a substantial decline in its share of the world total.

Complete information as to world production is not available as this is written, but returns already received from countries which produced 94 percent of the output in 1934 indicate a very material increase in the 1935 output. As has been the case for many years past, China was the largest producer in 1935, with an output about 14 percent above that of the previous year. Mexico and Bolivia, with smaller quantities but much greater relative increases, were also substantial contributors to the 1935 production.

China.—As China is the leading source of the world's antimony supplies, it is of interest to note some of the leading developments of the Chinese antimony trade in 1935. Exports of all grades of antimony from China increased about 16 percent over 1934. Stocks were exceptionally large during the first half of the year, reaching the peak of slightly more than 9,000 long tons at the end of April. By the end of the year they had receded to 3,645 tons.

The principal destinations of Chinese exports were, in order, Great Britain, United States, Japan, and Germany, the same relative rank

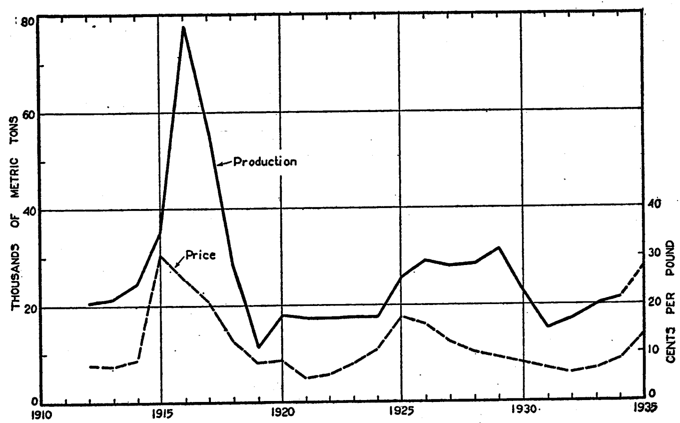

FIGURE 75.—World production of antimony (approximate recoverable metal content of antimony ore produced) and average price per pound in New York, 1912–35. Data on world production in 1935, as shown by the dotted line, are subject to revision.

as in 1934. Shipments to those countries increased materially over the previous year, but the outstanding increases were shown for countries receiving smaller tonnages, those to Belgium increasing 40 percent and shipments to Italy increasing nearly fivefold. Doubtless stimulated by the high price of regulus as well as by munitions demand, exports of crude were nearly double those of the previous year. Of the total exports, about 76 percent was regulus, 18 percent crude, and 6 percent "refuse and oxide."[2] Exports by grades for 1934 and 1935 are shown in metric tons in the following table.

	1934	*1935*	*Change from 1934, percent*
Crude	1, 805	3, 430	90. 0
Refuse and oxide	930	1, 176	26. 5
Regulus	13, 450	14, 186	5. 5

In Hunan Province, which supplies about 95 percent of the antimony produced in China, the Hunan Antimony Syndicate sponsored by the provincial government continued the dominant factor in the antimony trade for the greater part of the year. Control of production and shipments apparently proved difficult, however, and efforts to this end eventually were abandoned. During the last quarter of

[2] Statistical Department of the Inspectorate General of Customs, Monthly Returns of the Foreign Trade of China, December 1935, the Maritime Customs, China. I: Stat. Ser. 8, Shanghai, 1936, pp. 214–215.

the year the syndicate acted mainly to declare prices set by the dealers and to collect taxes. The Hunan Antimony Syndicate was abolished December 13, 1935. On January 1, 1936, the National Antimony Administration was established, with head offices to be located in Shanghai. The announced policy of the administration is to regulate production, "reform" the Hunan antimony industry, and collect taxes.[3]

World production of antimony, 1931–35, in metric tons [1]

[Compiled by R. B. Miller]

Country	1931	1932	1933	1934	1935
North America:					
Canada	6	-	-	-	-
Mexico	2,230	[2] 1,388	[2] 1,559	2,134	3,656
United States	-	304	426	293	32
South America:					
Bolivia [3]	1,078	1,176	1,517	961	2,674
Peru	[3] 24	[3] 14	32	134	343
Europe:					
Czechoslovakia	513	480	1,090	928	(4)
France	660	510	312	202	(4)
Greece	217	262	110	73	(4)
Italy	269	302	291	249	371
Yugoslavia	286	-	-	-	(4)
Asia:					
China [5]	10,104	12,468	13,800	15,548	17,700
Chosen	-	3	8	-	(4)
Japan	1	16	32	26	(4)
Turkey (Asia Minor)	34	-	36	53	(4)
Africa:					
Algeria	6	214	80	529	810
Morocco, Spanish	80	121	120	247	-
Morocco, French	-	-	-	-	110
Oceania:					
Australia:					
New South Wales	38	61	42	10	24
Queensland	-	-	(6)	-	(4)
	15,600	17,300	19,500	21,400	(4)

1 Approximate recoverable metal content of ore produced (80 percent of reported content), exclusive of antimonial lead ores.
2 Includes antimony content of antimonial lead.
3 Exports.
4 Data not available.
5 Figures represent antimony content of regulus, crude antimony, and oxide exported.
6 Less than 1 ton (434 kilos).

3 Current developments in the antimony trade of China are reported by American consular officers and published in Mineral Trade Notes, issued monthly by the Bureau of Mines. The publication of this report began in July 1935. Prior to July 1935, information from consular sources regarding the Chinese antimony trade was published by the Bureau of Foreign and Domestic Commerce.

ARSENIC

By A. P. van Siclen and C. N. Gerry [1]

SUMMARY OUTLINE

The arsenic industry was well-maintained during 1935, although domestic sales were somewhat lower than in 1934. Sales of crude arsenic declined slightly more than those of refined arsenic but far exceeded those of any year prior to 1934. However, it is becoming increasingly difficult to segregate crude and refined arsenic for statistical purposes. Considerable domestic arsenic classed as crude material carries 98 percent As_2O_3 and consequently compares favorably with some of the refined arsenic imported from certain foreign countries. Imports of arsenic exceeded the high record of 1934 by nearly 1,000 tons. Prices, after shading off late in 1934, remained unchanged throughout 1935.

Salient statistics for arsenic in the United States, 1925–29, 1932–35

	1925–29 (average)	1932	1933	1934	1935
WHITE ARSENIC					
Domestic sales: [1]					
Crude short tons	2,364	1,975	3,029	9,030	6,985
Refined do	10,035	10,508	8,768	6,593	5,685
Imports for consumption do	10,769	6,882	10,583	14,110	15,075
Apparent supply [1] do	23,168	19,365	22,380	29,733	27,745
Average value for domestic sales: [1]					
Crude cents per pound	2.69	2.28	2.42	2.36	1.47
Refined do	3.57	2.67	2.79	2.82	2.57
OTHER ARSENICALS					
Imports for consumption:					
Metallic arsenic pounds	208,672	45,474	100,258	61,918	64,376
Sulphide (orpiment and realgar) do	575,506	502,531	674,002	628,326	710,967
Arsenic acid (H_3AsO_4) do	14,692	1,703	150	100	150
Calcium arsenate do	1,452	4,500	11,023	24,000	182,900
Lead arsenate do	[2] 2,133		1,000		
Sheep dip do	135,929	62,509	106,751	237,037	163,660
Paris green and london purple do	4,402	2,364	46,051	8,899	38,085
Sodium arsenate do	82,105	5,763	4,974	8,244	11,411
Exports:					
Calcium arsenate do	[3] 2,159,168	2,533,599	2,585,824	3,356,342	4,104,810
Lead arsenate do	[3] 1,328,828	1,189,629	598,699	650,256	1,156,922

[1] Includes sales by domestic producers for export.
[2] 10,467 pounds in 1925 and 200 pounds in 1929; no imports from 1926 to 1928, inclusive.
[3] 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 compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Domestic production and sales.—In 1935 the four domestic producers of arsenious oxide (white arsenic)—the Anaconda Copper Mining Co., the U. S. Smelting, Refining & Mining Co., the American Smelting & Refining Co., and the Jardine Mining Co.—increased their output to 14,237 short tons compared with 13,096 short tons in 1934. Although in recent years the trend in production and sales of white arsenic has been away from refined arsenic and toward the crude product, production of refined arsenic rose to 6,654 short tons in 1935, approaching that of crude, which declined somewhat to 7,583 short tons. Domestic producers classified their output as refined white arsenic, crude white arsenic, refinery crude, flue dust, wood-preserver paste, and weed killer.

Of the total sales of white arsenic (12,670 short tons), 55 percent (6,985 short tons) was sold as crude for $204,681 and the remainder (5,685 short tons) as refined white arsenic for $292,777.

Prices.—Trade-journal quotations for domestic white arsenic were unchanged throughout the year at 3½ cents per pound for carload lots and 4½ cents for less than carload lots in kegs; these prices became effective in October 1934. Japanese arsenic in cases was quoted at 3½ to 4½ cents per pound until September, when the price was modified slightly to 3¾ to 4½ cents.

According to figures furnished the Bureau of Mines by domestic producers, average receipts from the sale of crude arsenic were only 1.47 cents per pound and from the sale of refined white arsenic, 2.57 cents per pound. To these amounts must be added charges for freight and packing.

Arsenic quotations on the London market registered further declines in 1935. Early in January Cornish white was quoted at £15 to £15 10s. per long ton, or 3.27 to 3.38 cents a pound at the current rate of exchange, and Mexican arsenic was quoted at £16. Early in March the quotation for Cornish white eased to £15, but it rose shortly thereafter to £15 10s., where it remained. Declines in quotations for Mexican arsenic to £15 late in January and £14 10s. to £15 in March restored the former price relation of the Cornish and Mexican products. The latter, however, continued to drop gradually during the spring and summer until it became stabilized at £13 5s. to £13 15s. Continental arsenic was quoted at £14 5s. early in January, and from March to June quotations were about the same as those for the Mexican product. In July the quotation was £14; it declined slightly to £13 15s. late in August and continued at that figure for the balance of the year.

Quotations for arsenic compounds changed little from the levels reached late in 1934. Imported red arsenic was quoted at 15¾ to 16½ cents per pound until early December, when the upper limit was modified to 16¼ cents.

In 1935, as in 1934, prices for calcium arsenate quoted in the Oil, Paint and Drug Reporter were segregated according to purchasers, that is, jobbers, dealers, and consumers east of the Rockies and in the southern cotton States. East of the Rockies the price was 6 to 6½ cents (6⅜ cents in November) to jobbers, 6¼ to 7½ cents (8¾ cents in November for lots of 100 pounds and less) to dealers, and 6⅜ to 8 cents to consumers. In the southern cotton States declines in price became effective in March, as follows: Jobbers, from 6 to 6½ to 6¼ cents; dealers, 6½ to 7 cents to 6 to 6¾ cents; consumers, 6¾ to 7½ to 6½ to 7¼ cents.

East of the Rockies lead arsenate was quoted at 9 to 9½ cents to jobbers, 9¼ to 10½ cents to dealers, and 9⅝ to 11 cents to consumers. In November the upper price to jobbers declined ⅛ cent and that to dealers rose to 11¾ cents for lots of 100 pounds or less. West of the Rockies the quotation for lead arsenate to jobbers remained at 9 cents per pound throughout the year. Prices to dealers and consumers were 10 and 11 cents, respectively, until early in November, when ¼-cent declines became effective.

In April 1935 the quotation for sodium arsenate was spread from the 1934 figure of 10½ cents to 9½ cents to 11½ cents per pound. The price range of sodium arsenite (liquid) remained at 40 to 75 cents throughout the year.

Uses.—During 1935 domestic sales of white arsenic were distributed approximately as follows: Insecticides, 70 percent; weed killer, 16 percent; glass industry, 6 percent; wood preservative, 2 percent; and exports, 6 percent.

Investigations of arsenical sprays and their removal continue, and during 1935 results of studies by State agencies in Illinois, Indiana, Iowa, Ohio, Oregon, and Virginia were made public. Straight calcium arsenate continues as the standard insecticide for the cotton boll weevil. Federal and State entomologists have found no insecticide better for boll-weevil control than this dust applied at the rate of 5 or 6 pounds to the acre. Tests in the Atlantic coastal region, however, show that a mixture of half calcium arsenate and half lime also gives effective results. During 1935 boll-weevil infestations were unusually spotty, being reported from Texas to North Carolina.

Studies by the Bureau of Entomology and Plant Quarantine of the Department of Agriculture have been described in a recent report.[2]

Large quantities of calcium arsenate are used in Peru as an insecticide. In 1924 an American company, later purchased by Peruvian interests, initiated the practice of dusting cotton fields from airplanes. This company, which has dusted about 30,000 acres annually, uses 110 to 125 short tons of calcium arsenate each year, or about 15 percent of the total consumption of the country.[3]

Spraying sugarcane with a solution containing 0.5 percent Na_3AsO_3 and 5 percent molasses was 100 percent effective in killing locusts at Amatikulu, South Africa, but caused the plants to wither. A preparation containing calcium arsenate, CaO, molasses, and citronella oil was very toxic and did not injure the cane.[4]

United States Patent 1988175, dated January 15, 1935 (David R. Merrill to the Union Oil Co. of California), describes a preparation to prevent termite infestation—an emulsion containing asphalt, water, a substantially water-insoluble toxic compound such as As_2O_3, and an emulsifier such as clay.

Sodium arsenite is useful as a poison bait for insects and as a weed killer. The function of sodium arsenite as a weed killer has been described by Long.[5]

2 Young, M. T., Boll-Weevil Control with Calcium Arsenate on Field Plots in Madison Parish, La., from 1924 to 1934: Dept. of Agriculture Tech. Bull. 487, 1935, 24 pp.
3 Chemical Age (London), vol. 32, no. 828, May 11, 1935, p. 423.
4 Bechard, R. M.: Reducing Locusts and Their Control at Amatikulu, Proc. Ann. Cong. So. Africa Sugar Tech. Assoc., 1934, pp. 42-46.
5 Long, H. C., Suppression of Weeds by Fertilizers and Chemicals: The Birknis, Orchard Road, Hook, Surbiton, Surrey, England, 1935, 60 pp.

That arsenic may gain in importance as a wood preservative is indicated by the appearance of an arsenic-copper combination developed recently in British India and patented in other countries. The product, known as Ascu, is said to be suitable for injection into wood in steel-pressure cylinders (as it does not corrode steel, iron, or brass) and to be as effective as creosote in its wood-preserving properties.[6]

Imports.—White arsenic imported for consumption in 1935 reached a new high, 15,075 short tons valued at $737,369; the previous record, made in 1934, was 14,110 short tons valued at $707,709. Mexico supplied more than 60 percent of domestic imports, and France, Canada, and Japan contributed substantial quantities. Imports from Sweden were important for the first time, amounting to 1,125 tons valued at $30,524.

Imports of arsenical compounds other than white arsenic are shown in the table of salient statistics. Imports of calcium arsenate rose sharply to an all-time high of 182,900 pounds. Substantial quantities of sheep dip were also imported.

Figures covering total imports of arsenic copper are not available, but shipments from Germany entering through the New York customs district in 1935 were 17,640 pounds valued at $4,458.

White arsenic imported into the United States, 1931–35, by countries

Country	1931		1932		1933		1934		1935	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Australia			6	$380	452	$23,001	39	$1,494	56	$2,334
Belgium	321	$23,203	278	18,698	239	13,760	11	705	129	4,450
Canada	1,532	114,324	841	60,462	457	31,404	672	44,710	1,068	65,540
France	17	1,079	537	16,194	3,810	113,606	3,338	94,859	2,354	65,609
Germany	66	4,626	252	15,927	219	12,482	35	3,845	10	906
Japan	1,546	66,324	1,643	63,659	1,337	60,397	1,311	61,126	1,059	42,866
Mexico	4,298	241,053	3,325	182,671	4,041	256,611	8,704	500,970	9,274	525,140
Netherlands	11	859								
Sweden					28	1,281			1,125	30,524
	7,791	451,468	6,882	357,991	10,583	512,542	14,110	707,709	15,075	737,369

Exports.—Official statistics are not available on exports of white arsenic, but reports of individual domestic producers indicate that less than 800 tons of arsenic were sold for export compared with 2,700 tons in 1934 and a normal quantity of about 2,000 tons.

THE INDUSTRY IN FOREIGN COUNTRIES

In Canada the production of white aresenic rose to 1,279 short tons valued at $75,326, an increase of 55 percent over the output in 1934 but somewhat below the general average of the last 20 years. Cobalt-silver-arsenic ores treated by the Deloro Smelting & Refining Co., Ltd., Deloro, Ontario, provide almost all the arsenic of domestic origin in Canada, but arsenical gold concentrates in Nova Scotia and

[6] Natarajan, K. R., Copper-Arsenic Wood Preservative Is Perfected: Ind. and Eng. Chem. (News Ed.) vol. 13, no. 6, Mar. 20, 1935, p. 114.

byproduct arsenic from the O'Brien gold mine in northwestern Quebec, recently made available, add to potential supplies in the Dominion.

The Mexican output of white arsenic, after reaching a high of nearly 13,000 metric tons in 1928, declined to less than 4,000 tons in 1932. Subsequently, production has increased, and in 1935 it rose to 9,950 tons.

German exports of arsenic were roughly twice as large in 1935 as in 1934. Gains in export trade are attributed to increased shipments to British South Africa and Brazil. Arsenic is produced in Germany mainly by the Arsenic Mining & Smelting Works "Reicher Trost" in Reichenstein, Silesia, which produces chiefly white arsenic and controls a chemical plant for producing insecticide.[7]

In Sweden the disposal of enormous stocks of arsenic, said to amount to 200,000 metric tons, is still a major problem. Annual production is probably 40,000 to 50,000 tons. An experimental laboratory has been established in Stockholm to work out new uses for arsenic in the control of plant diseases and in the impregnation of timber and concrete, and a larger refining plant has been built. Various concrete mixtures appear to offer the most promising means for disposing of large quantities of arsenic. The Boliden Mining Co. has developed an "arsenic concrete" which is said to be especially suitable for protecting piles and other wooden structures exposed to the action of sea water.

In a canal inside the Sote Fiord, Sweden, opened for traffic in July 1935, piles and other timbers are used that have been sprayed with this "arsenic concrete." The arsenic, cement, and sand were mixed in the proportion of 1:3:12. The admixture of arsenic helps the cement to adhere to the wood and makes the mixture sufficiently elastic to prevent the cement coating from spalling off.

The Boliden Mining Co. has also patented a new type of hydraulic cement with aluminum arsenate as the principal constituent; lime or lime-bearing substances and silica are also present. By hydration of the cement, the aluminum arsenate reacts with the lime, forming insoluble calcium arsenate which improves the resistance to disintegration of the hardened concrete. The aluminum arsenate also can be added to portland cement or fused aluminate cement; it is produced by oxidation of arsenic trioxide mixed with bauxite or other material containing aluminum. Another patent, taken out by T. R. Haglund, describes the preparation of an arsenic concrete by mixing 50 parts each of portland cement, arsenic trioxide, fine-ground basic slag, and ordinary clay. After a short interval 100 parts of water and 200 parts of sand are added, and mixing is continued for 20 minutes. The material is molded and hardened under steam pressure, thereby attaining high mechanical strength and resistance to water. It is said to be particularly suitable for railway ties, wood-pole covers, sewage pipings, etc.[8]

[7] Bureau of Foreign and Domestic Commerce, Record German Arsenious Acid Exports: World Trade Notes on Chemicals and Allied Products, vol. 10, no. 9, Feb. 29, 1936, pp. 5-6.
[8] Robak, C. A., Arsenic Trioxide Used for Cement Production: Ind. and Eng. Chem. (News Ed.) vol. 14, no. 8, Apr. 20, 1936, p. 151.

World production of arsenic ore and white arsenic, 1930–35, in metric tons

[Compiled by R. B. Miller]

Country and product	1930	1931	1932	1933	1934	1935
Algeria:						
Arsenate of lead:						
Gross weight	1,175	--------	--------	--------	--------	--------
Arsenic content	353	--------	--------	--------	--------	--------
Australia:						
New South Wales:						
Ore and concentrates [1]	6,809	3,977	(2)	2,685	4,185	(2)
White arsenic	809	672	495	452	632	(2)
Western Australia: White arsenic	--------	416	1,501	1,352	1,657	(2)
Belgium-Luxemburg Economic Union: White arsenic [3]	3,111	2,502	2,045	2,579	3,554	3,093
Brazil: White arsenic	--------	179	211	322	322	696
Canada:						
White arsenic	1,248	1,622	1,100	666	747	1,161
Arsenic content of ores and concentrates exported	804	--------	--------	--------	--------	--------
China: White arsenic	983	500	(2)	(2)	(2)	(2)
Chosen: White arsenic	--------	--------	--------	153	332	(2)
Czechoslovakia:						
Ore:						
Gross weight	--------	--------	5	--------	--------	(2)
Arsenic content [5]	--------	--------	1	56	--------	(2)
France:						
Ore: [4]						
Gross weight	48,795	105,635	109,268	(2)	(2)	(2)
Arsenic content [5]	4,970	5,774	4,460	5,885	7,010	(2)
White arsenic	3,950	4,725	[3] 3,894	[3] 6,886	[3] 7,508	(2)
Germany:						
Ore:						
Gross weight	29,437	27,935	2,824	28,200	(2)	(2)
Arsenic content	1,858	1,850	(2)	(2)	(2)	(2)
White arsenic [3]	4,614	4,425	3,459	2,662	2,752	5,508
Greece: White arsenic	841	659	385	336	(2)	(2)
Japan: White arsenic	1,654	2,588	2,637	2,375	2,734	(2)
Mexico: White arsenic	9,476	7,956	3,991	4,697	7,860	9,950
Portugal: White arsenic	176	159	59	2	40	(2)
Southern Rhodesia: White arsenic	50	--------	--------	--------	--------	(2)
Sweden:						
Ore:						
Gross weight	24,316	54,355	198,231	373,520	(2)	(2)
Arsenic content	4,350	11,182	20,035	38,446	28,618	(2)
Turkey:						
Ore:						
Gross weight	55	54	306	1,906	16,491	(2)
Arsenic content	22	22	122	762	6,596	(2)
Union of South Africa: White arsenic	15	9	4	--------	--------	(2)
United Kingdom: White arsenic and arsenic soot	588	180	251	123	188	(2)
United States: White arsenic (sales)	15,808	12,498	11,324	10,702	14,173	11,494
Yugoslavia: Ore.[1]	7	--------	--------	--------	--------	(2)

[1] Gross weight. Arsenic content not stated.
[2] Data not available.
[3] Exports of domestic product.
[4] Includes arsenopyrites, mispickel, and realgar.
[5] In addition, arsenic contained in ores worked primarily for gold and lead is reported as 137 tons in 1930. Data not available for later years.

RADIUM, URANIUM, AND VANADIUM

By Richard J. Lund [1]

SUMMARY OUTLINE

Reflecting the improvement in general business conditions, the production of radium, uranium, and vanadium in the United States showed a considerable increase over that of preceding years. However, the domestic output coming from small operations mining low-grade ores continues to furnish only a small proportion of domestic requirements, the bulk of the world demand for radium and uranium being supplied by the richer and larger deposits of the Belgian Congo and Canada, and the vanadium by Peru, South-West Africa, and Northern Rhodesia.

During 1935 the output of carnotite ores in the United States [2] amounted to 1,145 short tons valued at $56,223, containing 3,329 milligrams of radium, 22,009 pounds of uranium (25,946 pounds U_3O_8) and 50,776 pounds of vanadium (90,671 pounds V_2O_5). The ore mined ranged from 1 to 4 percent in U_3O_8 content and from 3.5 to 12 percent in V_2O_5 content. Most of the ore or concentrates was shipped to the Vitro Manufacturing Co. of Pittsburgh, Pa., and the Shattuck Chemical Co. of Denver, Colo.

In addition to the above, considerable vanadium was produced from complex ores carrying values in gold, silver, lead, molybdenum, and vanadium. The Bureau of Mines is not at liberty to publish figures on this production.

[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] Figures on domestic production compiled by H. W. Davis of the Bureau of Mines.

Salient statistics on the three metals are summarized in the following table:

Salient statistics on radium, uranium, and vanadium, 1934–35

	1934		1935	
	Quantity	Value	Quantity	Value
Production:				
Carnotite ores short tons	254	$11,074	1,145	$56,223
Radium contained milligrams	1,007	(1)	3,329	(1)
Uranium contained pounds	6,661	(1)	22,009	(1)
Vanadium contained do	12,528	(1)	50,776	(1)
Complex ores short tons	(2)	(2)	(2)	(2)
Vanadium contained pounds	(2)	(2)	(2)	(2)
Imports:				
Uranium oxide and salts of do	158,991	176,222	296,389	292,207
Radium salts grams [3]	21.97	1,082,462	11.41	525,807
Vanadium ores short tons	1,754	145,506	476	40,070
Vanadium contained pounds	414,400	----------	94,080	----------

[1] Figures not available.
[2] Bureau of Mines not at liberty to publish figures.
[3] Bureau of Foreign and Domestic Commerce publishes quantities as follows: 1934, 339 grains; 1935, 176 grains.

Imports.[3]—Imports into the United States of radium and uranium salts and of vanadium ores during 1935 and preceding years are shown in the following tables:

Radium and uranium salts imported for consumption in the United States, 1932–35

Class	1932		1933		1934		1935	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Radioactive substitutes	(1)	$2,513	(1)	$74	(1)	$1,851	---------	---------
Radium salts grams [2]	9.14	479,028	11.6	576,026	21.97	1,082,462	11.41	$525,807
Uranium oxide and salts of pounds	122,229	146,051	186,461	245,656	158,991	176,222	296,389	292,207
	---------	627,592	---------	821,756	---------	1,260,535	---------	818,014

[1] Weight not recorded.
[2] Bureau of Foreign and Domestic Commerce publishes quantities as follows: 1932, 141 grains; 1933, 179 grains; 1934, 339 grains; 1935, 176 grains.

Vanadium ore (steel-hardening) imported for consumption in the United States, 1930–35 [1]

Year	Gross weight (gross tons)	Vanadium content (gross tons)	Value
1930	5,168	(2)	$491,633
1934	1,566	185	145,506
1935	425	42	40,070

[1] No imports reported for 1931–33.
[2] Not recorded.

Of the total imports of radium salts Belgium supplied 167 grains valued at $490,823 and Canada 9 grains valued at $34,984. Of the imports of uranium oxide and salts of uranium, Belgium supplied

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

286,505 pounds valued at $280,804, Canada 9,858 pounds valued at $11,240, and Germany 26 pounds valued at $163. All vanadium ore came from Peru.

Prices.—Purely nominal prices for radium were quoted throughout 1935 by Metal and Mineral Markets at $50 per milligram of radium content, while vanadium ore was quoted at the nominal figure of 27½ cents per pound of contained V_2O_5, f. o. b. shipping point.

DOMESTIC PRODUCTION

Arizona.—Complex gold ores carrying recoverable values in lead, silver, molybdenum, and vanadium were mined and treated jointly by Mammoth-St. Anthony, Ltd., on their Mammoth and Collins claims, and by the Molybdenum Gold Mining Co. (a subsidiary of the Molybdenum Corporation of America) from their Mohawk and New Year mines, both operations being in the Old Hat district near Mammoth. The United States Bureau of Mines aided in experimental work leading to the successful flotation of vanadium in these ores.

The United Vanadium Corporation carried on development work on its Uvanco mine near Dripping Springs, Gila County. Vanadium-bearing minerals are descloizite and vanadinite.

Colorado.—North Continent Mines, Inc. (231 South La Salle Street, Chicago), took over the carnotite-roscoelite mining and milling operations previously conducted by the S. W. Shattuck Chemical Co. in the McIntyre district, western San Miguel County.

Small tonnages of carnotite ore running from 2 to 4 percent U_3O_8 and about 5 percent V_2O_5 were mined by Sullivan Bros. from their Gypsum Valley claims near Nucla, San Miguel County; and by W. C. Martin, W. G. Gibson, A. E. Riddle, and J. B. Riddle from their Yellow Bird placer mine near Paradox, Montrose County.

T. C. Brammeier mined 20 tons of carnotite ore running 2 percent U_3O_8 and 5 percent V_2O_5 from his Black Foot and Grass Root mine in the vicinity of Naturita, Montrose County.

George A. McKee reported production of 55 tons of carnotite ore carrying 2 percent U_3O_8 and 5.5 percent V_2O_5 from his Ground Hog mine near Norwood in San Miguel County.

Utah.—The Yellow Circle Mining Co. (H. W. Balsley, manager) produced carnotite ore from 30 small mines under contract. Balsley also purchased ore from many other operators on behalf of The Vitro Manufacturing Co. of Pittsburgh. Combined production and purchases amounted to 301.7 short tons carrying 1.58 percent U_3O_8 and 5.26 percent V_2O_5

J. W. Lewis mined and shipped 90 tons of ore containing 1.5 percent U_3O_8 and about 12 percent V_2O_5 from his property in Grand County.

USES AND TECHNOLOGY

Radium.—The principal use of radium is therapeutic, its chief application being in the treatment of cancer and skin diseases. Aside from this, it is used along with zinc sulphide in luminous paint for watch and clock dials, compasses, and other instruments; and in recent years industrial radiography for the nondestructive testing of metal parts has been expanding.[4]

[4] Gezelius, R. A., and Briggs, C. W., Radium for Industrial Radiography: Radon Co., Inc., New York.

A new process for producing so-called artificial radium was described by Prof. Ernest Lawrence,[5] by which a radium salt having a very brief radioactive life is produced from common salt (NaCl) or other cheap substance such as phosphorus by atomic bombardment with high-voltage electricity.

Uranium.—Uses for uranium are few, small quantities in the form of ferro-uranium being employed in the hardening and toughening of steel. Principal uses are in the form of various uranium salts in the glass and ceramic industry as a coloring material, in the textile industry for dyeing, and in photography.

United States Patent 2000656 on a new process for floating carnotite or similar uranium ores was issued to H. H. Armstrong and A. Burley on May 7, 1935, following an application dated January 30, 1933. It involves the use of nitrogen or potassium soap and fatty acids as conditioning agents followed generally by pine oil or other additional frothers and a soluble lead salt such as acetate or nitrate.

Vanadium.—The principal use of vanadium is in the steel industry; it is employed in a great variety of steels, frequently in combination with other alloys. Although its chief function was formerly described as a scavenger (deoxidizer), recent descriptions stress its importance as an alloying agent. Added to steel in rather minute quantities it markedly increases the elastic limit, yield point, and impact strength; in slightly larger amounts it also increases the tensile strength without loss in ductility. Other important functions of vanadium in steel are its action in controlling grain size and of imparting to high-speed tool steels the ability to maintain a larger proportion of their strength and hardness at high temperatures. In cast iron, vanadium tends to maintain a strong, tough structure, restrains graphitization, and favors formation of small grain size.

Steels containing vanadium, with one or more other alloying elements, find their widest use in such highly stressed parts as springs and axles for both track and road vehicles, crankshafts, pinion gears, brake parts, and many other locomotive and automotive castings.

Vanadium in the form of pentoxide finds an important use as a catalyst in the manufacture of sulphuric acid and of certain organic chemicals. Use of vanadium for this purpose was analyzed in detail by Adadurov[6] and Boreskov.[7]

Saklatwalla[8] presented a résumé of recent advance in technology of vanadium, including a discussion of new uses. In addition to predicting possible new methods of preparation and use of the metal itself, he states that alloys of vanadium with other rare metals may have remarkable properties and that the application of catalysis to chemotherapy may develop a more extensive use of vanadium compounds.

A description of the history, uses, and manufacture of vanadium and its salts was given by Ravier.[9]

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[5] Lawrence, Ernest, Artificial Radium from Salt: Chem. Age, Aug. 31, 1935, p. 198.

[6] Adadurov, I. E., Vanadium Catalyzers for the Production of Sulphuric Acid: Trans. VI Mendeleev Cong. Theoret. Applied Chem., 1932, 2, pt. 1, 1935, pp. 154–159; Chem. Abs., Sept. 20, 1935, p. 6371.

[7] Boreskov, G. K., Vanadium Catalyzers for Sulphuric Acid Production: Trans. VI Mendeleev Cong. Theoret. Applied Chem., 1932, 2, pt. 1, 1935, pp. 159–166; Chem. Abs., Sept. 20, 1935, pp. 6371–6372.

[8] Saklatwalla, B. D., Vanadium: Trans. Electrochem. Soc., vol. 66, 1934, pp. 33–38.

[9] Ravier, F., Vanadium in Industry: Chimie et Industrie, vol. 33, 1935, pp. 817–822.

PRODUCTION IN FOREIGN COUNTRIES

RADIUM AND URANIUM

Belgian Congo.—No data are at hand to indicate production from the Shinkolobwe deposits in Katanga, operated by the Union Minière du Haut Katanga, but the latest annual report of this company (that for the calendar year 1934) stated:

The radium market has also improved and sales during the year under review reached a most satisfactory figure.

Canada.—The Mines Branch at Ottawa, in a letter to the Bureau of Mines, reports as follows concerning current developments in this industry in Canada:

Eldorado Gold Mines remained the only company actively engaged in the production of radium and uranium, and of the ores of these elements. During the year, this company proceeded with development of its mine at La Bine Point, Great Bear Lake, N. W. T., reaching a depth of 340 feet below surface, with ore drawn from three levels. Conditions on the lowest level were found to be essentially similar to surface, with rich pitchblende in shoots associated with high grade native silver. Increasing amounts of cobalt arsenides were found in some sections, together with niccolite. Work has so far been confined to the central, or No. 2 vein, development of other known parallel leads being left until sufficient ore has been blocked out on the No. 2 vein to take care of immediate mill requirements.

The mill was in steady operation throughout the year, handling about 65 tons per day. High-grade pitchblende and silver are picked out below ground and also on a picking table, and are bagged separately for shipment to the Port Hope refinery and the Trail smelter, respectively. Grinding is effected by rod mill, and concentration is by Wilfley and blanket tables, followed by re-grinding and flotation. The table product contains both pitchblende and coarse leaf silver. Further table, flotation, and jig equipment was installed towards the close of the year, and it is expected that mill capacity will shortly be increased to 75 tons per day. All concentrates and high-grade ore on hand were shipped out by water before the close of navigation, and regular shipment will be maintained during the freeze-up period by the company's 2-ton pay-load plane. About 70 men are employed.

So far, the Eldorado property remains the only operator at Great Bear Lake where pitchblende has been found in important amount, the others having principally silver mineralization. At Beaverlodge Lake, 100 miles south of Great Bear Lake, a little prospecting was conducted during the year on pitchblende discoveries made in 1934, but it is not yet possible to say anything definite about the commercial possibilities of the deposits. The mineralization differs from that at Great Bear Lake, the pitchblende being apparently in small and irregular lenses, associated with hematite, either in or near the borders of large quartz bodies.

During the year, pitchblende was also discovered on a group of claims in the new Goldfields area, on the north shore of Lake Athabasca, in Saskatchewan; the surface showings are small and do not show much indication of commercial ore, though the grade of selected samples was high.

The Port Hope refinery of Eldorado Gold Mines was in active operation throughout the year, producing both radium and uranium salts. Several additions were made to the plant, and various modifications were made in the process. By salt-roasting of the ore, followed by a hyposulphite leach, it has been found possible to effect a much improved extraction of the silver content of the pitchblende. With adequate supplies of ore coming in, it is expected shortly to have the plant operating on a 1-ton daily capacity.

Further detail regarding the operations of the Port Hope refinery was given by the Ontario Department of Mines,[10] as follows:

In 1935 a total of 232,114 pounds of pitchblende and silver concentrates was treated chemically at Port Hope, from which radium and uranium products worth $420,000 were recovered. In addition, 116,902 ounces of silver were produced, having a value of $68,840.

[10] Ontario Department of Mines, Preliminary Report on Mineral Production of Ontario in 1935, p. 23.

Excellent illustrated articles describing the radium operations in the Great Bear Lake area were presented by Spence.[11]

Czechoslovakia.—Radium stocks produced from the Government mines in Jachymov (Joachimsthal) have been accumulating for several years, in spite of progressive curtailment of operations during which the working days per week have been cut from six to five and finally to four. Plans for 1936 call for continued curtailment, although maintenance work will be given special attention. The production program for 1936 provides for an output of 2.55 grams of radium and 13,750 kilograms of uranium colors.[12]

Late in 1935 the hundredth gram of radium was produced from this district, extraction having started there 40 years ago. The working capacity of the institute is an output of 8 grams annually, but ordinarily only 2 to 3 grams are produced. The Jachymov product enjoys the advantage of being free of mesothorium. It is reported that the radioactive element, ionium, is to be extracted commercially from the residues left during the isolation of uranium and radium compounds at the State Radiological Institute at Jachymov.[13]

Portugal.—The Urgerica mine continues to produce, and up to the end of November its output was 1,081 tons of uranium ore as against 727 tons in 1934. The capital employed is entirely British.[14]

Sweden.—A report [15] states that a deposit of pitchblende has been discovered in the district of Torpa in the south of Sweden, the extent of which is being examined by deep drilling.

Switzerland.—The Société Anglo-Suisse du Radium (Anglo-Swiss Radium Co.) was recently organized at Lausanne with a nominal capital of 10,000 Swiss francs.[16] The object of this corporation was to acquire interest in companies engaged in extracting radioactive ores and to construct a factory in Switzerland for treating the concentrates. According to another report,[17] this concern has taken up about 30 claims (50 hectares each) near Vizeu and Trancoso in Portugal. The company also proposes to acquire a factory at Shepton Mallet in Somersetshire, England.

VANADIUM

World production.—The world production of vanadium contained in ores and concentrates for 1931–35 was as follows:

World production of vanadium in ores and concentrates, 1931–35, in metric tons

[Compiled by R. B. Miller]

Country	1931	1932	1933	1934	1935
Northern Rhodesia	216	307	36	3	173
Peru				1 133	67
South-West Africa	445	305	18	34	2 365
United States	(3)	245	2	(3)	(3)

1 Shipments from stock.
2 Exports.
3 Bureau of Mines not at liberty to publish figures.

11 Spence, Hugh S., Radium Discoveries in North West Canada: Sands, Clay, and Minerals, June 1935, pp. 8–23. Status of Mining Developments for Silver and Radium in Northwestern Canada, 1935: Canadian Min. Jour., December 1935, pp. 569–573.
12 Bureau of Foreign and Domestic Commerce, Foreign Metals and Minerals: Feb. 10, 1936, p. 13.
13 Chemistry and Industry (London), Ionium as an Industrial Product: Jan. 24, 1936, p. 83.
14 Mining Journal (London), Feb. 29, 1936, p. 210.
15 Industrial and Engineering Chemistry, News Ed., Jan. 20, 1936, p. 23.
16 L'Industrie chimique,, vol. 22, no. 60, September 1935, p. 714.
17 Mining Journal (London), Oct. 12, 1935, p. 751.

Germany.—A report [18] states that the Rochling Iron & Steel Works after experimenting in the extraction of vanadium from French minette ores have now succeeded in obtaining it from South Baden oolitic ores.

Italy.—Vanadium ores and alloys were among the list of items, the export of which to Italy by members of the League of Nations was banned as a sanction measure.

Northern Rhodesia.—The output of vanadium contained in ores and concentrates amounted to 173 metric tons in 1935 compared with 3 tons in 1934, all of which came from the operation of the Rhodesia Broken Hill Development Co., Ltd. In its annual report for the year 1934 (meeting held July 15, 1935), this company stated that production for the first 6 months of 1935 amounted to 24.5 tons of fused vanadium oxide and 635 tons of vanadium concentrates. It was stated further that production to December 31, 1935, had already been sold. A later report [19] announced that a prospecting campaign with the object of increasing the vanadium ore reserves is in progress.

A brief description of this deposit, together with a more detailed discussion of the vanadium recovery processes employed there, was given by Pickard.[20] A more recent article on the same subject was presented by Jackson.[21]

Peru.—Operations at the Minasragra deposit of the Vanadium Corporation of America were resumed during 1935 after several years' idleness, the Peruvian Government reporting the production of 67 metric tons of vanadium contained in ores and concentrates. Shipments from past accumulated stocks apparently continued, since exports for the first 11 months of 1935 were reported at 423 metric tons of vanadium in ores and concentrates. Reopening of the mine was no doubt aided by action of the Peruvian Congress in passing a law [22] on February 28, 1935, that reduced the export duty on vanadium ore from $22 to $1.50 per metric ton.

An exhaustive review [23] of the Peruvian mining industry appeared recently, in which statistics relating to production, costs, and mining conditions are presented for the various metals and nonmetals produced by Peru, including vanadium.

South-West Africa.—According to the annual report of The South-West Africa Co., Ltd., for the fiscal year ended June 30, 1935, operations at its Abenab mine near Grootfontein were resumed, production having been restarted in September 1935. The company's prospecting operations in the Damaraland Concession and other parts of the mandated territory were continued, resulting in the production of a quantity of vanadium concentrates. Sales of vanadium concentrates increased, although exchange restrictions hampered the company's business in Germany. Exports from South-West Africa amounted to 365 metric tons of vanadium in concentrates in 1935.

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[18] Metal Bulletin (London), Dec. 6, 1935, p. 15.
[19] Metal Bulletin (London), Jan. 31, 1936, p. 15.
[20] Pickard, T. R., Recovering Zinc and Vanadium at the Rhodesia Broken Hill Plant: Eng. and Min. Jour., October 1935, pp. 489–493.
[21] Jackson, O. A. E., The Production of Electrolytic Zinc and Vanadic Oxide at Broken Hill, Northern Rhodesia: Jour. Chem. Met. and Min. Soc. South Africa, vol. 36, no. 7, January 1936, pp. 173–183.
[22] Commerce Reports, Mar. 23, 1935.
[23] Cuerpo de Ingenieros de Minos de Peru, Boletin 111, published by the Ministerio de Fomento of Peru.

U. S. S. R.—It has been reported [24] recently that success has been achieved in mastering the process of manufacturing pure vanadium and high grade ferrovanadium pig from the titaniferous magnetite ores of the Urals, and that ferrovanadium has been removed from the list of needed imports. Details of processing the open-hearth slags to obtain ferrovanadium have been presented by Krasnokutski.[25]

[24] Bureau of Foreign and Domestic Commerce, Russian Economic Notes: Mar. 15, 1936, p. 16.
[25] Krasnokutski, J. M., Extraction of Vanadium from the Basic Open-Hearth Slag of Titanomagnetite Ore of Ural: Zhurnal Khimicheskvy Promishlennosti, vol. 12, March 1935, pp. 281–84; Metals and Alloys, vol. 7, January 1935, p. M A 1.

PLATINUM AND ALLIED METALS [1]

By H. W. Davis

SUMMARY OUTLINE

Although platinum occurs over a wide area in Alaska, California, and Oregon (the chief producing localities of this country) the proportion of the platinum metals present usually is small, and the deposits could not be worked profitably if it were not for the gold content. The quantity of platinum metals recovered annually from these placer deposits averaged about 500 ounces during the decade 1925–34 and was almost negligible in the world supply. Considerable quantities—775 ounces in 1924, 2,842 ounces in 1925, 3,330 ounces in 1926, and 108 ounces in 1927—of palladium formerly were recovered from domestic palladium-bearing copper ore, but none has been recovered since 1927. Much larger quantities of platinum metals are obtained in the United States as byproducts of gold and other metals (about 6,700 ounces annually during the 10 years 1925–34), but the total output from domestic sources has small importance compared with domestic consumption. The United States, however, is an important contributor to the world supply of refined new metals, as it has furnished about 48,000 ounces annually for 1925–34. The bulk of this output comes from crude platinum imported from foreign sources, notably Colombia. In addition, this country has supplied about 45,000 ounces of secondary platinum metals annually for the period 1925–34.

It is estimated that the world's known workable deposits of platinum can supply annually a production of about 400,000 ounces of new platinum and about 70,000 ounces of palladium. Canada can furnish about 125,000 ounces of platinum; Colombia 50,000 ounces; U. S. S. R. (Russia), 150,000 ounces; Union of South Africa, 50,000 ounces; and the rest of the world about 25,000 ounces. Canada also can produce about 60,000 ounces of palladium annually and the remainder of the world about 10,000 ounces.

[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 platinum and allied metals in the United States, 1934–35, in troy ounces

	1934	1935
Production:		
Crude platinum from placers	3,720	9,069
New metals:		
Platinum	[1] 43,392	[1] 37,284
Palladium	1,471	1,432
Other	2,411	3,344
	47,274	42,060
Secondary metals:		
Platinum	35,494	47,107
Palladium	5,606	7,852
Other	2,656	4,166
	43,756	59,125

	1934	1935
Stocks in hands of refiners, Dec. 31:		
Platinum	41,370	50,265
Palladium	26,377	27,807
Other	16,174	15,475
	83,921	93,547
Imports for consumption:		
Platinum	133,299	122,550
Palladium	29,954	26,579
Other	11,059	15,020
	174,312	164,149
Exports: [2]		
Unmanufactured	1,897	3,271
Manufactures (except jewelry)	759	1,954

[1] In 1934 includes 2,976 ounces of new platinum from domestic sources, comprising 1,914 ounces derived from crude placer platinum and 1,062 ounces obtained from domestic gold and copper ores as a byproduct of refining; in 1935 includes 6,593 ounces of new platinum from domestic sources, comprising 5,232 ounces derived from crude placer platinum and 1,361 ounces obtained from domestic gold and copper ores as a byproduct of refining.
[2] Exclusive of exports by parcel post.

CRUDE PLATINUM

Production.—Mine returns for 1935 indicate a production of 8,685 troy ounces of crude platinum in Alaska, 293 ounces in California, and 91 ounces in Oregon—a total of 9,069 ounces (3,720 ounces in 1934). The greater part of the production in Alaska came from placers in the Goodnews Bay district south of the mouth of the Kuskokwim River, but small quantities were recovered in placer-gold mining in the Koyuk district, Seward Peninsula, and in reworking the tailings from earlier lode-mining operations in the Ketchikan district, Kasaan Peninsula. In California most of the platinum produced was a byproduct of dredges working the gold placers in Merced, Sacramento, Stanislaus, and Yuba Counties. The production in Oregon came mainly from the ocean beach near Cape Blanco in Curry County.

Many gold and copper ores in the United States contain comparatively small quantities of platinum. These ores usually furnish the greater part of the new platinum recovered annually from domestic sources. In 1935, however, much the greater part of the new platinum recovered from domestic sources was from placer platinum. For example, 5,232 ounces of platinum were recovered from placer platinum in 1935 and 1,361 ounces as a byproduct of refining gold and copper ores.

Purchases.—Platinum refiners in the United States reported purchases of domestic crude platinum from the following sources in 1935: Alaska, 7,386 ounces; California, 223 ounces; Oregon, 119 ounces; and Nevada, 2 ounces—a total of 7,730 ounces (2,821 ounces in 1934). Refiners in the United States also reported purchases of 44,642 ounces (51,810 ounces in 1934) of foreign crude platinum in 1935—28 ounces from Canada, 37,229 ounces from Colombia, 3,656 ounces from Ethiopia, 3,656 ounces from South Africa, and 73 ounces unspecified.

Markets and prices.—Returns received from the sale of crude platinum are disappointing to miners who are unaware that quotations usually refer not to the price of the metallic content of crude platinum but to that of the pure metals that have been subjected to treatment costs.

Sellers of domestic crude platinum reported that they were paid for metal content based on assay. Buyers reported purchases at $12.82 to $31.40 an ounce for domestic and $19.37 to $25.24 an ounce for foreign crude platinum. A list of refiners in the United States who purchased foreign and domestic crude platinum in 1935 follows:

American Platinum Works, 225 New Jersey Railroad Avenue, Newark, N. J.
Baker & Co., Inc., 54 Austin Street, Newark, N. J.
Goldsmith Bros. Smelting & Refining Co., 1300 West Fifty-ninth Street, Chicago, Ill.
Kastenhuber & Lehrfeld, 24 John Street, New York, N. Y.
Pacific Platinum Works, Inc., 814 South Spring Street, Los Angeles, Calif.
Western Gold & Platinum Works, 589 Bryant Street, San Francisco, Calif.
Wildberg Bros. Smelting & Refining Co., 742 Market Street, San Francisco, Calif.

REFINED PLATINUM METALS

New metals recovered.—Reports from refiners of crude platinum, gold bullion, and copper indicate that 42,060 ounces of platinum metals were recovered in the United States from these sources in 1935, a decrease of 11 percent compared with 1934. It is estimated that 9,231 ounces of the total in 1935 were derived from domestic sources.

New platinum metals recovered by refiners in the United States, 1934–35, by sources, in troy ounces

	Platinum	Palladium	Iridium	Osmiridium	Others	Total
1934						
Domestic:						
Crude platinum	1,914	8	349	21	124	2,416
Gold and copper refining	1,062	1,271	1		1	2,335
	2,976	1,279	350	21	125	4,751
Foreign: Crude platinum	40,416	192	1,238	564	113	42,523
Total recovery	43,392	1,471	1,588	585	238	47,274
1935						
Domestic:						
Crude platinum	5,232	27	1,073	40	376	6,748
Gold and copper refining	1,361	1,115	4		3	2,483
	6,593	1,142	1,077	40	379	9,231
Foreign: Crude platinum	30,691	290	1,361	409	78	32,829
Total recovery	37,284	1,432	2,438	449	457	42,060

New platinum metals recovered by refiners in the United States, 1931–35, in troy ounces

Year	Platinum	Palladium	Iridium	Osmiridium	Others	Total
1931	31,274	2,742	1,732	272	185	36,205
1932	14,666	1,252	1,362	328	8	17,616
1933	48,581	942	1,434	492	90	51,539
1934	43,392	1,471	1,588	585	238	47,274
1935	37,284	1,432	2,438	449	457	42,060

Secondary metals recovered.—Secondary platinum metals are those recovered from the treatment of scrap metal, sweeps, and other waste products of manufacture that contain platinum. In 1935, 59,125 ounces of secondary platinum metals were recovered, an increase of 35 percent over 1934 and the largest quantity recovered since 1919.

Secondary platinum metals recovered in the United States, 1931–35, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1931	33,837	6,331	1,823	1,743	43,734
1932	21,635	5,783	3,726	1,444	32,588
1933	35,073	4,814	692	783	41,362
1934	35,494	5,606	1,328	1,328	43,756
1935	47,107	7,852	2,191	1,975	59,125

Prices.—Refiners reported the following prices for platinum in 1935: High $40, low $25.66, and average for the year $32.60 an ounce, compared with $40.50, $26, and $34.50 an ounce, respectively, for 1934. They gave the following prices for palladium: High $26, low $18, and average for the year $23.25 an ounce, compared with $26, $13, and $22.54 an ounce, respectively, for 1934.

Figure 76 shows the average monthly official prices quoted for the platinum metals from 1932 to 1935.

Consumption.—The next table shows sales of platinum metals to consumers by refiners in the United States in 1934 and 1935. The figures include sales, by refiners in the United States, of platinum metals recovered from crude platinum, from gold bullion, from copper and nickel bullion and matte, from electrolytic muds, and from scrap materials and sweeps; in addition, they include sales of considerable quantities of imported platinum metals that are handled by refiners in the United States.

Sales of platinum metals by refiners in the United States increased from 95,904 ounces in 1934 to 125,064 ounces in 1935. The increase (from 32,959 ounces in 1934 to 56,182 ounces in 1935) in sales of platinum to the jewelry industry and the concurrent smaller gain (from 19,555 ounces in 1934 to 20,916 ounces in 1935) in sales of palladium to the dental industry are noteworthy.

The uses of platinum and its allied metals are many and varied. The most widely used metal of the group is platinum, which constituted 87,652 ounces (70 percent) of the total platinum metals sold by domestic refiners in 1935. The principal consumer of platinum was the jewelry industry. The improvement in the demand for fine jewelry was reflected in the requirements of the jewelry industry for platinum, which increased from 32,959 ounces in 1934 to 56,182 ounces in 1935. Lower prices for platinum have led to wider distribution and sales of certain platinum articles, such as wedding rings, settings for remounting of old jewelry, collar pins, cuff links, pencils, and knives. Platinum-clad nickel has been produced for dresser sets, after-dinner coffee services, trophies, medals, and watchcases. Second in magnitude as a consumer of platinum in 1935 was the chemical industry, which used the metal chiefly as a catalyzer in the manufacture of sulphuric, acetic, and nitric acids; as a still for sulphuric acid; as an anode for electrochemical processes; and as chemical ware in the form of crucibles, dishes, and other laboratory equipment. The dental industry, in which platinum is used chiefly in posts and pins for artificial teeth, ranked third as a consumer in 1935. The electrical industry was the fourth largest consumer of platinum in 1935, the metal being used chiefly in contact points, telephone and telegraph apparatus, and magneto contacts.

Next to platinum, palladium is the most extensively used metal of the platinum group; it constituted 31,770 ounces (25 percent) of the total platinum metals sold by domestic refiners in 1935. It is by far the cheapest metal of the platinum group, especially volume for volume, and tends more and more to replace other metals. The largest consumer of palladium in 1935 was the dental industry, which purchased 20,916 ounces from domestic refiners compared with 19,555 ounces in 1934, 15,946 ounces in 1933, and with average annual purchases of about 13,200 ounces during the 5 years 1929–33. The presence of platinum and palladium is not only beneficial in the preparation of dental alloys with desirable physical properties but also economical, especially when palladium replaces a considerable quantity of gold. The fact that dental alloys of high palladium content

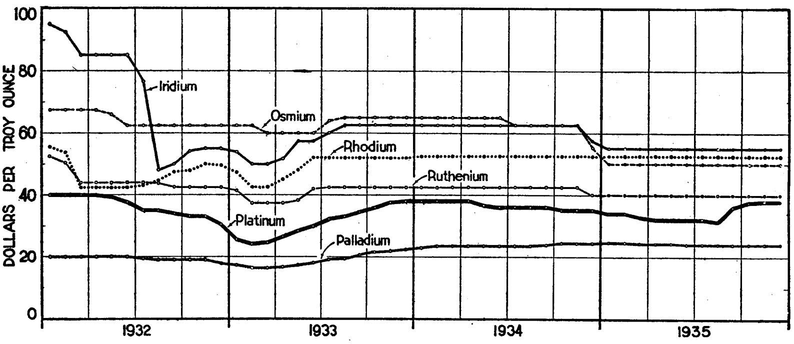

FIGURE 76.—Average monthly price per troy ounce of platinum and allied metals at New York, 1932–35.

are less conspicuous than gold and are nontarnishable has led to an increase in the demand for palladium in dentistry. The electrical and jewelry industries are the next largest users of palladium, and small quantities are used in the manufacture of chemical ware and for miscellaneous purposes. Palladium leaf, first introduced in 1933, is finding wider acceptance in diverse fields. Like gold, palladium can be beaten successfully into leaf for use for decorative effects on shoes, hats, gloves, pocketbooks, picture frames, and display signs. Some palladium-clad molybdenum has been produced for special purposes.

The uses of iridium are few compared with those of platinum and palladium, but it ranks third in consumption among the platinum group; in 1935, of the total sales of platinum metals, 4,497 ounces (3.6 percent) were iridium. It is employed chiefly as a hardener for platinum, principally in the manufacture of jewelry, in which a 10-percent iridium alloy is used; and in the electrical industry, in which an alloy containing 15 percent or more iridium is used. Some iridium is used in making fountain-pen points.

The consumption of the other platinum metals—osmium, rhodium, and ruthenium—is very small, amounting to only 0.92 percent of the total consumption of this group in 1935. Because of its brilliance and durability, rhodium has been called "the diamond of the metals."

As rhodium is one of the whitest and hardest of all metals and never tarnishes, rhodium plating is being used more and more as a finish for jewelry and silverware and for surfacing reflectors in searchlights.

Platinum metals sold by refiners in the United States, 1934–35, by consuming industries, in troy ounces

Industry	Platinum	Palladium	Iridium	Others	Total	Percentage of total
1934						
Chemical	14,699	285	53	89	15,126	16
Electrical	3,587	4,468	544	59	8,658	9
Dental	6,776	19,555	69	11	26,411	28
Jewelry	32,959	6,015	2,246	380	41,600	43
Miscellaneous	3,113	506	164	326	4,109	4
	61,134	30,829	3,076	865	95,904	100
1935						
Chemical	13,404	69	102	1	13,576	11
Electrical	5,867	5,490	662	276	12,295	10
Dental	9,694	20,916	130	43	30,783	25
Jewelry	56,182	5,095	3,508	579	65,364	52
Miscellaneous	2,505	200	95	246	3,046	2
	87,652	31,770	4,497	1,145	125,064	100

Stocks.—On December 31, 1935, 93,547 ounces of platinum metals were in the hands of refiners, compared with 83,921 ounces in 1934.

Stocks of platinum metals in the hands of refiners in the United States, Dec. 31, 1931–35, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1931	51,231	17,553	10,193	9,508	88,485
1932	37,976	19,707	10,307	7,921	75,911
1933	41,204	20,581	7,622	7,615	77,022
1934	41,370	26,377	8,269	7,905	83,921
1935	50,265	27,807	9,202	6,273	93,547

FOREIGN TRADE

Imports.—The following tables show imports of platinum metals into the United States. The imports decreased from 174,312 ounces in 1934 to 164,149 ounces in 1935. Chief sources of imported platinum metals in 1935 were the United Kingdom (100,861 ounces), Colombia (31,419 ounces), and the U. S. S. R. (Russia) (25,033 ounces). Imports of crude platinum from Colombia decreased from 48,315 ounces in 1934 to 25,440 ounces in 1935. Imports of palladium (chiefly from the United Kingdom) declined from 29,954 ounces in 1934 to 26,579 ounces in 1935. Imports of platinum metals from the U. S. S. R. (Russia) increased from 12,763 ounces in 1934 to 25,033 ounces in 1935.

Platinum metals imported for consumption in the United States, 1934–35, by metals

Metal	1934		1935	
	Troy ounces	Value	Troy ounces	Value
Platinum:				
Ores of platinum metals (platinum content)			688	$13,716
Grain, nuggets, sponge, or scrap	119,469	$2,925,153	61,159	1,480,450
Ingots, bars, sheets, or plates not less than ⅛-inch thick	13,829	462,069	60,703	1,849,114
	133,298	3,387,222	122,550	3,343,280
Manufactures of, not jewelry	1	77		
Iridium	2,922	121,228	5,456	245,146
Osmiridium	5,361	131,988	4,589	115,326
Osmium	42	2,026	110	3,216
Palladium	29,954	442,336	26,579	400,098
Rhodium	2,734	72,641	3,990	96,882
Ruthenium			875	24,074
	174,312	4,157,518	164,149	4,228,022

Platinum metals (unmanufactured) imported for consumption in the United States in 1935, by countries, in troy ounces

Country	Platinum			Iridium	Osmium and osmiridium	Palladium	Rhodium and ruthenium	Total
	Ores of platinum metals (platinum content)	Grain, nuggets, sponge, or scrap	Ingots, bars, sheets, or plates not less than ⅛-inch thick					
Argentina		4						4
Canada		82					46	128
Colombia		25,440	5,979					31,419
Ecuador		1,228						1,228
France						500	61	561
Germany							102	102
Japan		668	4,000					4,668
Mexico		3						3
Panama		142						142
U. S. S. R. (Russia)	38	4,680	17,636	2,629			50	25,033
United Kingdom	650	28,912	33,088	2,827	4,699	26,079	4,606	100,861
	688	61,159	60,703	5,456	4,699	26,579	4,865	164,149

Platinum metals imported for consumption in the United States, 1931–35

Year	Troy ounces	Value	Year	Troy ounces	Value
1931	129,632	$3,531,071	1934	174,312	$4,157,518
1932	56,047	1,417,037	1935	164,149	4,228,022
1933	162,081	3,939,846			

Exports.—A complete record of exports of platinum is no longer available, for, beginning with July 1933, the Bureau of Foreign and Domestic Commerce discontinued reporting exports by parcel post, by which the greater part is shipped.

Platinum exported from the United States in 1935, by countries

[Exclusive of exports by parcel post]

Country	Unmanufactured (ingots, sheets, wire, alloys, and scrap)		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value
Asia, other			1	$65
Barbados			(1)	38
Bolivia			1	90
Brazil			65	2,200
Canada	544	$17,217	78	4,284
Chile	13	698	22	1,265
China	107	4,356	50	2,995
Colombia	4	146		
France			1	63
Germany			300	11,400
Japan			474	27,722
Malaya, British			1	137
Mexico	153	4,898	17	635
Panama	(1)	23		
Philippine Islands			4	225
United Kingdom	2,450	78,557	862	31,032
Uruguay			78	2,450
	3,271	105,895	1,954	84,601

[1] Less than 1 ounce.

Platinum exported from the United States, 1931–35

Year	Unmanufactured		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value
1931	1,209	$40,769	1,190	$48,464
1932	20,106	665,029	2,032	107,396
1933	[1] 23,686	[1] 608,552	[1] 1,323	[1] 56,812
1934	[1] 1,897	[1] 83,337	[1] 759	[1] 35,456
1935	[1] 3,271	[1] 105,895	[1] 1,954	[1] 84,601

[1] Beginning July 1933 excludes exports by parcel post, the reporting of which was discontinued by the Bureau of Foreign and Domestic Commerce.

PRODUCTION IN FOREIGN COUNTRIES

Canada.—Virtually all of the Canadian output of metals of the platinum group is recovered in refining nickel-copper matte from the Sudbury district of Ontario. Residues obtained in the metallurgical treatment of the nickel-copper matte are refined by the International Nickel Co. of Canada, Ltd., at its refinery at Acton, England, which has an annual capacity of 300,000 ounces of platinum-group metals. Recoveries of platinum metals from the nickel-copper ores in 1935 were 105,335 ounces of platinum and 84,772 ounces of other platinum-group metals, compared with 116,177 ounces of platinum and 83,932 ounces of other platinum-group metals in 1934.[2]

[2] Dominion Bureau of Statistics, Preliminary Report on the Mineral Production of Canada During the Calendar Year 1935: Ottawa, 1936.

British Columbia placers yielded only 20 ounces of stream platinum in 1935 compared with 53 ounces in 1934.

Colombia.—Colombia exported 38,020 ounces of crude platinum in 1935, of which 23,363 ounces were the output of dredges and 14,657 ounces the product of hand-working by native operators.

The South American Gold & Platinum Co. produced 27,414 ounces of crude platinum and 44,846 ounces of crude gold in 1935 compared with 26,090 ounces of crude platinum and 38,812 ounces of crude gold in 1934.

Ethiopia.—The production of crude platinum in Ethiopia in 1935 was 6,320 ounces compared with 5,644 ounces in 1934.

Germany.—Although Germany produces no crude platinum, it is important in the international platinum trade. Germany is the largest European consumer of platinum and has an important fabricating industry. Before the World War, Germany had an important platinum-smelting industry at Hanau, a suburb of Frankfurt-am-Main, which depended chiefly on Russia for its crude material. After the war, with the distribution of Russian platinum in the form of metal, Germany had to discontinue smelting the ore. The plants at Hanau, however, import platinum metals, which are fabricated into products for various industries.

Imports of platinum metals and alloys into Germany increased from 73,641 ounces in 1934 to 84,981 ounces in 1935, the chief sources of supply being U. S. S. R. (23,959 ounces), Switzerland (22,174 ounces), Great Britain (20,747 ounces), and the United States (9,960 ounces). In 1934 the United States was the chief source of supply (31,411 ounces), followed by U. S. S. R. (17,175 ounces) and Great Britain (11,076 ounces).

Exports of platinum metals and alloys from Germany increased from 72,304 ounces in 1934 to 102,288 ounces in 1935, Great Britain receiving 50,573 ounces. Presumably the increase in exports to Great Britain was due to the transfer from Berlin to London of platinum belonging to the Soviet Government.

The following table on platinum metals and alloys imported into and exported from Germany indicates the trend in consumption, because the country depends entirely on imports.

Platinum metals and alloys imported into and exported from Germany, 1928–35, in ounces

Year	Imports	Exports	Year	Imports	Exports
1928	98,871	83,397	1932	107,605	22,342
1929	125,986	88,306	1933	114,151	82,177
1930	109,525	58,762	1934	73,641	72,304
1931	110,422	84,765	1935	84,981	102,288

Sierra Leone.—The production of crude platinum in Sierra Leone in 1935 was 750 ounces compared with 474 ounces in 1934.

Tasmania.—The production of osmiridium in Tasmania in 1935 was 235 ounces compared with 488 ounces in 1934. The Adams River field continues to be the chief producing area, although the northwestern fields are yielding small quantities.

Union of South Africa.—According to the Department of Mines and Industries, sales of platinum in South Africa in 1935 amounted to 31,338 ounces valued at £179,697 (£5.73 an ounce) compared with 22,889 ounces valued at £139,516 (£6.10 an ounce) in 1934. The average composition of the product shipped in 1934 was platinum 79.83 percent, palladium 13.59 percent, iridium 0.08 percent, osmium and osmiridium 0.02 percent, ruthenium 0.08 percent, and gold 6.40 percent.

Sales of osmiridium in 1935 amounted to 4,817 ounces valued at £22,350 (£4.64 an ounce) compared with 5,845 ounces valued at £27,072 (£4.63 an ounce) in 1934. The average composition of the product shipped in 1934 was osmium 31.79 percent, iridium 29.18 percent, ruthenium 12.20 percent, platinum 11.46 percent, gold 0.85 percent, rhodium 0.51 percent, and undetermined 14.01 percent.

U. S. S. R. (Russia).—No authentic statistics on the production of platinum in the U. S. S. R. (Russia) in recent years are available. However, it is generally estimated that an annual output of 100,000 ounces of crude platinum has been maintained.

WORLD PRODUCTION

World production of platinum and allied metals, 1931–35, in troy ounces

[Compiled by M. T. Latus]

Country and product	1931	1932	1933	1934	1935
Australia:					
New South Wales: Placer platinum	283	336	113	180	98
Tasmania: Placer osmiridium	1,280	785	548	488	235
Belgian Congo: From refineries—					
Palladium		2,025	547	3,569	(1)
Platinum		96		1,254	(1)
Canada:					
Placer platinum	50	59	40	53	20
From refineries: [2]					
Platinum	44,725	27,284	24,746	116,177	105,335
Other platinum metals	26,918	37,593	31,009	83,932	84,772
Colombia: Placer platinum (exports)	44,311	16,055	44,543	54,216	38,020
Ethiopia: Placer platinum	6,430	4,823	3,215	5,644	6,320
Japan: Placer platinum	275	267	207	118	(1)
New Zealand: Placer platinum	1				(1)
Panama: Placer platinum					16
Papua: [3]					
Placer platinum		2		96	(1)
Placer osmiridium	20	1	29	4	(1)
Sierra Leone: Placer platinum	594	531	431	474	750
Union of South Africa:					
Platinum (content of platinum metals)[4]	41,220	7,766		26,369	19,735
Concentrates (content of platinum metals)[4]	5,943	1,480	2,386	11,372	11,494
Osmiridium [5]	6,306	6,523	6,712	5,088	5,047
U. S. S. R. (Russia): Placer platinum [6]	100,000	100,000	100,000	100,000	100,000
United States:					
Placer platinum	885	1,074	1,266	3,720	9,069
From refineries: [7]					
Platinum	5,397	1,694	1,050	1,062	1,361
Other platinum metals	2,729	1,150	707	1,273	1,122

[1] Data not 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] New platinum recovered in gold and copper refining of domestic material.

NICKEL

By R. B. Miller

SUMMARY OUTLINE

Nickel production and consumption reached an all-time high in 1935, although the year was marked by no major technologic discoveries. Estimated world deliveries of nickel metal in all forms from all sources during 1935 were 80,000 short tons compared with 61,000 tons in 1934 and 68,000 tons in 1929. The automotive industry continued to be the largest consumer.[1] Material increase in production indicated that mines and plants were being run to full capacity.

Efforts to achieve economic autarchy, or national self-sufficiency, prevalent in many countries during recent years, may account in part for the efforts made in Italy, Germany, Japan, and Soviet Russia to locate domestic reserves of nickel. The development of deposits in Brazil, Finland, and Netherland India is significant. Normal commercial development continued in Norway, Greece, New Caledonia, and Canada, the last-mentioned country maintaining its position as the world's principal source of both crude and refined nickel. During 1935 the quoted price of nickel and nickel semimanufactures continued steady at the level prevailing since 1929. Electrolytic nickel was quoted throughout the year at 35 cents a pound.

Salient statistics for nickel, 1933–35

	1933	1934	1935
World:			
Production [1] ....short tons	50,989	77,753	(2)
United States:			
Production, byproduct of copper refining ....do	126	157	160
Secondary production ....do	1,650	1,850	1,950
Imports [3] ....do	26,430	29,298	37,848
Exports [4] ....do	1,051	2,727	2,193
Price per pound [5] ....cents	35	35	35
Canada:			
Production ....short tons	41,632	64,344	69,044
Exports ....do	44,041	59,076	71,363
Imports ....do	496	345	286

[1] Approximate.
[2] Adequate information not available.
[3] Excludes "All other manufactures of nickel"; weight not recorded.
[4] Excludes "Manufactures"; weight not recorded.
[5] Price quoted by International Nickel Co. of Canada, Ltd., for electrolytic nickel at New York, in 2-ton minimum lots.

[1] Annual Report, International Nickel Co. of Canada, Ltd., Dec. 31, 1935.

Uses and consumption.—During the World War consumption of nickel reached a record height. At that time its use in the manufacture of alloys was developed to an unprecedented degree. Immediately after the cessation of hostilities large stocks of metallic nickel as well as surplus plant equipment threatened the industry. Technical research, directed toward increasing consumption through extending its use, has broadened the market for the metal to such a degree that maximum production has been necessary to satisfy industrial demands.

The demand for stainless steels and such alloys as 18–8 (chromium 18 percent, nickel 8 percent) has increased materially the consumption of the metal. Likewise, the use of corrosion-resisting light-weight steels and intermediate alloys, particularly in railway transportation, is a significant factor in the progress of the nickel industry. In transportation, nickel-bearing aluminum alloys and low-cost nickel-manganese cast steels are in greater demand. To meet the competition of other alloys, gray cast iron has been improved and hardened by the addition of nickel. Structural grades of bronzes have been improved mechanically and their cost decreased by the addition of nickel and tin. Welding rods are a recent development in the use of nickel-steel and monel metal. An outstanding development in the field of electrical plating is the perfection of the bright-plating process, by which nickel is deposited at a high rate of speed. Materials so plated require less grinding and buffing. By this process irregular shapes can be plated satisfactorily.[2]

Technical research has developed an outlet for nickel alloys in the food and beverage-manufacturing industries, where resistance to corrosion and the nontoxic qualities of the metal are major requirements. In the manufacture of chemicals, which requires equipment having a high degree of resistance to corrosion, the market for nickel and its alloys is ever increasing. Modern methods for the manufacture of phenol, caustic soda, and noncombustible synthetic solvents depend in part upon the use of nickel. Nickel and monel metal fabricates are being put to new use in the textile industries, especially where dyes come in contact with metal parts. The ever increasing demand for high-speed, heavy-duty machinery indicates an expanding market for nickel and its alloys, based upon the ability of this metal to resist heavy strains.

A large part of the nickel consumed annually is required in the manufacture of stainless steels, which are being used widely in automobile, railway car, and airplane manufacture. In marine transportation, in which corrosion resulting from contact with salt water is a serious problem, nickel alloys are considered essential. The corrosion-resisting properties of nickel are responsible for the extensive use for decorative purposes of nickel alloys in the building industry. The variety and extent of public-work projects and soil-conservation programs during the past few years, to which an increase in the use of excavating and road-building machinery is due, account for part of the greater consumption of nickel. Nickel is used in the production of crushers, cars, pumps, drills, etc.—equipment that must withstand corrosion, shocks, abrasion, and severe temperature changes and that is essential in the extractive industries. In the petroleum industry,

[2] Stanley, R. C., The Nickel Industry in 1935. International Nickel Co., New York, Dec. 26, 1935, 35 pp. Mathewson, C. H., Modern Uses of Nonferrous Metals, New York, 1935, pp. 229–269.

nickel and its alloys play a prominent part in both production and refining. Nickel coinage continued to expand in 1935, and it is estimated that over 4 billion nickel pieces, representing 77 denominations and issued by 28 countries, are now in use. As an ornamental and decorative material, nickel and its alloys continue to find a widening outlet in the jewelry industry.[3]

WORLD PRODUCTION

World production of nickel (content of ore) in 1931–35, by countries, in metric tons

	1931	1932	1933	1934	1935
Australia (Tasmania)	(1)	1	9	(2)	(2)
Brazil			31	39	5
Canada (Ontario)	29,786	13,756	37,768	58,371	62,830
Greece	649	953	1,377	(2)	(2)
India, British	817	945	989	1,188	(2)
New Caledonia	5,500	5,000	5,000	8,600	(2)
Norway	531	975	969	1,334	(2)
Southern Rhodesia					(3)
U. S. S. R. (Russia)				863	(2)
United States	338	177	114	142	145
	37,621	21,807	46,257	(2)	(2)

1 Production was less than 1 metric ton.
2 Data not available.
3 Production of nickel ore, 58 metric tons; nickel content not stated.

UNITED STATES

The domestic supply of nickel is obtained from secondary sources, chiefly from scrap metal, although a small amount is recovered as a byproduct in the refining of copper. No new discoveries of nickel ore were reported during 1935.

Since early colonial times nickel mines have been operated for relatively short periods in Pennsylvania and Missouri. Nickel-bearing ores have been reported in Arizona, Arkansas, California, Colorado, Connecticut, Idaho, Iowa, Maine, Massachusetts, Nevada, New Mexico, North Carolina, Oregon, Virginia, and Washington. Developmental work was done at two properties in Montana during 1935, and an analysis of the sulphide material indicates the presence of 1.85 percent copper and 0.55 percent nickel.[4]

Nickel content of nickel salts and metallic nickel produced in the United States as a byproduct in the electrolytic refining of copper, 1926–35

Year	Short tons	Value	Year	Short tons	Value
1926–30 (average)	471	$285,642	1933	126	$62,913
1931	373	202,406	1934	157	108,414
1932	195	88,515	1935	160	129,500

Secondary nickel recovered as metal and in nonferrous alloys and salts in the United States, 1926–35

Year	Short tons	Value	Year	Short tons	Value
1926–30 (average)	3,636	$2,545,200	1933	1,650	$1,155,000
1931	2,070	1,449,000	1934	1,850	1,295,000
1932	1,450	1,015,000	1935	1,950	1,365,000

3 Manufacturing Jeweler, vol. 94, no. 14, Providence, R. I., July 18, 1935, p. 16.
4 Howland, A. L., Peoples, J. W., and Sampson, E., The Stillwater igneous complex and associated occurrences of nickel and platinum group metals: Montana Bureau of Mines and Geol., Misc. Contrib. 7, Butte, Mont., April 1936, 15 pp.

Imports and exports.—The value of nickel imports in 1935 was $17,181,538 compared with $13,431,333 in 1934. Exports of nickel were valued at $2,747,751 compared with $2,712,263 in 1934.[5]

Value of nickel imported into and exported from the United States, 1925–35

Year	Imports for consumption			Exports				
	Nickel, nickel ore and matte, nickel oxide, and alloys of nickel with copper, etc.	Manufactures and nickel sheets and strips	Total	Nickel, Monel metal, and other alloys	Manufactures	Nickel silver or German silver in bars, rods, or sheets	Nickel-chrome electric resistance wire	Total
1925–29 (average)	$11,830,285	$177,747	$12,008,032	$772,008	$846,292	$296,272	(1)	[2]$1,920,972
1930	12,750,721	128,106	12,878,827	1,207,612	923,547	243,528	(1)	[2]2,429,964
1931	7,565,824	48,010	7,613,834	648,026	438,333	72,350	$253,107	1,411,816
1932	4,660,489	33,941	4,694,430	635,399	432,173	43,219	250,681	1,361,472
1933	10,746,721	15,696	10,762,417	546,878	504,760	57,645	285,033	1,394,316
1934	13,409,338	21,995	13,431,333	1,505,286	738,515	95,562	372,900	2,712,263
1935	17,128,213	53,325	17,181,538	1,207,048	1,101,476	114,218	325,009	2,747,751

1 Not separately recorded.
2 Includes nickel salts valued at $6,400 in 1929 and $55,277 in 1930; not separately recorded for other years.

Nickel imported for consumption in the United States, 1933–35, by classes

Class	1933		1934		1935	
	Pounds	Value	Pounds	Value	Pounds	Value
Unmanufactured:						
Nickel ore and matte	19,220,399	$2,522,682	11,845,865	$1,608,515	15,924,300	$2,087,259
Nickel alloys, pigs, bars, etc	31,621,203	7,850,443	45,799,511	11,616,100	58,858,726	14,877,182
Nickel oxide	2,019,155	373,596	950,236	184,723	912,907	163,772
Manufactured:						
Nickel silver or German silver in sheets, strips, and rods			75	74		
All other manufactures of nickel	(1)	15,696	(1)	21,921	(1)	53,325
		10,762,417		13,431,333		17,181,538

1 Quantity not recorded.

Nickel exported from the United States, 1933–35, by classes

Class	1933		1934		1935	
	Pounds	Value	Pounds	Value	Pounds	Value
Nickel; Monel metal and other alloys	1,509,301	$546,878	4,576,459	$1,505,286	3,452,590	$1,207,048
Manufactures	(1)	504,760	(1)	738,515	(1)	1,101,476
Nickel-chrome electric resistance wire	262,743	285,033	345,482	372,900	264,633	325,009
Nickel silver or German silver in bars, rods, or sheets	330,176	57,645	531,339	95,562	668,448	114,218

1 Quantity not recorded.

CANADA

The record recovery of the Canadian nickel industry has had a beneficial effect throughout Canada. Total production in 1935 exceeded the output for 1934 by 7.6 percent, the Sudbury district of Ontario accounting for nearly all of the output.

Falconbridge Nickel Mines, Ltd.—The company owns a mine and smelter at Falconbridge, Ontario, and a refinery at Kristiansand, Norway, in addition to investments in other mining and smelting properties. The ore produced by this company, according to its annual report for 1935, averaged 1.93 percent nickel and 0.91 percent copper. In 1935, 302,337 short tons of ore were treated. Sales

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.

during the year aggregated 10,829,865 pounds of nickel and 5,129,483 pounds of copper. During the year the main operating shaft was sunk to 1,400 feet, and through lateral exploration a large body of new ore was added to the known reserves. During the year the company added 633 claims to its holdings. The capacity of the refinery was increased to 7,000 short tons of nickel per year.

International Nickel Co. of Canada, Ltd.[6]—In addition to several inactive mines at Sudbury, this company has two operating properties known as the Frood and Creighton mines; two smelters, one at Copper Cliff and the other at Creighton; and two refineries, one at Copper Cliff, full control of which was acquired during 1935, and another at Port Colborne, Ontario. The International Nickel Co. of Canada, Ltd., controls the Mond Nickel Co., which, in turn, owns the Acton Platinum Metals Refinery, London, and a refinery and colliery near Swansea, Wales. The company also owns Henry Wiggin & Co., Ltd., and Birmingham Electric, Ltd., of Birmingham, England, and the Zenith Works of Glasgow, Scotland. In the United States the International Nickel Co. of Canada, Ltd., owns a rolling mill at Huntington, W. Va., and a foundry at Bayonne, N. J. During 1935 plans were made to spend about $9,400,000 in new works and improvements at the Sudbury properties of the company. The smelting and refining equipment was in operation during the year, and milling operations reached a record high—8,000 tons daily.

Other Canadian mines.—In the Sudbury district Van Nickel Mines, Ltd., has been incorporated to operate properties near Worthington and a refinery at Hamilton, Ontario. It is reported that the refined product will be shipped to the United States. British Columbia Nickel, Ltd., during 1935 blocked out 950,000 tons of ore, averaging 1.3 percent nickel and 0.4 percent copper, near Hope, British Columbia.[7]

OTHER COUNTRIES

New Caledonia.—In 1935 certain Japanese groups showed pronounced interest in New Caledonia nickel properties. The Japanese organization is reported to have a nickel mine on the eastern coast of Kua. The Karoola mine located near St. Louis, began operations during 1935. The ore from this property is reported to contain over 5 percent nickel. The principal nickel deposits of New Caledonia are operated by the Société Calédonickel, a company formed by the amalgamation of the Société le Nickel and La Société Calédonia. The deposits are in the N'goye district, the smelter is at Nouméa, and the nickel matte is shipped to France and Belgium.

Japan.—For several years the Japan Mining Co. has treated ferronickel at its Hinodi plant, but the amount of metal recovered from this source has been negligible. A new plant has been erected at Saganoseki, where this type of ore will be treated. Two thousand tons of New Caledonian ore were imported during 1935 for treatment at a refinery at Omachi. The Oceania Mining Co., controlled by the Nippon Mining Co. and the Masuyada Trading Co., has acquired and will develop a mine in New Caledonia. During 1935 the Japanese Electroindustry Co. produced a small tonnage of 99.8-percent nickel at its aluminum plant in Yokohama, using ores from the Hyogo prefecture.[8]

[6] Annalist, International Nickel Co. of Canada, Ltd.: vol. 46, New York, Nov. 22, 1935, p. 721.
[7] North, C. B., The nickeliferous Deposits near Hope: The Miner, vol. 8, no. 3, Vancouver, March 1935, pp. 23-25.
[8] Chemical Age, Far Eastern Chemical Notes: Vol. 34, no. 868, London, Feb. 15, 1936, p. 157.

India.—The Burma Corporation, Ltd., continued shipping to Hamburg, Germany, speiss composed of about 25 to 30 percent nickel and some copper, sulphur, and cobalt, which is mined in the Northern Shan States.[9]

Brazil.—Progress was made during 1935 in the development of Brazilian nickel deposits.[10] The most important deposits located thus far are in the State of Goyaz. The Empreza Commercial de Goyaz S/A operates these properties, and over 2 million tons of ore averaging 5 percent nickel have been outlined. Transportation difficulties have influenced exploitation of these deposits adversely.

Many nickel deposits occur in the State of Minas Geraes, the most important of which is the Livramento deposit, which carries ore running from 2 to 5 percent nickel.[11] The Siemens Co. of Germany is reported to have erected a blast furnace at this locality for the Companhia Nickel de Brasil.

Other deposits of nickel have been reported in the States of Bahia and Rio de Janeiro.

Thus far Brazil has exported no metallic nickel.

U. S. S. R. (Russia).—For years exploratory work has been under way in Soviet Russia in an effort to be independent of foreign sources for its nickel.[12] Nickel deposits occur in the vicinity of Orsk and Aktubinsk in the Ural Mountains. In 1934 a refinery was completed at Ufalei with a planned capacity of 3,000 tons of ferronickel. Although the output of this plant is increasing, the established quota has not been reached. In 1935 a plant with a productive capacity of 500 tons of metallic nickel was under construction at Orsk. This plant is expected to begin operations by 1937. It is reported that plans are under consideration for the construction of comparatively small nickel plants in the Kola Peninsula and in the Norilsk district, Siberia.

Germany.—Although nickel ore was produced at Frankenstein, Prussian Silesia, during the World War, the annual output running as high as 100,000 tons per year, none of the metal has been produced from domestic ores in recent years. The Gewerkschaft Frankensteiner Nickelwerke, a property of the Krupp Co. of Essen, operates a nickel smelter but obtains its ore from Greece.

Italy.—Although in the past nickel has been recovered from ores produced in Sardinia and the Province of Novara, northwestern Italy, cessation in the exploitation of Italian nickel deposits accompanied the development of the richer oxidic ores of New Caledonia.

Norway and Greece.—Little change occurred in either country during 1935. Mining activity generally expanded in Norway during the year, and the Falconbridge Mines, Ltd., made known its plan to expand its Norwegian smelter some time in 1936. The nickel deposits of Locris and Boetia, Greece, remained the principal sources of Greek nickel ore, the greater part of which was shipped to Germany in 1935.

Finland.—In Finland, the Mond Nickel Co. began exploratory work of the Petsamo concession.

[9] Roy, S. K., and Krishnaswamy, S., Notes on the Microscopic Character of Bawdwin Ores: Geol., Min., and Met. Soc., India, Q. J., vol. 7, no. 2, Calcutta, June 1935, pp. 59–69, 6 pl.

[10] Moraes, L. J. de, Nickel no Brasil: Serviço de Fomento da Producção Mineral, Bol. 9, 168 pp. (Portuguese), Rio de Janeiro, 1935. Reviewed by M. C. Malamphy in Mining and Metallurgy, vol. 17, no. 351, New York, March 1936, p. 161. Also Malamphy, M. C., More Respect Claimed for Brazil's Nickel Deposits: Vol. 16, no. 342, New York, June 1935, p. 270.

[11] Guerreiro, A., [Nickel at Livramento]: Rev. chim. ind., vol. 4, Rio de Janeiro, 1935, pp. 104–107, 140–142, 183–186.

[12] Mining World, Russian Nickel Industry: Vol. 130, no. 3385, London, Feb. 15, 1936, pp. 153–154. Russian Economic Notes, Bureau of Foreign and Domestic Commerce, no. 296, May 15, 1935, p. 8, no. 316, Mar. 30, 1936, pp. 7–8.

MINOR METALS: BERYLLIUM, BISMUTH, CADMIUM, COBALT, SELENIUM, TANTALUM AND COLUMBIUM, TELLURIUM, TITANIUM, AND ZIRCONIUM

By Paul M. Tyler and A. P. van Siclen [1]

SUMMARY OUTLINE

Many of the minor metals are recovered as byproducts in the production of copper, lead, or zinc. Due largely to the intensive research work along the lines of commercial applications the consumption of these minor elements increased during the depression; and, when the pace of industry quickened, accumulated supplies were depleted, notwithstanding the fact that stocks of the major metals still remained. The current demand for certain of these byproduct metals in 1935 tended to outstrip the supply, which in turn is limited by the demand for the major metals.

BERYLLIUM

Interest in the supply and uses of beryllium has increased materially in recent years, and in 1935 the output appears to have attained larger proportions than ever before. Research continues to disclose new uses for beryllium alloys, but unalloyed the metal has no commercial applications. In the United States, beryllium-copper alloys have leading interest; in Germany, considerable progress has been made with nickel-base beryllium alloys. Close cooperation is maintained between the American producers of beryllium master alloys and leading German interests.

Two companies in the United States continue to share the responsibility for furnishing primary beryllium products. The Beryllium

[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.

Products Corporation produces master alloys, chiefly beryllium copper as well as beryllium oxide, and the Brush Beryllium Co., Cleveland, Ohio, reports encouraging results in the field of beryllium compounds. In 1935 the Beryllium Products Corporation transferred its plant facilities from Marysville, Mich., to Temple, Pa., near Reading. At least one large chemical company is expected to engage in the production of beryllium in 1936. The beryllium situation in Germany roughly parallels that in the United States, as there are two producers whose interests are segregated in the same fashion as in this country. Heraeus Vacuumschmelze A. G. (Heraeus Vacuum Smelting Co.) of Hanau specializes in the manufacture of beryllium alloys and maintains close contact with the Beryllium Products Corporation of America. Since 1934 the operations of the Heraeus Vacuumschmelze A. G. have included the beryllium activities of Siemens & Halske A. G. This company was for many years an important factor in German research and production. The other producer of beryllium in Germany is the Deutsche Gold-und-Silberscheideanstalt of Frankfurt-am-Main, whose activity is confined mainly to producing oxide and crucibles.

Uncertainty as to the probable magnitude of raw-material supplies has tended to retard development of the beryllium industry. Offerings of beryl, however, continue to be encouraging, the supplies coming to a considerable extent from British India in 1935, although Brazil, Argentina, and South Africa also seem to be important, and our own domestic contributions appear likely to be susceptible of large increase. Italian interests are said to be contemplating developing African ores as well as utilizing home supplies, which are probably meager. Madagascar exported 132 metric tons during the first 9 months of 1935 compared with 164 tons during the corresponding period of 1934. Statistics from other countries are not now available. In Canada, nothing was done in 1935 in the way of beryl production. The beryl pegmatite in Lyndoch Township, Renfrew County, Ontario, was worked during part of the year for feldspar; but the richer feldspar zones are away from beryl shoots, and there was no production of beryl. In Maine 50 beryl deposits are to be investigated, according to State Geologist Freeman F. Burr.

A forward step in the achievement of cheaper beryllium alloys is the adoption in this country of the production of beryllium copper directly by electrolysis without going through the pure metal stage.

Prices.—Master alloys of beryllium with copper, nickel, and ore are sold in the United States at $30 to $40 per pound of contained beryl. The selling price for finished beryllium-copper alloys containing approximately 2.25 percent beryllium, as marketed by leading copper fabricators, is about $1 per pound. Beryl was quoted at $30 to $35 per short ton f. o. b. mine throughout 1935. The German price for minimum 98-percent metal remained at 600 marks per kilo until September, when the quotation was reduced to 500 marks.

Uses.—Interesting new uses reported during the year include the application of cast beryllium copper to molds for the manufacture of plastics. It is stated that under favorable conditions this innovation may provide a satisfactory and sometimes cheaper substitute for steel dies and that cast-beryllium copper containing 2.75 percent beryllium also may be employed for metal-forming dies. Beryllium copper may be utilized also for severe bearing and worn gear problems. Among ternary alloys, beryllium-cobalt-copper may be mentioned; it can be hardened by heat treatment alone to approximately 95 Rockwell B and is said to have a conductivity of over 50 percent of copper. Uses for beryllium in the field of light metal alloys and as a tarnish-resistant addition to silver alloys are still in the experimental stage. Beryllium oxide is one of several oxides said to offer possibilities in the production of plastic and fire-resisting ceramic materials and laboratory apparatus.[2]

Sintered beryllium oxide of a high degree of purity is claimed to be suitable for use in grinding or polishing hard alloys.[3] A more detailed discussion of actual and potential uses for beryllium will be found in the chapter on Minor Metals of Minerals Yearbook, 1935.

BISMUTH

As in previous years, bismuth was recovered in the United States by the American Smelting & Refining Co. (from Betterton-Kroll skimmings from Parkes refining) and the United States Smelting, Refining & Mining Co. (from electrolytic slimes). Additional supplies have also become available through utilization of byproduct resources of the Anaconda Copper Mining Co., the American Metal Co. (which sends Parkes skimmings to American Smelting & Refining Co.), and the Boliden Mining Co. (Sweden). Research was in progress at the University of Utah on the metallurgy of the bismuth ore from the Alta Champion mine;[4] the ore shoot is 3 feet wide and 25 feet long, with a vertical extent of over 800 feet, and averages 3 percent.

In July domestic quotations for bismuth dropped from $1.10, the figure in effect since the previous October, to 90 cents, but after remaining at this level until October 1935 rose to $1 per pound. A similar crescent was described by London quotations, which opened the year at 4s. per pound, declined to 3s. 6d. on July 19, and recovered to 4s. in October. The latter price, equivalent to around 99 cents in London, is roughly the same as the New York quotation, notwithstanding the 7½-percent duty chargeable upon imports into the United States.

Imports.—Recorded figures covering imports of bismuth in 1935 were the largest since 1922. This may or may not indicate a noteworthy increase, inasmuch as the bulk of bismuth of foreign origin consumed in the United States is brought in as intermediate metallurgical products, chiefly lead bullion. Import statistics, as reported for recent years, are shown in the following table.

Bismuth and "compounds, mixtures, and salts of bismuth" imported for consumption in the United States, 1931–35

Year	Bismuth		Compounds, mixtures, and salts of bismuth	
	Pounds	Value	Pounds	Value
1931	7,718	$8,191	951	$5,318
1932	28,620	29,295	3,095	5,283
1933	28,530	28,504	36	206
1934	19,327	19,927	305	1,814
1935	102,051	78,061	871	4,798

[2] Chemical and Metallurgical Engineering, vol. 42, no. 9, September 1935, p. 519.
[3] Reichmann, Reinhold (to Siemens & Halske A. G.), U. S. Patent 1984841, Dec. 18, 1934.
[4] Watson, George H., Mining Bismuth in Utah: Mining Cong. Jour., vol. 21, no. 10, October 1935, pp. 25, 36.

New minerals.—The discovery of two new bismuth minerals was reported from South Africa during 1935. One, bismoclite, is a soft, creamy white, heavy mineral (hardness, 2.5; specific gravity, 7.36), with the probable composition, BiOCl. The other, baksputite, is definitely harder (3.5 on Mohs' scale) and of about the same specific gravity; its color ranges from yellow to iron-gray and, as the analysis shows 22.92 Bi_2O_3, the indicated formula is $6PbO.Bi_2O_3.3CO_2$.

Foreign developments.—Froth flotation is employed for recovering a bismuth-gold concentrate at the Biggenden Bismuth Products Mines, Ltd., in Queensland, Australia. From France comes word that bismuth recovery was undertaken by Société des Mines et Usines de Salsigne, and in Sweden the bismuth plant of the Boliden Mining Co. was extended considerably.

CADMIUM

The demand for cadmium, once the unwanted stepchild of zinc, continued at an accelerated pace; and, notwithstanding an increase in domestic production to a new all-time record, an acute shortage developed in the late summer. The domestic quotation rose from 55 cents, where it had remained since 1931, to 65 cents in April, 70 cents in August, 85 cents in October, and $1.05 in December. These prices, however, were largely nominal, as little or no metal was available beyond that contracted for in advance, and actual sales were probably transacted at higher figures. The London market quoted 1s. (about 24 cents) per pound, in January but rose steadily throughout the year to 4s. 9d. ($1.17) in December. Including the American duty of 15 cents a pound the New York parity of the London price at the close of the year was almost 30 cents a pound higher than the domestic quotation, whereas in January it had been about 15 cents lower. Although the demand for cadmium sprang primarily from the needs of American automobile manufacturers, this disparity in price reflects the difficulty experienced in supplying requirements of the United Kingdom and the Continent.

First to suffer was the cadmium-plating industry, which in recent years has served as a fairly substantial and dependable outlet for cadmium. Being reluctant to risk further shortages of cadmium with attendant higher prices, a move was made to develop substitutes in this field. It is reported that several bright zinc-plating solutions have become available which may tend to displace the more expensive cadmium product.

Anxiety has been expressed by those in close touch with the situation that cadmium depends for its market too much upon the automobile industry, which is notoriously fickle in its demands. Whether such fears are justified remains to be seen, but at any rate 1935 will be long remembered as a boom year in the cadmium trade.

Domestic production.—Cadmium was produced in the United States in 1935 by the same companies listed in the chapter of this series for last year. Eight companies reported recovering the metal (two of which sold only from stock in 1934), and five manufactured cadmium compounds—mainly sulphide, selenide, and lithopone. The total production expanded to 3,984,000 pounds, topping the previous year's high record by almost 20 percent.

Uses.—Of leading interest from an economic standpoint is the sudden adoption on a large scale of cadmium as a bearing metal by the motorcar industry. Prior to its use in this field fully 90 percent of the cadmium output went into rustproofing nuts, bolts, and other small parts for automobiles.

Cadmium produced and sold in the United States, 1931–35, in pounds

Year	Metallic cadmium		Cadmium compounds produced (estimated cadmium content)	Total produced
	Produced	Sold		
1931	1,050,529	1,544,414	337,200	1,388,000
1932	799,501	1,154,151	259,800	1,059,000
1933	2,276,933	2,447,014	401,400	2,678,000
1934	2,777,384	2,472,971	566,700	3,344,000
1935	3,477,091	4,023,900	507,400	3,984,000

Although the silver-cadmium alloys have been publicized extensively, nickel-cadmium alloys have equal if not greater importance as bearing metals. For one such combination (Asarcoloy No. 7) it is claimed that compared with ductile babbitts the compression strength or load-carrying capacity is much greater at all temperatures and the ductility is a little better; compared with tin babbitts the hardness is greater at all temperatures and the coefficient of friction is lower; the alloy will bond directly with copper or steel, forming a strong, ductile joint very similar to a weld; the microstructure is similar to that of babbitt; and the melting point is 604° F., or about 130° above that of babbitts.[5]

Another bearing combination involving the use of cadmium as the base—along with 0.2 to 1.5 percent Cu and 0.1 to 0.75 percent Mg—is said to have higher strength, hardness, and melting point, together with improved steel-bonding and speed characteristics. A typical alloy for connecting rod bearings has 0.5 percent Cu and 0.25 percent Mg; more copper and magnesium can be introduced for heavy-duty bearings, such as for railway vehicles.[6]

Cadmium-copper (0.8 to 1 percent Cd) is reputed to have the best combination of electrical and mechanical properties of any material available for trolley wires and other electrical uses.[7]

A heat-insulating material was patented which calls for a mixture of powdered metal (zinc or cadmium), which is melted and the pressure lowered to permit the metal to evaporate and produce a porous mass in whose cells the metal, cooled under vacuum, condenses.[8]

Another interesting patent describes the coating of steel wool with cadmium by electrodeposition, the contacting filaments being separated to insure a uniform deposit.[9]

Imports.—During 1935, imports of cadmium metal were over 30 percent greater than in the previous year but considerably below the record years 1928 and 1929. Belgium and Norway were important contributors, supplying, respectively, 38 and 29 percent of total imports into the United States; France furnished 18 percent, and the remaining 15 percent was divided among the United Kingdom, Canada, Netherlands, and Germany.

Imports of metallic cadmium from 1926 to 1935, inclusive, are shown in the following table.

[5] Swartz, Carl E., Cadmium-Nickel as a Bearing Alloy: Metal Ind. (N. Y.), vol. 33, no. 4, April 1935, p. 142.
[6] Bohn Aluminum and Brass Corporation, Cadmium Bearing Metals: British Patent 439616.
[7] Preston, G. W., Cadmium Copper for Overhead Lines: Elec. Review, vol. 116, Mar. 15, 1935, pp. 372–373.
[8] Munters, Carl G., Heat Insulation Formed of Glass Foam and Metal: U. S. Patent 2012617, Aug. 27, 1935.
[9] Miller, E. H., and Leeson, W. S., Cadmium-Plated Steel Wool: British Patent 429798.

Metallic cadmium imported for consumption in the United States, 1926–35 [1]

Year	Pounds	Value	Year	Pounds	Value
1927	22,400	$13,172	1931	271	$183
1928	233,101	128,901	1933	108,861	31,704
1929	214,307	184,527	1934	125,955	35,305
1930	40,105	27,915	1935	185,387	57,199

[1] None imported in 1926 and 1932.

The industry in foreign countries.—The value of cadmium production in Canada in 1935 was $441,203 compared with $95,665 in 1934. In both years the output originated entirely in the zinc-refining operations of the Consolidated Mining & Smelting Co., of Trail, British Columbia.

The Hudson Bay Mining & Smelting Co. was constructing a cadmium refinery, to begin operating in January 1936, for treatment of accumulated residues as well as the current output from the refinery. At the beginning of 1935, there was an accumulation of 5,495 tons of cadmium precipitate averaging 3.63 percent Cd, 6.76 percent Cu, and 55 percent Zn.

An interesting development in the consumption of cadmium-red pigments in Germany is recorded in the announcement that facilities of the Reichspost, including all mail boxes, trucks, collection vehicles, and autobusses operated by the German post, have been painted red. Cadmium red is produced from cadmium sulphide and selenium.[10]

Potential supplies of 40 to 50 tons of cadmium might be recovered annually from zinc ores by two Italian companies—Società Meniere di Monteponi and the Perlusolu-Penarroya Co., according to Sansone.[11]

Another source of cadmium previously untapped is the flue dust accumulated at the Otavi mines at Tsumet (British South-West Africa). Shipments of the flue dust were sent to Germany in 1934, and last year recovery of cadmium was undertaken.[12]

World production of cadmium, 1931–35, by countries, in kilograms

[Compiled by R. B. Miller]

Country	1931	1932	1933	1934	1935
Australia [1]	201,921	160,852	162,074	172,588	(2)
Belgium [3]	2,903	23,300	83,200	196,700	183,200
Canada	146,573	29,676	111,602	133,179	250,018
France	82,176	124,488	161,000	226,000	(2)
Germany	39,300	[4] 40,000	[4] 40,000	[4] 40,000	[4] 30,000
Italy	8,000	6,238	6,934	8,345	(2)
Japan [5]	(2)	4,539	3,047	(2)	(2)
Mexico	(6)	(6)	(6)	(6)	(6)
Norway [7]	92,000	109,000	139,734	137,324	(2)
Poland	109,000	34,602	53,083	143,557	120,700
South-West Africa				207,274	(2)
U. S. S. R. (Russia)				2,585	12,000
United Kingdom	2,171	1,683	15,922	6,073	(2)
United States:					
Cadmium compounds [8]	152,951	117,843	182,071	257,049	(2)
Metallic cadmium	476,509	362,646	1,032,794	1,259,794	(2)

[1] Smelted in Tasmania.
[2] Data not available.
[3] Exports of domestic product. Production figures not available.
[4] Approximate production.
[5] Output of the Miyagi plant of the Kyoritsu Mining Co.
[6] The Mexican Government reports the total cadmium content of material produced in Mexico as follows: 1931, 462,907 kilos; 1932, 86,174 kilos; 1933, 1,291,867 kilos; 1934, 334,714 kilos; 1935, 597,527 kilos. This material is exported for extraction of cadmium elsewhere; therefore, to avoid duplication of figures the data are not included in this table.
[7] Output of the Eitrheim plant of the Norsk Zinkkompani A/S.
[8] Estimated cadmium content.

[10] Bureau of Foreign and Domestic Commerce, Germany Increases Use of Cadmium Red Pigments: World Trade Notes on Chemicals and Allied Products, vol. 9, no. 40, Oct. 5, 1935, p. 8.
[11] Industrial and Engineering Chemistry (News Ed.), Recovery of Cadmium from Zinc Ores Studied: Vol. 13, no. 3, Feb. 10, 1935, p. 47.
[12] Metal Bulletin (London), no. 2012, Aug. 9, 1935, p. 17.

COBALT

In the autumn of 1935 the cobalt syndicate, comprising leading Belgian, Canadian, Northern Rhodesian, and Moroccan producers, was strengthened by addition of the Association of German Cobalt Producers. The latter association, formed in October 1934, is composed of 12 concerns, only 2 of which produce cobalt metal, the others being engaged in manufacturing cobalt oxides and salts. The former syndicate controlled about 80 percent of the world output, and addition of the German producers has increased the percentage substantially.

Cobalt ore (10- to 12-percent grade) was quoted at 30 cents per pound during the first 9 months of the year, and for 12- to 14-percent grade ore 35 cents was asked. In October, however, following reentry of the Deloro Smelting & Refining Co., Ltd., into the cobalt market, a broad scale of price quotations was inaugurated ranging from 40 cents per pound for ore assaying at least 8 percent and up to 9 percent cobalt to 55 cents when the cobalt assay exceeds 14 percent. The New York contract price for cobalt metal, less quantity discounts, was equivalent to about $1.25 a pound, delivered, and the London price during the first half of the year was 5s. to 5s. 3d. ($1.20 to $1.26); in July the price range was expanded to 5s. to 5s. 4d. ($1.24 to $1.32). The domestic quotation for black oxide, which has remained at $1.35 per pound (71 percent Co), was adjusted in August to $1.39 for lots of 350 pounds or more and $1.49 for smaller quantities. The London market quoted 4s. to 4s. 6d. ($0.97 to $1.08) in January, 4s. 3d. to 4s. 9½d. ($1.05 to $1.18) in July, and 4s. 10½d. to 5s. ($1.19 to $1.23) in December. Gray oxide quotations rose from 4s. 6d. to 4s. 11d. ($1.08 to $1.19) in January to 5s. to 5s. 4d. ($1.24 to $1.32) in July.

An important contribution to the technology of cobalt was made during the year at the Bureau of Mines Experiment Station at Rolla, Mo., where the flotation concentration of Nevada cobalt ores was worked out successfully. The cobalt material, erroneously called heterogenite, proved to be stainierite.

Late in the year discovery of a 30-foot vein of cobaltite containing 5 percent cobalt was reported 18 miles northwest of Butte, Mont. Cobalt and nickel were said also to have been found in the vicinity of Ovington, Wash.

Uses.—Among the most important metallurgical uses of cobalt are for high-speed cutting steels and permanent magnets. The patent literature is rich in descriptions of alloy-steel combinations employing various percentages of cobalt. Two interesting combinations mentioned in a German review [13] of recent patents for magnet steel include an alloy containing 7 to 40 percent Ni, 3 to 20 percent Al, and 0.5 to 40 percent Co, the balance being Fe, and another with 1 to 5 percent Cr, 7 to 30 percent Ni, 3 to 15 percent Al, 0.5 to 40 percent Co, and less than 1.5 percent C. Other important uses of cobalt are for stellite alloys, superhard carbide cutting-tool materials, as an alloy with aluminum, and as a catalyst for synthetic processes. An interesting application for a Co-Cr-W alloy (stellite?) is in hard-facing blades of shears used for cutting off the surplus from the suction mold

[13] Metallwirtschaft, vol. 14, no. 15, Apr. 12, 1935, pp. 290–292.

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for making blown water glasses. The glass is red-hot and plastic when cut, so the blades operate at extremely high temperatures. Only 0.10 pound of hard-facing alloy is required to protect each blade.[14]

Cobalt anodes have been employed successfully in the mordanting of fabrics by electrolysis.[15]

That cobalt, like iron, may form the bases of mineral tannages, is suggested by Lloyd.[16] Chrome leathers are all green, iron leathers are brown, and other metals might give leathers of a more convenient color in the crust for special purposes.

Imports.—On page 592 of Minerals Yearbook 1935, the reference was made to shipments by the Rhokana Corporation of "crude cobalt-bearing residues", aggregating 439,476 pounds valued at $150,263. Previously reported by the Bureau of Foreign and Domestic Commerce as "ore" these shipments were later submerged in the classification "metallic mineral substances, not specially provided for", and import tables that follow have been corrected. In 1935 shipments from the Rhokana Corporation were 378,848 pounds valued at $133,428. Even after allowing for this correction, the imports of cobalt ore in 1935 declined 44 percent in quantity and slightly also in value, whereas imports of metal and compounds, especially oxide, increased substantially.

Cobalt ore, cobalt metal, oxide, and other compounds of cobalt imported for consumption in the United States, 1932–35

	1932		1933		1934		1935	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Cobalt ore	27,193	$12,516	556,119	$117,261	748,513	$47,435	419,110	$46,608
Cobalt metal	123,112	147,925	281,713	331,828	506,119	599,791	563,866	630,289
Oxide	225,896	220,497	568,057	413,584	328,730	258,172	557,083	503,445
Sulphate	51,048	12,040	51,045	13,225	43,590	11,350	80,082	23,333
Other salts	41,050	18,586	48,186	14,607	197	395	472	679

Cobalt and cobalt ore imported into the United States, 1933–35, by countries

Country	1933		1934		1935	
	Pounds	Value	Pounds	Value	Pounds	Value
Australia	76,377	$5,917	76,388	$6,719	34,225	$2,184
Belgium	252,990	315,747	431,750	518,856	498,659	559,543
Canada	461,663	85,619	708,850	81,553	384,885	44,424
France			1,602	2,195		
Germany	37,687	39,930	36,042	37,903	63,007	67,852
Japan	2,400	62				
Morocco	2,235	256				
United Kingdom	4,480	1,558			2,200	2,894
	837,832	449,089	1,254,632	647,226	982,976	676,897

THE INDUSTRY IN FOREIGN COUNTRIES

Canada.—Output of Nipissing Mines Co. increased, 918 tons of cobalt ore being shipped in the 5 months ended July 31 compared with 360 tons for all of 1934. Increased tonnages of cobalt-silver

[14] Steel, Hard-Facing Glass Shearing Blades: vol. 97, no. 23, Dec. 2, 1935, p. 46.
[15] Downie, C. C., A New Use for Cobalt: Rayon and Melliand Textile Monthly, vol. 16, 1935, p. 35.
[16] Lloyd, D. Jordan, Leather: Chem. Industries, vol. 37, no. 1, July 1935, p. 37.

ores were shipped from the Cobalt camp, in part from reworking old dumps. Massive smaltite was found over a width of 3 inches on the 450-foot level of Smith Cobalt; silver values were low, but smaltite was bagged and shipped as cobalt ore.

Canada's total production of cobalt—including metal and metallic content of oxides sold and of ores and residues exported—amounted to 679,943 pounds valued at $512,224 in 1935 compared with 594,671 pounds valued at $592,497 in 1934. The value of exports of cobalt alloys, metal, oxides, salts, and ores declined from $614,364 in 1934 to $497,092 in 1935; tonnage figures are not available.

Germany.—Under a decree issued in April 1935 cobalt was included with a number of other metals restricted from use in any form for the manufacture of products for the domestic market. However, this prohibition was never really enforced, as the order was rescinded before expiration of the 3-month period of grace allowed.

Japan.—After several years of experimenting, the Japan Cobalt Mining Co. succeeded in producing metallic cobalt and cobalt oxide on a commercial scale. Ore supplies are obtained from the Nagatomura cobalt-copper deposits, which are said to be ample to furnish about 3 tons monthly for 30 years. Japan's annual consumption of cobalt has been estimated at 40 tons of metal and 60 tons of oxide, nearly all of which is obtained from Canada.[17]

Northern Rhodesia.—According to the annual report of the Rhokana Corporation, sales of cobalt during the year ended June 30, 1935, were 711,132 pounds compared with 621,153 pounds in the corresponding period of the previous year.

U. S. S. R. (Russia).—Encouraged by results obtained in exploiting cobalt deposits in Narimanov near Daschkessan, it was proposed early in 1935 to form a Transcaucasian Cobalt Combination for their further development. Improvements were to include construction of a water-power station, a plant with a 50-ton daily capacity, and a 3-mile service road from Kuschtschi to the mines.

SELENIUM

The consumption of selenium in the United States increased further in 1935. The flow from domestic sources was diminished 87,007 pounds, but this reduction was offset twice over by the extraordinary increase in imports (mainly from Canada) to an all-time record of 179,331 pounds. Moreover, although statistics are lacking there is reason to believe that most of the domestic output, much of which was formerly sold abroad, was retained for home consumption.

Selenium sold by producers in the United States, 1931–35

Year	Sales		
	Pounds	Value	
		Total	Average
1931	292,234	$386,255	$1.32
1932	244,123	(1)	(1)
1933	331,963	(1)	(1)
1934	319,838	(1)	(1)
1935	232,831	(1)	(1)

1 Bureau of Mines not at liberty to publish figures.

17 Bureau of Foreign and Domestic Commerce, Cobalt and Cobalt Oxide Production: Foreign Trade Notes—Minerals and Metals, vol. 4, no. 8, Aug. 27, 1935, pp. 9–10.

Selenium and selenium salts imported for consumption in the United States, 1931–35

Year	Pounds	Value	Year	Pounds	Value
1931	2,189	$2,777	1934	17,719	$24,591
1932	1,914	2,240	1935	179,331	322,332
1933	1,855	2,402			

Prices.—The New York quotation for selenium (black, powdered, 99.5 percent pure) remained at $2 per pound throughout the year. Overseas the metal was quoted at 8s. to 10s. ($1.93 to $2.41) in January, narrowing to 8s. ($1.95) in February, and remaining at that figure for the remainder of the year.

Uses.—Patents granted to Frank R. Palmer (Carpenter Steel Co.) claim that selenium is superior to sulphur as a free machining element because (1) a given percentage of selenium does not produce nearly as much slaglike material as an equal percentage of sulphur, thereby increasing cleanness and uniformity of the products; and (2) selenium is more potent than sulphur in its free machining effects. Now in commercial application, this use consumes larger quantities of ferroselenium each year and several analytical methods for determination of selenium in stainless steel were published in 1935, confirming the growing importance of this relatively new outlet. Selenium and tellurium also can be used in the manufacture of free-cutting brass and other copper alloys and several patents to cover this use were taken out during the year under review although sales for this purpose are small, awaiting commercial developments.

Gooding and Murgatroyd [18] propose the theory concerning the action of selenium in glass, that ferric oxide is partly reduced in the melt and forms a ferroselenide which, unlike certain other iron compounds (including ferrous arsenide) is not ionized by sunlight. The various colors of different types of selenium glass are attributed to four oxidation stages of the element rather than merely to dispersion. The sequence of color changes is colorless to rose to brown to colorless.[19]

As mentioned under "Cadmium", there was developed in Germany during the year a new outlet for cadmium-red pigments (made from cadmium sulphide and selenium) in changing the color of all facilities of the Reichspost from yellow to red. Further developments in use of television and the "electric eye" in Germany promise additional outlets for selenium.

Significant also is the recent development in selenium rectifiers in the electrical industry for converting alternating into direct currents. Such rectifiers have been used in the past mostly for small electrical effects in the radio and telegraphic apparatus, but are beginning to invade the higher tensions and strengths of current up to 440 volts and 40 amperes. Other uses of selenium are in various alloys, including alloy steels, as a catalyst for certain special reactions, and to some extent in medicines.

Occurrence in soils, streams, and the sea.—The ill effects of selenium poisoning on cattle and possibly human beings are reviewed in a comprehensive report of the Bureau of Chemistry and Soils [20] that

[18] Gooding, E. J., and Murgatroyd, J. B., Selenium Decolorizing: Jour. Soc. Glass Tech., no. 19, 1935 pp. 43–103T.

[19] Verre & Silicates Industry, Selenium: Its Use in Decoloring Glass: Vol. 6, nos. 7 and 8, 1935, pp. 118–120 and 137–140.

[20] Byers, Horace G., Selenium Occurrence in Certain Soils in the United States: Dept. of Agriculture, Bureau of Chem. and Soils Tech. Bull. 482, 1935, 24 pp.

became available during the year. While not attempting to minimize the seriousness of the problem, the authors point out that the only new aspect of the question is the discovery of the cause of certain known results—that is, the relatively high selenium content of certain soils from which grain for cattle feed has been produced. A suggested remedy is the addition of sulphur compounds to the soil. The chemical relationship of sulphur and selenium is so close that plants absorb one element as readily as the other, and by increasing the ratio of sulphur to selenium in the soil the absorption of sulphur may be raised automatically and that of selenium diminished.

Analyses of water samples from the Colorado River and soil incrustations in the vicinity of Montrose and Grand Junction, Colo., disclosed the presence of selenium. Discovery of the selenium in the river water is of special interest as indicating a previously unsuspected source of selenium. The Colorado River water is diverted near Cameo, Colo., to irrigate a large tract of land in the vicinity of Grand Junction, Mesa County. Water from the Gunnison River, also containing selenium, is diverted near Cimarron, Colo., for similar purposes.[21]

Williams and Byers [22] have also reported on the presence of selenium in deep-sea deposits. They cite another investigator (Strock) as having demonstrated the presence of 4 parts per billion of Se in sea water—only about one-fiftieth of that he considers should have been added to the sea by erosion of sedimentary rocks.

THE INDUSTRY IN FOREIGN COUNTRIES

Canada continues important as a source of selenium, and in 1935 production more than trebled that of the previous year. The metal is obtained as a byproduct in copper refining, and the first production was reported in 1931 by the Ontario Refining Co., Ltd., at Copper Cliff, Ontario. It is also produced by Canadian Copper Refineries at Montreal East, Quebec. In 1935 Canadian output totaled 345,159 pounds valued at $662,705 compared with 104,924 pounds worth $171,311 in 1934.

Germany has produced little or no selenium since the Mansfeld copper concern discontinued byproduct recovery from cupriferous shale about 10 years ago. Selenium supplies, formerly obtained almost entirely from the United States, are now imported from Sweden and amount to about 60 metric tons annually. Productive capacity in Sweden was increased by enlargement of the byproduct plant at Boliden. A small quantity of selenium is recovered from copper refineries in Japan.

TANTALUM AND COLUMBIUM

The uses of tantalum and columbium have been reviewed in previous chapters of this series, and for a résumé of present-day conditions reference is made to a recent paper by Balke,[23] the pioneer investigator in this field. Utilization of these sister elements progressed

[21] Williams, Kenneth T., and Byers, Horace G., Occurrence of Selenium in the Colorado River and Some of Its Tributaries: Ind. and Eng. Chem. (Anal. Ed.), vol. 7, no. 6, Nov. 15, 1935, pp. 431–432.
[22] Williams, K. T., and Byers, H. G., Selenium in Deep-Sea Deposits: Ind. and Eng. Chem. (News Ed.), vol. 13, no. 17, Sept. 10, 1935, p. 353.
[23] Balke, C. W., Columbium and Tantalum: Ind. and Eng. Chem. (Ind. Ed.), vol. 27, no. 10, Oct. 1935, pp. 1166–1169.

satisfactorily in 1935. The name of the Fansteel Products Co., Inc., North Chicago, Ill., was changed to Fansteel Metallurgical Corporation. This firm is the world's leading producer of tantalum, using imported ores, and specializes in rare metals, including tungsten, molybdenum, cesium, rubidium, tantalum carbide, and columbium. It is the sole producer of columbium, but the demand for this metal is insignificant as yet. Ferrocolumbium, on the other hand, is finding increasing use in weldable stainless steels; this alloy is made by the Electro Metallurgical Co. at Niagara Falls, N. Y.

In 1935, 7,681 pounds of columbite valued at $4,521 were reported shipped from domestic mines. Of the total, 7,241 pounds containing about 75 percent Ta_2O_5 and Cb_2O_5 were produced by George V. Bland, lessee of the property of Greene & Collingwood in South Dakota, and shipped to England; and 440 pounds were shipped by the Black Hills Keystone Corporation (also in South Dakota) to the South Dakota School of Mines. In addition, 4,000 pounds of columbite were produced (but not sold) in New Mexico by Philip S. Hoyt; the ore contained 70 percent Cb_2O_5 and 14 percent Ta_2O_5.

Imports.—Imports of tantalum and columbium ores in 1935 aggregated 1,190,398 pounds valued at $107,079, of which 6,083 pounds (tantalite) valued at $9,342 came from Australia and 1,184,315 pounds (columbite) valued at $97,737 came from Nigeria. In 1934 imports from Australia amounted to 24,630 pounds valued at $35,441.

World supplies.—Tantalite, either alone or sometimes with tin ore, occurs in several deposits in Southwestern Uganda, some of which may be opened up.[24] Russian occurrences likewise are reported, but no plans seem to have been made for working them. The leading developments recently have been in Nigeria, the world source of columbite at present, which ships its entire output to the United States. According to the report of the Jantar Nigeria Co., Ltd.,[25] for the year ended September 30, 1935, the 20-percent dividend declared by the company was due largely to profits derived from the sale of columbite recovered in connection with tin-mining. Proceeds from the sale of 420 long tons of columbite were reported as £23,000, or £55 ($270) a ton. Of this, 350 tons were from a dump, and for the ensuing fiscal year a maximum output of 240 tons of newly mined material was contemplated. Test borings on "Kuru 3" have already proved some 1,800 tons of columbite concentrates at an average yield of 1.5 pounds per cubic yard.

TELLURIUM

After many years of apparently fruitless research, commercial uses were found for tellurium, and since about 1929 domestic production has reached sizeable figures, as shown in the subjoined table. Tellurium lead, the Tainton electrolytic zinc process, and rubber cable-making are the main outlets at present. However, the use of tellurium ("metalloid of the selenium-tellurium group") is covered by Carpenter Steel Co. patents for free-machining steels (United States Patents 2009713–16). Three American companies reported production of tellurium in 1935, and a fourth reported sales from stock. Exports are made to Europe, and in 1935 inquiry developed from Germany for additional supplies of the element either in ore or metal-

24 Bulletin Imperial Institute (London): Vol. 33, no. 1, April 1935, p. 82.
25 Mining Journal (London): Vol. 191, no. 5232, Nov. 30, 1935, p. 914; vol. 192, no. 5238, Jan. 11, 1936, p. 25.

lurgical residues. British requirements formerly were supplied principally from Germany, but more recently from the United States and Canada; they may aggregate as much as 1,000 or even 2,000 pounds a month, predominantly for hardening lead. In Canada, tellurium is now being produced at Copper Cliff, Ontario, and at Montreal East, Quebec, as a byproduct in the refining of nickel-copper ores. Production in 1935 totaled 14,375 pounds valued for statistical purposes at the high figure of $65,550 compared with 5,130 pounds valued nominally at $25,599 in 1934; prior to October 1934 the element was not produced commercially in Canada.

From Russia comes word that tellurium is recovered as a byproduct from treatment of the Kyshtym copper ores and that it also has been produced from Cottrell-precipitator dust at a superphosphate plant in Odessa. There is no occasion yet to fear that byproduct supplies of this hitherto obnoxious element are becoming inadequate for current needs, but it is significant that inquiry has developed for additional supplies of metallurgical residues and for deposits of tellurium-bearing ores. An occurrence of native tellurium, associated with more or less gold, in Catron County, N. Mex., was being seriously investigated in 1935.

The New York quotations for tellurium have continued nominally unchanged at $2 a pound for several years, but toward the end of the year London trade journals began quoting 6s. 6d. to 7s. 6d. ($1.60 to $1.85), which doubtless approaches more nearly the actual sales value than the former nominal quotations, which were much higher.

Tellurium sold by producers in the United States, 1931–35, in pounds

1931	[1]	1934	21,027
1932	1,567	1935	22,610
1933	11,980		

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

TITANIUM

Only long-established custom justifies inclusion of titanium among the rare or minor metals. It ranks ninth in abundance among nature's elements, being more than five times as plentiful as manganese, and following a rather late start commercially it now enjoys a rapidly growing consumption in three distinct fields—pigments, ceramics, and metallurgy. World production of titanium pigments is of the order of 200,000 tons, with an aggregate titanium dioxide content of probably 50,000 tons, according to W. F. Meredith, president of both the Titanium Pigments Co. and the Titanium Alloy Mfg. Co., in a statement at the February meeting of the Rare Metals and Minerals Committee of the American Institute of Mining and Metallurgical Engineers. Titanium pigments are being produced by three companies in the United States, two in England, one in Germany, one or two in Italy, and one or two in France. Even so, production has scarcely begun.

New plants [26] are projected in Australia, at Little Burleigh, Queensland, under license agreement with the International Titanium Co. of Toronto, and in Japan. In the latter country, the Sakai Kagaku K. K. plans an initial output of 800 tons yearly by its own patented

[26] Bureau of Foreign and Domestic Commerce, World Trade Notes on Chemical and Allied Products: Vol. 9, no. 15, Apr. 13, 1935, p. 7; no. 20, May 18, 1935, p. 7.

process. Further increases are on the way, but large factories and investments are involved. The United States is by far the leading producer of titanium pigments, production representing 32,000 tons of dioxide in 1934, rising to 35,000 tons in 1935. The majority of the tonnage is in the titanium-calcium, titanium-barium, and other composite pigments, although use of pure dioxide seems to be gaining somewhat at present. Lead titanate, $PbTiO_3$, is the latest addition to the list of titanium pigments; remarkable durability, accompanied by better gloss retention and less cracking and flaking, is claimed for paints containing 20 percent or more of this material. It has a very high refractive index and high hiding power, but the color is light yellow, whereas other leading titanium pigments are brilliant white. Still another new pigment product is "Ti-Sil", a combination of 30 percent of titanium dioxide and 70 percent of specially treated silicate extender. It is recommended for blending with other pigments, especially leaded zinc oxide, and is quite durable. From an industrial point of view the most important domestic development in the pigment industry during 1935 was the completion of a large new factory at Sayreville, N. J., and the completion of the first unit of the new plant at Edge Moor, Del. Productive capacity in terms of titanium-inert combination pigment was thus increased to 125 tons or more per day.

Inasmuch as the ilmenite used for pigment manufacture is largely of foreign origin, the import statistics afford an index of the growth of the titanium-pigment industry, although it should be noted that some portion of the large increase during the last 2 years represents building up of adequate raw-material stocks at newly constructed plants.

Rutile, the natural dioxide, is also finding a rapidly growing market, largely in the field of welding-rod coatings. Although imports of rutile (latterly all from Brazil) have been increasing greatly during the last several years, domestic requirements are largely supplied from Virginia. The leading producing company formerly operated its milling plant only 2 or 3 months out of every other year, but in 1935 the mill was operated almost continuously and treated 300 tons of raw ore daily. A new modern mill is under construction. In addition to its use in welding rods, rutile is finding a steadily growing market for sundry other uses, chiefly in the ceramic industries.

E. L. Lasier, vice president, Titanium Alloy Manufacturing Co., in a letter to one of the authors summarizing 1935 development in the metallurgical field, notes the launching of a nickel-titanium alloy with commercial possibilities; the development of an alloy containing manganese and titanium in aluminum for which is claimed similar strength and ductility in the as-cast condition to that of the strongest aluminum alloys after heat treating; and interesting results with beryllium-copper which indicate that titanium additions help to maintain hardness at temperatures that otherwise would cause softening of the alloy.

Domestic production of ilmenite is largely a byproduct of rutile or a joint product of monocalcium phosphate. The latter item is produced at Piney River, Amherst County, Va., by the Southern Mineral Products Corporation from apatite, the output of which is roughly one-fourth the ilmenite output from this particular deposit; assuming that disposal of the phosphate is the limiting factor at this operation, its output of ilmenite could still be increased to about 50,000 tons a year. The leading domestic producer of rutile, the American Rutile Co., produces about as much ilmenite as rutile from its Roseland (Nelson County, Va.) operation. A third Virginia producer is in prospect. The Burgess Laboratory interests of Madison, Wis., after quietly exploring the Nelson-Amherst County areas for several years, have acquired properties and are expected to begin operations in 1936. In Arkansas, the Titanium Corporation of America (Tulsa, Okla.) made carload shipments of brookite-rutile concentrates from its Malvern property but was unable to find sale for its entire production at a satisfactory price. In addition to 94-percent concentrates, this company has attempted to market a 55- to 60-percent product, but this low-grade material must compete with ilmenite costing around $12 a ton delivered at Niagara Falls, which is within about 25 cents of the freight rate from Arkansas to the same destination.

Imports.—Imports of ferrotitanium and other titanium alloys are quite small, amounting in 1935 to 4,480 pounds valued at $654 compared with 3,240 pounds valued at $434 in 1934; the United Kingdom was the only source of these shipments, although in earlier years there have been imports from Italy under this category.

Ilmenite imports recently came exclusively from British India, but at least a temporary limit seems to have been reached in expanding production from Travancore beach sand, and a rise in freight rates may act as a further deterrent to these shipments from half way around the globe. In 1935 Norway contributed 22,472 long tons, Canada 94 tons, and British India 93,305 tons. The Norwegian ore, it may be noted, carries some magnesium and may advantageously be mixed with Virginia concentrates which carry phosphates as a principal impurity.

Titanium ores imported for consumption in the United States, 1930–35

Year	Ilmenite		Rutile	
	Long tons	Value	Pounds	Value
1930	22,298	$150,466	6,720	$974
1931	29,857	144,951	2,000	189
1932	33,491	231,652	176,395	4,508
1933	38,610	196,211	157,658	3,737
1934	71,710	356,208	309,221	7,350
1935	115,871	636,293	423,577	13,124

According to official reports from British India, the number of persons employed daily in producing ilmenite, zircon, and monazite in Travancore rose from 421 in 1929 to 1,654 in 1933, whereas output of ilmenite meanwhile increased only from 23,670 to 52,980 long tons and the concurrent production of zircon and also of monazite decreased. The figures for individual years show a progressive reduction in output per person from 50 tons a year in 1929 to 32 tons in 1933, indicating that more intensive operations—during that period, at least—lowered rather than increased labor efficiency.

World production of titanium minerals, 1931–35, in metric tons

[Compiled by M. T. Latus]

Mineral and country	1931	1932	1933	1934	1935
Ilmenite:					
Australia: Tasmania	----------	----------	559	----------	(1)
Canada (Quebec)	1,369	----------	----------	1,835	2,076
Egypt	----------	487	----------	164	(1)
French West Africa (Senegal)[2]	370	----------	160	540	959
British India (Travancore)	36,746	50,856	53,830	76,858	(1)
Norway	5,000	13,481	23,213	26,306	(1)
Portugal	152	766	645	434	385
Sierra Leone	10	----------	----------	----------	(1)
United States	(3)	(3)	(3)	(3)	(3)
Rutile:					
Brazil[2]	----------	35	96	116	(1)
Norway	[4] 21	[4] 30	[4] 56	247	(1)
United States	(3)	(3)	(3)	(3)	(3)

[1] Data not available.
[2] Exports.
[3] Bureau of Mines not at liberty to publish figures.
[4] Concentrates.

ZIRCONIUM

The feature of the zirconium situation in 1935 was the extraordinary increase in imports of zirconium ores, reflecting rapidly expanding consumption. No zircon is known to have been produced in the United States for several years, and hitherto domestic needs have been supplied almost exclusively by imports of baddeleyite from Brazil, but in 1935 zircon was imported in large quantities, both from British India and Australia, the former country supplying 3,099,732 pounds valued at $45,606 and the latter country 1,325,060 pounds valued at $17,433, whereas Brazil contributed only 1,331,934 pounds of ore valued at $13,884. In British India the zircon is a byproduct of the ilmenite output from Travancore beaches. The Australian zircon likewise is recovered from beach sands, though in these operations zircon is apparently the main product. According to a New South Wales Department of Mines statement forwarded by F. E. McFadden, American vice consul, the beach deposits extend discontinuously from Fort MacQuarie to the Queensland border and have been worked mainly in the vicinity of Evan's Head and Ballina. Typical concentrates from different beaches carry: Zircon, 40 to 75 percent; ilmenite, 14 to 43 percent; rutile, 7 to 18 percent; and other minerals, 2 to 8 percent. Small amounts of gold, platinum, and tin occur in the concentrate and in some small patches of beach, reconcentrated by wave action, are found in recoverable quantities. In 1935 these sands were being worked by three companies. The Zircon Mining Co., Ltd., a Titanium Alloy Mfg. Co. subsidiary, secured a lease at the mouth of Clarence River, Yamba. Metals Recoveries, Ltd. (head office, Sydney), is operating near Brunswick Heads, and Zircon Rutile, Ltd. (head office, Melbourne), near Byron Bay.

Zirconium powder is used in flashlight mixtures and in ammunition primers. Pure, wrought metal is marketed by the Foote Mineral Co., the wire being used in radio tubes and sheet metal in spinneret cups for rayon manufacture. Zirconium-silicon and zirconium-ferrosilicon are finding a growing use in steel making. From a tonnage standpoint, however, the main uses of zirconium compounds are in enamels and for electrodes or welding-rod coatings. A new product developed in 1935, known as TAM Hy-Opax permits pound-for-pound substitution for tin oxide as an opacifier for vitreous enamels of all types, and at about one-half the price.

Another new product is a practically C. P. zirconium silicate in powder form, spectrographically free of such coloring impurities as titanium and iron.

Zirconium ores and alloys imported for consumption in the United States, 1931–35

Year	Zirconium ores		Ferrozirconium, zirconium, and zirconium ferrosilicon	
	Pounds	Value	Pounds	Value
1931	1,124,034	$18,945	496	$312
1932	26,506	437		
1933	568,581	5,306		
1934	1,706,192	27,197	112,000	7,605
1935	5,756,726	76,923	25,166	2,079

PART III. NONMETALS

COAL[1]

By F. G. Tryon, W. H. Young, L. Mann, and J. R. Bradley

SUMMARY OUTLINE

The events of 1935 in the anthracite and bituminous-coal industries moved in opposite directions. In the bituminous fields demand increased, prices rose (though apparently not in proportion to costs), and employment and wages advanced. In the anthracite region, on the other hand, demand contracted, prices fell, and employment and pay rolls declined. In both industries, however, attention was focused during the year upon the problem of stability. The anthracite industry attacked the problem through its trade association—the Anthracite Institute. The bituminous industry continued its search for a solution through a code of fair competition under the National Industrial Recovery Act and later, when that law was declared invalid, through the Guffey-Snyder Act. Pending clarification of the constitutional issues involved, the full significance of these developments is hard to appraise but it is not unlikely that 1935 will stand as a landmark in the evolution of the national policy regarding fuel resources. No detailed account of the methods and the objectives of these varying approaches can be attempted in the present report, which is concerned rather with the factors of supply, demand, and the market. The statistical developments of 1935 and comparisons with the year preceding are summarized in tables 1 and 2.

The size of the coal industry often is not fully appreciated. In terms of dollars alone the production of coal far outweighs the national output of precious metals. From the beginning of mining to the end

[1] Figures for 1935 are preliminary; detailed data with final revisions will be released later.

of 1935 the anthracite mines of Pennsylvania have yielded coal valued at $11,630,000,000, and the bituminous mines coal valued at $29,641,000,000. Gold production in the United States from 1792 to 1934 was valued at $4,839,602,000 and silver production in the same period at $2,549,765,000.

Because of the great number of producing units in the coal industry, months are required to obtain complete reports, especially from the smaller mines. As this book goes to the printer many mines have not yet reported for 1935. The following analysis is based on preliminary reports and the figures are subject to revision. Details will be published later when final reports from all operators have been received.

TABLE 1.—*Salient statistics of the coal industry, 1934–35* [1]

[All tonnage figures represent net tons of 2,000 pounds]

	Bituminous coal			Pennsylvania anthracite		
	1934	1935 [1]	Percent of change in 1935	1934	1935 [1]	Percent of change in 1935
Production .... net tons	359, 368, 022	369, 324, 000	+2. 8	57, 168, 291	51, 003, 000	−10. 8
Value at mines	$628, 112, 000	$699, 900, 000	+11. 4	$244, 152, 000	$207, 600, 000	−15. 0
Average retail price [2]	$8. 26	$8. 30	+. 5	(3)	(3)	[3] −3. 2
Average cost of railroad fuel excluding direct freight	$1. 83	$1. 89	+3. 3	(4)	(4)	(4)
Average cost of coal charged at byproduct coke ovens	$3. 70	$3. 82	+3. 2			
Average value per ton, all coal, f. o. b. mine	$1. 75	[5] $1. 895	(6)	$4. 27	$4. 07	−4. 7
Stocks on hand: [7]						
Jan. 1 .... net tons	32, 840, 000	34, 476, 000	+5. 0	1, 106, 000	1, 921, 000	+73. 7
Dec. 31 .... do	34, 476, 000	37, 017, 000	+7. 4	1, 921, 000	1, 911, 000	−. 5
Exports .... do	10, 869, 000	9, 742, 000	−10. 4	1, 298, 000	1, 609, 000	+24. 0
Imports .... do	180, 000	202, 000	+12. 2	478, 000	571, 000	+19. 5
Consumption (calculated) .... do	347, 043, 000	357, 243, 000	+2. 9	55, 500, 000	50, 000, 000	−9. 9
Number of men employed	458, 011	462, 000	+. 9	[8] 106, 251	[8] 100, 539	−5. 4

1 Figures for 1935 are in most instances preliminary and subject to revision.
2 Compiled from reports of the U. S. Bureau of Labor Statistics, with allowance for August, September, November, and December, 1935, when no returns were collected because the system of reporting was shifted from a monthly to a quarterly basis.
3 The average prices in dollars are not quoted because, until weighted by tonnage sold, they may not be typical. The quotations are comparable from year to year, however, and the average quotations for stove decreased 3.2 percent in 1935 compared with 1934.
4 The small amount of anthracite used for railroad fuel is included with bituminous coal.
5 Average sales realization of all commercial operations reporting to the N. R. A. from divisions I and II for the month of January 1935. Final figures for the entire year and for all districts and operations, including captive mines, are not yet available. The figure, therefore, is not fully comparable with that for 1934.
6 See note 5.
7 Figures for bituminous coal represent consumers' stocks; for anthracite, producers' stocks.
8 Pennsylvania Department of Mines.

TABLE 2.—*Summary of coal produced, value, men employed, days operated, and output per man per day, by States, in 1934 and estimated production in 1935 (exclusive of wagon mines producing less than 1,000 tons a year)* [1]

State	1934 final statistics												1935 production (preliminary)
	Net tons						Value						
	Loaded at mines for shipment	Commercial sales by truck or wagon	Other sales to local trade, or used by employees, or taken by locomotives at tipple	Used at mines for power and heat	Made into coke at mines	Total quantity	Total	Average per ton	Number of employees	Average number of days mines operated	Average tons per man per day [2]	
Alabama	8,779,450	206,433	104,488	51,746	----------	9,142,117	$18,838,000	$2.06	18,851	185	2.62	8,412,000
Alaska	101,060	----------	5,370	1,078	----------	107,508	451,000	4.20	93	217	5.33	90,000
Arkansas	832,588	8,211	807	14,826	----------	856,432	2,564,000	2.99	3,415	102	2.46	} 2,570,000
Oklahoma	1,138,599	42,738	9,946	17,006	----------	1,208,289	2,846,000	2.36	3,225	124	3.02	
Colorado	3,976,652	982,316	62,971	130,983	58,011	5,210,933	12,309,000	2.36	8,094	158	4.08	5,872,000
Illinois	35,023,844	4,781,525	774,651	692,364	----------	41,272,384	64,238,000	1.56	46,067	160	5.62	43,845,000
Indiana	13,307,212	771,011	499,549	215,871	----------	14,793,643	21,838,000	1.48	11,173	171	7.75	15,440,000
Iowa	2,011,749	1,263,483	50,384	41,376	----------	3,366,992	7,862,000	2.34	7,721	156	2.80	3,468,000
Kansas	2,256,220	233,628	6,579	11,827	----------	2,508,254	4,619,000	1.84	3,744	151	4.45	} 6,104,000
Missouri	2,738,697	558,818	31,291	23,477	----------	3,352,283	6,278,000	1.87	5,540	141	4.29	
Kentucky	37,283,960	601,631	384,371	255,273	----------	38,525,235	60,548,000	1.57	49,509	180	4.33	40,478,000
Maryland	1,403,154	137,764	78,160	8,034	----------	1,627,112	3,089,000	1.90	2,976	176	3.12	1,650,000
Michigan	324,509	260,640	10,830	25,762	----------	621,741	1,940,000	3.12	1,556	157	2.54	550,000
Montana	2,411,093	133,972	13,031	7,606	----------	2,565,702	3,997,000	1.56	1,590	166	9.73	2,990,000
New Mexico	1,150,825	40,656	28,029	39,813	----------	1,259,323	3,402,000	2.70	2,342	164	3.29	1,382,000
North Dakota	1,281,830	347,306	64,193	60,559	----------	1,753,888	2,363,000	1.35	1,518	174	6.65	} 1,910,000
South Dakota	16,785	25,225	347	50	----------	42,407	76,000	1.79	91	152	3.07	
Ohio	17,813,518	2,239,110	511,540	126,396	----------	20,690,564	34,774,000	1.68	29,247	167	4.23	20,610,000
Pennsylvania	80,696,259	4,493,554	2,796,698	702,377	1,136,987	89,825,875	165,371,000	1.84	126,079	179	3.98	90,795,000
Tennessee	3,866,802	156,541	49,038	50,907	12,502	4,135,790	7,514,000	1.82	7,308	185	3.05	4,110,000
Georgia	32,394	----------	----------	322	----------	32,716	80,000	2.45	113	185	1.56	} 40,000
North Carolina	100	2,290	----------	750	----------	3,140	9,000	2.87	18	221	.79	
Texas	720,807	27,883	101	10,498	----------	759,289	1,145,000	1.51	805	178	5.30	760,000
Utah	2,293,892	63,088	17,728	6,322	25,153	2,406,183	4,746,000	1.97	2,807	171	5.00	2,985,000
Virginia	9,058,264	78,530	79,836	28,776	131,275	9,376,681	16,375,000	1.75	12,207	200	3.84	9,915,000
Washington	1,059,695	288,371	17,967	14,272	2,686	1,382,991	4,002,000	2.89	2,161	193	3.32	1,575,000
West Virginia	94,775,558	860,344	1,716,415	500,885	281,191	98,134,393	167,104,000	1.70	105,906	196	4.73	98,589,000
Wyoming	4,059,131	123,345	52,584	132,901	----------	4,367,961	9,591,000	2.20	3,760	188	6.17	5,150,000
Other States	17,050	10,907	7,239	3,000	----------	38,196	143,000	3.74	95	189	2.13	34,000
Total bituminous, 1934	328,431,697	18,739,320	7,374,143	3,175,057	1,647,805	359,368,022	628,112,000	1.75	458,011	178	4.40	369 324 000
Total bituminous, 1933	306,279,665	15,462,739	7,589,672	2,857,721	1,440,736	333,630,533	445,788,000	1.34	418,703	167	4.78	

[1] The figures relate only to active bituminous-coal mines of commercial size that produced coal in 1934, excluding wagon mines producing less than 1,000 tons.

[2] Based upon (1) the "reported" number of man-shifts where the operator keeps a record thereof; otherwise upon (2) the "calculated" number of man-shifts obtained by multiplying the average number of men employed underground and on the surface at each mine by the number of days worked by the mine and tipple, respectively. Using throughout the "calculated" man-shifts as developed before the year 1932, namely, the product of the total number of men employed at each mine times the tipple days, the average output per man per day for the bituminous mines of the country as a whole was 4.42 tons, a figure which is strictly comparable with 5.06 in 1930, previously published.

BITUMINOUS COAL

THE MARKET IN 1935

Production.—Increased activity characterized the bituminous-coal market in 1935. Such advance in prices as occurred seems to have fallen short of the increase in costs attendant on recent wage advances, but production, consumption, employment, and pay-roll totals all gained over 1934. In volume of output, however, the industry achieved a smaller percentage of increase than was made by the mineral industry as a whole or by the total industrial production as recorded by the index numbers of the Federal Reserve Board. The increased production was due primarily to greater activity in the coke, iron, and steel industries and to additions in consumers' stocks.

The upward trend in output evidenced in 1933 and 1934 continued. Compared with the year before, production in 1935 increased 2.8 percent, a somewhat lower rate of gain than in the previous year. Production in 1935 was 369,324,000 net tons and in 1934, 359,368,000

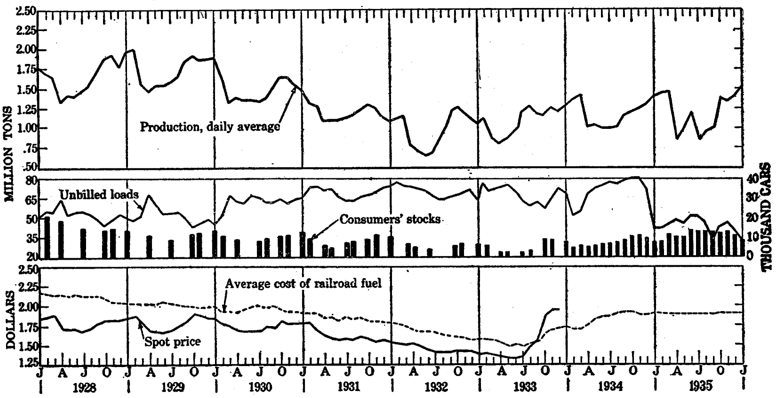

FIGURE 77.—Trends of production, stocks, and prices of bituminous coal, 1928–35.

tons—an increase of 9,956,000 tons. Compared with 1932, 59,614,000 more tons of coal were raised, a gain of 19.2 percent. Despite the increase the output for 1935 was far below that for many years before 1932.

Monthly output.—The normal demand of the winter months was stimulated by greater industrial activity than in the first quarter of 1934. Output increased decisively in March due to the prospect of a suspension of mining when the existing wage agreements expired at the end of the month and consequent purchasing for storage by the railroads, electric power utilities, byproduct-coke plants, and steel works. (See fig. 77.) The agreement, however, was extended temporarily, consumption declined as the heating season approached its end, and during April and May production was at low ebb (fig. 78). The prospect of labor disturbances again caused production to rise abruptly in June, to be followed by another temporary agreement and decline in output in July and August. Industrial activity in the last half of 1935 was materially greater than in the same period of 1934, resulting in a rapid increase in the production of coal.

Commercial stocks.—The trend of commercial stocks during most of the year was influenced by the prospect of labor disturbances.

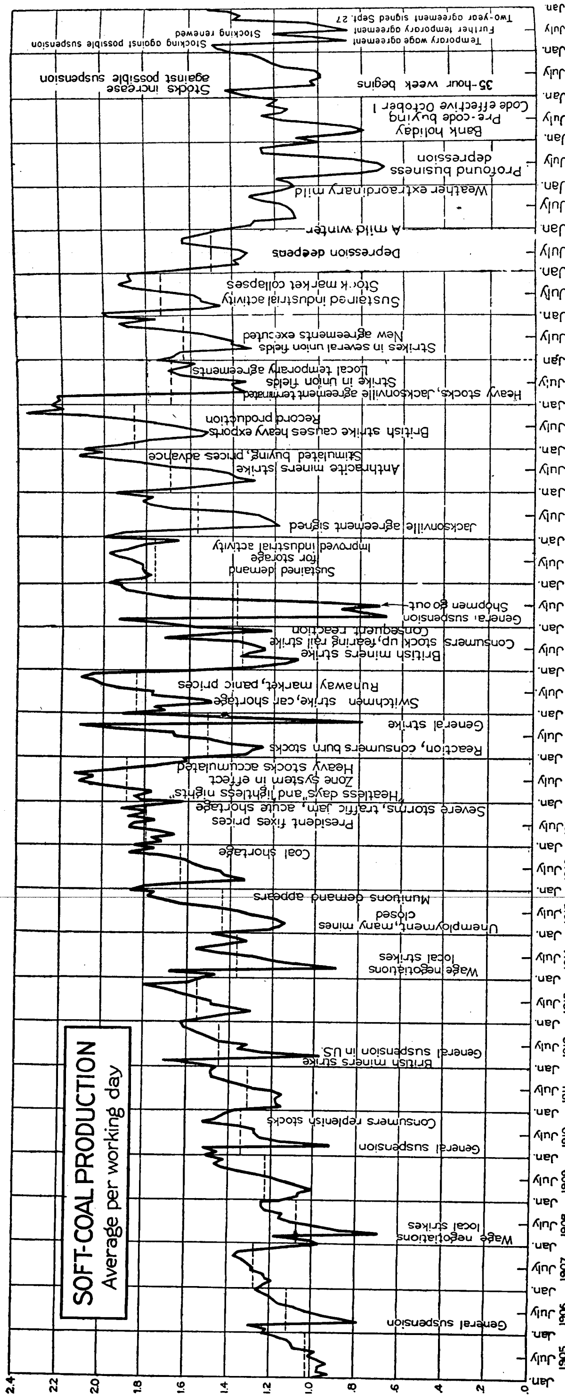

FIGURE 78.—Average production of bituminous coal per working day in each month, 1905–35.

75731—36——36

Stocks rose sharply in March, declined slightly in April and May, increased to a peak of 41,127,000 net tons in June, and remained high throughout the summer and early fall. In the last quarter of the year stocks declined seasonally. (See fig. 77.)

The reserves of coal held by industrial consumers and retail dealers at the end of 1935 had risen from 34,476,000 tons on hand January 1 to 37,017,000, an increase of 2,541,000 tons (7.4 percent). Many groups of industrial consumers of coal increased their stocks during the year.

TABLE 3.—*Statistical summary of monthy developments in the bituminous-coal industry in 1935* [1]

[All tonnage figures represent thousands of net tons]

	1935						
	January	February	March	April	May	June	July
Production, including mine fuel and local sales:							
Monthly total	36,752	34,834	38,701	21,970	26,849	30,117	22,339
Average per working day	1,408	1,457	1,489	868	1,021	1,205	859
Distribution:							
Rail movement (including railway fuel)—							
From Appalachians north of Alabama—							
To tidewater	2,572	2,735	3,152	2,261	1,926	2,384	1,999
To New England	604	593	666	384	335	456	307
To Lake Erie	76	150	1,349	2,829	4,788	5,265	4,151
Westbound commercial	7,853	7,728	7,757	4,040	3,857	4,362	2,971
East- and south-bound, local and railway fuel (all rail)	9,261	8,955	10,224	4,476	6,636	7,217	5,327
From Alabama field	826	880	956	647	769	766	585
From interior fields	8,180	7,111	8,097	3,251	4,283	4,949	3,214
From far western fields	2,067	1,487	1,519	1,114	1,111	1,072	948
Lake dock receipts	3	7	6	387	1,783	2,017	1,536
Lake dock deliveries	1,522	1,037	898	820	721	614	618
New England tide receipts	1,016	1,175	1,202	1,006	727	827	709
Exports to Canada and Mexico	350	289	316	933	820	1,035	1,046
Exports to Caribbean region	42	66	65	41	14	24	35
Exports "overseas"	18	38	18	14	30	11	20
Imports	31	13	10	12	8	8	9
Industrial consumption by—							
Railroads (class I only)	6,557	6,034	6,363	5,696	5,554	5,340	5,106
Electric-power utilities	3,008	2,670	2,634	2,536	2,578	2,608	2,803
Byproduct coke ovens	4,058	4,029	4,218	3,862	4,043	3,763	3,692
Beehive coke ovens	141	149	163	107	97	97	73
Steel works and rolling mills	1,142	1,091	1,053	1,020	931	793	852
Coal-gas retorts	213	192	195	189	192	177	168
Cement mills	155	125	179	270	400	441	384
Other industrials	9,419	8,446	8,196	7,653	7,010	6,200	6,100
Bunker coal, foreign	89	92	111	107	148	161	180
Coal-mine fuel	325	308	342	194	238	266	198
Stocks at end of period shown:							
Railroads (class I only)	4,861	5,764	8,663	6,619	6,875	8,621	8,518
Electric-power utilities	5,421	5,564	6,031	6,205	6,333	6,662	6,635
Byproduct coke ovens	5,014	4,989	5,680	5,657	5,592	6,446	6,608
Steel works and rolling mills	773	915	1,414	1,384	1,381	1,471	1,409
Coal-gas retorts	434	407	458	484	448	518	522
Cement mills	220	242	324	358	352	459	380
Other industrials	7,222	7,016	8,873	8,892	8,480	9,650	9,200
Total commercial stocks, including retail yards	32,045	32,197	38,543	36,249	35,541	41,127	40,772
Stocks on Lake docks	6,221	5,196	4,309	3,890	4,952	6,356	7,272
Unbilled loads	1,495	1,559	1,722	1,922	1,771	2,123	2,106
Trend of prices (average per net ton):							
Average cost of railroad fuel, excluding freight charges	$1.90	$1.89	$1.89	$1.89	$1.89	$1.89	$1.89
Average retail price, 38 cities	$8.37	$8.39	$8.39	$8.24	$8.11	$8.05	$8.12
Labor conditions: [4]							
Index of employment (1929 average=100.0)	80.0	81.1	81.6	74.3	75.3	77.9	70.0
Index of pay-roll totals (1929 average=100.0)	59.6	66.1	67.5	45.0	49.1	64.7	35.9

See footnotes at end of table.

TABLE 3.—*Statistical summary of monthly developments in the bituminous-coal industry in 1935*—Continued

[All tonnage figures represent thousands of net tons]

	1935—Continued						1934 total
	August	September	October	November	December	Total	
Production, including mine fuel and local sales:							
Monthly total	26,164	25,038	37,768	33,404	35,388	369,324	359,368
Average per working day	969	1,043	1,399	1,363	1,416	1,207	1,173
Distribution:							
Rail movement (including railway fuel)—							
From Appalachians north of Alabama—							
To tidewater	2,064	2,248	2,397	2,438	2,789	28,965	28,743
To New England	291	419	367	415	504	5,341	5,509
To Lake Erie	5,105	3,713	4,531	3,750	129	35,836	34,396
Westbound commercial	4,048	5,040	6,257	5,755	7,533	67,201	64,479
East- and south-bound, local and railway fuel (all rail)	5,478	3,676	9,475	7,106	8,465	86,296	90,125
From Alabama field	667	593	70	422	938	8,119	8,730
From interior fields	4,135	4,919	7,227	6,439	7,658	69,463	65,602
From far western fields	1,131	1,352	2,427	2,340	2,093	18,661	16,251
Lake dock receipts	1,451	1,272	917	1,487	6	10,872	12,557
Lake dock deliveries	760	932	1,313	1,172	1,330	11,737	11,535
New England tide receipts	740	782	932	860	1,042	11,018	11,584
Exports to Canada and Mexico	1,121	864	860	950	460	9,044	10,212
Exports to Caribbean region	73	21	7	39	29	456	409
Exports "overseas"	16	15	17	22	23	242	248
Imports	11	15	32	29	24	202	180
Industrial consumption by:							
Railroads (class I only)	5,381	5,625	6,425	6,182	6,743	[2] 71,001	70,496
Electric-power utilities	3,039	2,961	3,437	3,143	3,390	34,807	33,555
Byproduct coke ovens	3,996	4,083	4,396	4,488	4,850	49,478	44,343
Beehive coke ovens	89	88	143	161	192	1,500	1,635
Steel works and rolling mills	901	874	999	974	1,117	11,747	10,898
Coal-gas retorts	172	178	186	185	198	2,245	2,475
Cement mills	319	315	335	317	212	3,452	3,465
Other industrials	6,385	6,480	7,950	8,370	9,380	91,589	83,798
Bunker coal, foreign	175	143	180	102	88	1,576	1,321
Coal-mine fuel	231	221	334	295	313	3,265	3,175
Stocks at end of period shown:							
Railroads (class I only)	7,530	6,518	5,847	5,865	5,589	5,589	4,856
Electric-power utilities	6,590	6,581	6,455	6,438	6,250	6,250	5,507
Byproduct coke ovens	6,950	6,803	5,986	6,129	5,559	5,559	5,577
Steel works and rolling mills	1,283	1,257	1,050	958	954	954	817
Coal-gas retorts	517	534	516	491	479	479	482
Cement mills	343	367	309	290	266	266	232
Other industrials	9,265	10,044	10,040	10,370	9,620	9,620	7,905
Total commercial stocks, including retail yards	40,378	40,904	39,553	39,911	37,017	37,017	34,476
Stocks on Lake docks	7,963	8,308	7,912	8,228	6,904	6,904	7,738
Unbilled loads	1,819	891	1,593	1,791	1,372	1,372	1,736
Trend of prices (average per net ton):							
Average cost of railroad fuel, excluding freight charges	$1.89	$1.90	$1.90	$1.90	$1.90	$1.89	$1.83
Average retail price, 38 cities	(3)	(3)	$8.41	(3)	(3)	$8.30	$8.26
Labor conditions:[4]							
Index of employment (1929 average=100.0)	73.4	77.1	74.3	76.1	79.1	76.7	77.2
Index of pay-roll totals (1929 average=100.0)	45.8	60.1	69.8	65.5	69.5	58.2	54.2

[1] Preliminary; subject to revision.
[2] Taken from Interstate Commerce Commission reports; sum of months does not agree with total.
[3] No data.
[4] Bureau of Labor Statistics index numbers.

Consumption.—The consumption of bituminous coal, allowing for imports, exports, and changes in stocks, rose from 347,043,000 tons in 1934 to 357,243,000 in 1935, an increase of 10,200,000 tons (table 4). A small decline in consumption at beehive coke ovens, coal-gas retorts, and cement mills was more than offset by greater consumption by railroads, electric-power utilities, byproduct ovens, steel works, other industrials, and foreign bunkers. (See fig. 79.)

TABLE 4.—*Changes in United States consumption of bituminous coal by such classes of consumers as report currently, and by all other consumers, 1929–35, in thousands of net tons.*

[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 [7]
	Colliery fuel	Electric public utilities [1]	Bunkers, foreign trade [2]	Locomotive fuel, class I roads [3]	Coke beehive ovens [4]	Coke byproduct ovens [4]	All other uses [5]	Total consumption [6]	To Canada and Mexico [2]	To all other countries [2]	
1929	4,663	44,937	4,287	113,894	10,028	76,759	264,987	519,555	14,727	2,702	536,984
1930	3,993	42,898	3,497	98,400	4,284	65,521	236,397	454,990	13,667	2,210	470,867
1931	3,205	38,735	2,195	81,725	1,767	46,846	197,396	371,869	10,647	1,479	383,995
1932	2,781	30,290	1,350	66,498	1,030	30,887	174,081	306,917	8,429	385	315,731
1933	2,858	30,575	1,316	66,198	1,461	38,681	180,659	321,748	8,600	437	330,785
1934	3,175	33,555	1,321	70,496	1,635	44,343	192,518	347,043	10,213	656	357,912
1935 ([8])	3,265	34,807	1,576	71,001	1,500	49,478	195,616	357,243	9,044	698	366,985

[1] U. S. Geological Survey. Includes a small amount of anthracite.
[2] Bureau of Foreign and Domestic Commerce.
[3] Interstate Commerce Commission. Note that consumption in shops, roundhouses, and stations is excluded, also the entire consumption of class II and III roads.
[4] U. S. Bureau of Mines.
[5] Obtained by subtracting the known items from the total consumption. Includes general manufacturing, domestic, and many miscellaneous uses. From other sources it is known that consumption in steel works and general manufacturing is decreasing and that consumption for domestic uses is increasing.
[6] Production plus imports minus exports, plus or minus changes in consumers' stocks.
[7] Note that consumption includes the small amount imported.
[8] Preliminary.

Prices.—In considering the trend of bituminous prices in 1935, it must be remembered that costs of production had been increased by the adoption of the 7-hour day and the wage advance that became effective April 1, 1934, and that they were increased further by another wage advance on October 1, 1935. Responding to these increases in cost, prices averaged higher in 1935 than in 1934 but apparently not enough higher to absorb in full the additions to cost. No data on average sales realization for the year as a whole have yet been published. In January 1935, according to returns collected by F. E. Berquist of the N. R. A., the average sales realization of commercial operators in divisions I and II was $1.89. This alone would indicate a substantial advance in realization over the corresponding month of 1934. Shortly thereafter, however, rumors of price evasions began to be heard, and there is some evidence that during the next 4 months the average realizations were moving downward. The decline was accentuated further by the decision of May 27 invalidating the N. R. A. The passage of the Guffey Act on August 30 and subsequent appointment of the National Bituminous Coal Commission though undoubtedly helping to maintain the price structure for a time was largely offset by uncertainty as to the constitutionality of the new law. Final appraisal of the effects of these opposing forces on the price level must await more complete information. Meanwhile, it is known that the average cost of railroad fuel, excluding direct freight charges, was $1.89 a ton in 1935, as against $1.83 in 1934, an increase of 6 cents a ton. (See table 1.) The average cost of coal charged in byproduct coke ovens increased 12 cents a ton, but as this figure represents the price delivered, a considerable part of the increase probably was due to the emergency surcharge granted to the railroads in April. The average retail price in 38 cities, sidewalk delivery, increased about 4 cents a ton—a decline in retail dealers' margins acting to offset in part the freight surcharge and the higher prices at the mines.

Employment and earnings.—In line with continued improvement in production and shorter working hours that prevailed throughout the year, more men were at work in bituminous-coal mines in 1935 (table 1). A preliminary figure of employment, as indicated by incomplete returns from the operators to the Bureau of Mines, is about 462,000, which, compared with the final data for 1934, represents an increase of some 4,000 men. The best guide to current fluctuation in employment at the mines is the monthly report of the Bureau of Labor Statistics. The trend in monthly employment followed very closely the trend in production described above.

The total wages paid advanced slightly. With 1929 as 100, the wage index for the year 1935 was 58.2 as against 54.2 for 1934.

The prospects of labor difficulties were in the foreground from the beginning of the year until the latter part of September. Preliminary

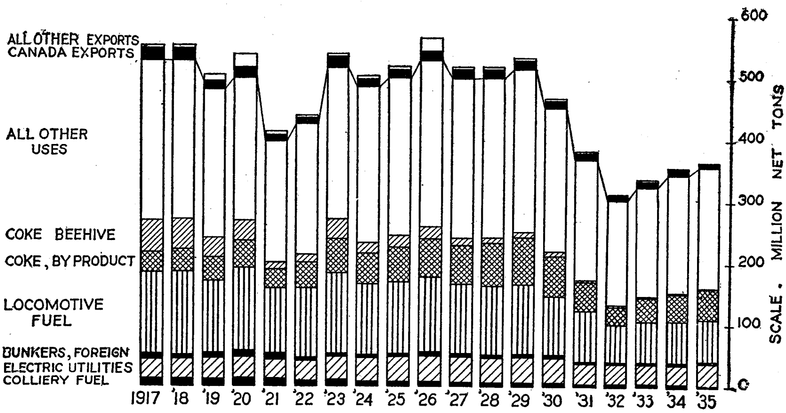

FIGURE 79.—Tonnage of bituminous coal absorbed by the principal branches of consumption, 1917–35.

wage conferences were unsuccessful in making a new contract before the old one terminated on March 31. Five extensions were granted before the conference finally came to an agreement on September 27 after a 5-day strike had been in progress which represented the most complete shut-down in the history of the industry. During this period about 410,000 men, or 90 percent of the present working force, laid down their tools. Terms of the new Appalachian agreement, which expires March 31, 1937, represented a compromise in the demands of each side. No changes were made in working schedules, and the wage increases established were as follows: Day wages, 50 cents, with 70 cents to miners on mechanical loading and conveying equipment; shortwall cutting and loading rates and pick-mining rates, 9 cents per ton; yardage and deadwork rates, 10 percent, except in the case of rates in connection with mechanical mining, to be increased in the same proportion as the basic cutting and loading rates. Some adjustment was made in the differentials established in certain of the fields. For instance, Alabama received an increase in day rates of 20 cents.[2]

Railroad freight charges.—Aside from minor adjustments in individual rates, the principal changes in the structure of coal freight rates in recent years have been the emergency surcharges granted to meet the financial needs of the carriers. Effective January 4, 1932, the

[2] Coal Age, vol. 41, no. 2, February 1936, p. 71.

Interstate Commerce Commission authorized a surcharge of $3 per car, which continued in operation to September 30, 1933. This amounted to approximately 6 cents per ton of coal. No surcharge was in effect in 1934, but the continued difficulties of the carriers led to further application for relief, and a new surcharge was authorized, effective April 18, 1935, to run until June 30, 1936. The second surcharge has averaged approximately 13 cents a ton.

The relation between mine prices and freight rates is shown in table 5. Compared to the fluctuating prices of coal at the mines, the variations in freight charges from year to year have been small. For more than a decade the average freight charge on bituminous coal has exceeded substantially the average mine price. In 1933 freight charges made up 62.1 percent of the cost of 1 ton of bituminous coal delivered at a typical destination. The ratio of freight charges to total delivered cost was higher than for almost any other commodity covered by the current records of the Interstate Commerce Commission.[3] For all freight handled, the average freight charge constituted 10.7 percent of the delivered cost.

TABLE 5.—*Average price of bituminous coal f. o. b. mines, average freight charge, and computed delivered cost at consignee's siding, per net ton, 1923, and 1928–35*

Year	(1) Average sales realization per ton [1] f. o. b. mines	(2) Average freight charge per ton [2]	(3) Total delivered cost (1)+(2)	(4) Percent freight charges of total
1923	$2.68	[3] $2.36	$5.04	46.9
1928	1.86	2.27	4.13	55.0
1929	1.78	2.25	4.03	55.8
1930	1.70	2.23	3.93	56.7
1931	1.54	2.22	3.76	59.0
1932	1.31	2.26	3.57	63.3
1933	1.34	2.20	3.54	62.1
1934	1.75	2.15	3.90	55.1
1935	[4] 1.895	2.24	4.135	54.2

[1] Value of all coal, including nonrevenue railroad fuel and deliveries of captive coal to consumer owners, as reported by operators to the U. S. Bureau of Mines.
[2] Average revenue received by class I steam railroads per net ton of revenue bituminous coal originated, as reported to Interstate Commerce Commission.
[3] Interstate Commerce Commission, Bureau of Statistics, Report No. 23157.
[4] Average for all commercial operators reporting to the N. R. A. from divisions I and II for the month of January 1935.

Distribution trends.—The flow of coal from the producing fields to the consuming regions is depicted in figure 80 in major movements for purposes of convenient comparison. In this figure are shown the monthly variations in bituminous tonnages moving in each group during 1934 and 1935.

The movement of coal into the principal channels of distribution followed the normal seasonal pattern, except when influenced by the prospect of labor difficulties or by the strike in the last week of September. Virtually all of the variations in tonnages for 1935 compared with 1934 in the different channels were small. (See table 3.) Increases were as follows: Shipments to tidewater, 0.8 percent; to Lake Erie, 4.2; westbound commercial, 4.2; from interior fields, 5.9; from far western fields, 14.8; Lake dock deliveries, 1.8. However, the movement was slower in some of the channels of

[3] Interstate Commerce Commission, Bureau of Statistics, Freight Revenue and Value of Commodities Transported on Class I Steam Railways in the United States, 1933, Statement 3552.

distribution, namely, to New England, 3 percent; east and southbound, local and railway fuel (all rail), 4.2; from Alabama, 7; Lake dock receipts, 13.4; New England tide receipts, 4.9.

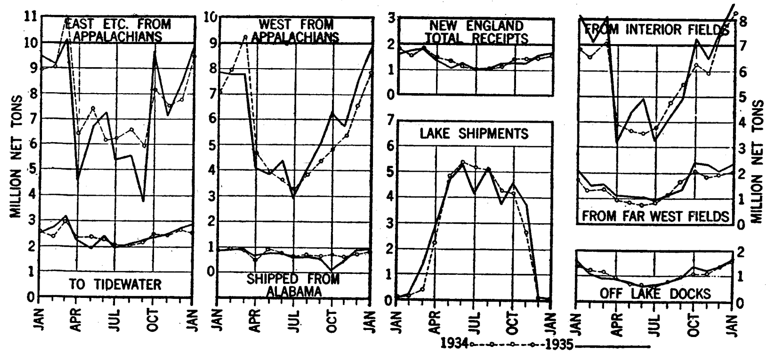

Figure 80.—Monthly movement of bituminous coal in the major channels of distribution, 1934–35.

FOREIGN TRADE [4]

Exports.—The quantity of bituminous coal exported declined from 10,869,000 net tons in 1934 to 9,742,000 in 1935, a loss of 10.4 percent. The principal customer for bituminous coal exported from the

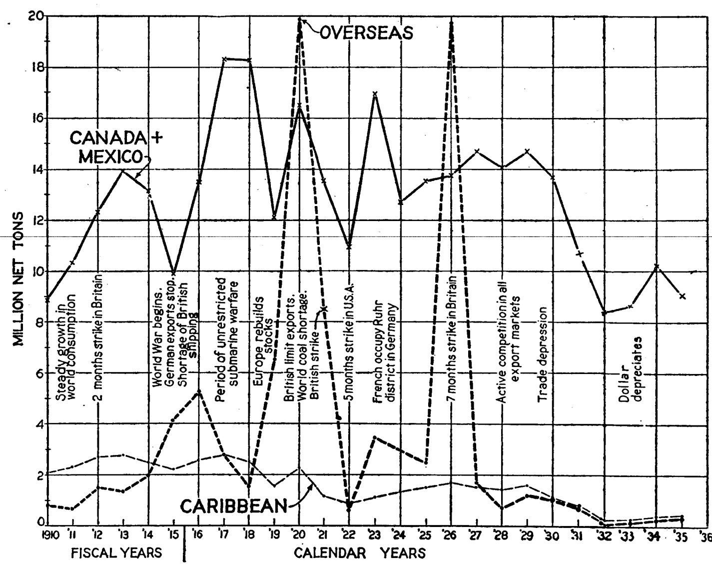

Figure 81.—Twenty-six years' exports of bituminous coal to (1) Canada and Mexico, (2) the Caribbean, and (3) "overseas" destinations.

United States is Canada, which usually takes over 90 percent of the total. (See fig. 81.) In 1935 exports of bituminous coal to Canada were 9,038,902 net tons, a decrease of 11.5 percent from 1934, yet the tonnage represented 92.8 percent of total exports. According to

[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.

figures of the Dominion Bureau of Statistics, of Canada, imports of bituminous coal from the United States in 1935 comprised 96 percent of Canada's total bituminous-coal imports, compared with 97 percent in 1934.

Exports of bituminous coal to the Caribbean region amounted to 456,000 tons in 1935—11.2 percent more than shipments in 1934. The increase in 1935 was due chiefly to larger shipments to Panama, British Trinidad, and Cuba. Exports of bituminous coal overseas were 242,000 net tons, a decrease of 1.6 percent from 1934.

TABLE 6.—*Exports of bituminous coal to (1) Canada and Mexico, (2) the West Indies and Central America, and (3) "overseas" destinations, 1929–35, in thousands of net tons*

[Compiled from records of the Bureau of Foreign and Domestic Commerce]

Year	(1) Canada and Mexico	(2) West Indies and Central America [1]	(3) "Overseas" (all other countries)							Grand total
			Newfoundland, Miquelon, and Bermuda	South America	Europe	Asia	Africa	Oceania	Total "overseas"	
1929	14,727	1,500	211	332	567	8	84	-------	1,202	17,429
1930	13,667	1,180	95	353	469	14	97	2	1,030	15,877
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

[1] Includes Bahamas, Panama, and Virgin Islands prior to 1935.
[2] 2 tons.

TABLE 7.—*Bituminous coal exported, by countries, 1934–35, in net tons* [1]

[Compiled from records of the Bureau of Foreign and Domestic Commerce]

Country	1934	1935	Country	1934	1935
North America:			South America:		
Bermuda	4,624	6,657	Argentina	35,093	19,535
British Honduras	274	222	Brazil	136,231	143,997
Canada	10,210,070	9,038,902	Colombia	91	1,019
Central America:			Ecuador	28	29
Costa Rica	----------	2	Guiana:		
Guatemala	1,210	274	British	460	269
Honduras	1,269	484	Surinam (Netherland)	2,119	3,944
Nicaragua	47	93	Peru	13	--------
Panama	44,864	68,905	Uruguay	29,139	28,760
Salvador	32	18	Venezuela	95	18
Mexico	2,215	4,925		203,269	197,571
Miquelon and St. Pierre Islands	14,564	16,353	Europe:		
Newfoundland and Labrador	21,245	8,015	Italy	----------	8,771
West Indies:			United Kingdom	----------	56
British:				----------	8,827
Jamaica	18,217	23,647	Asia:		
Trinidad and Tobago	5,164	30,780	East Indies: Netherland	1,766	--------
Other British	7,698	13	Other Asia	----------	2
Cuba	289,987	324,233	Saudi Arabia	----------	1
Dominican Republic	102	105	Philippine Islands	1,681	5,065
French	12,239	6,479		3,447	5,068
Haiti	13	30		10,868,552	9,742,430
Netherland	2,162	827			
Virgin Islands of the United States	25,840	(2)			
	10,661,836	9,530,964			

[1] Amounts stated do not include fuel or bunker coal loaded on vessels engaged in the foreign trade, which aggregated 1,348,837 tons in 1932, 1,315,592 tons in 1933, 1,320,623 tons in 1934, and 1,576,192 tons in 1935.
[2] Commencing Jan. 1, 1935, Virgin Islands shown as a district.

TABLE 8.—*Bituminous coal exported, by districts and ports, 1934–35, in net tons*

[Compiled from records of the Bureau of Foreign and Domestic Commerce]

Customs district	1934	1935	Customs district	1934	1935
North Atlantic:			Rail gateways on Canadian border:		
New York	347	3,476	Eastern:		
Philadelphia	23,307	9,138	Maine and New Hampshire	162	155
Maryland	38,263	47,579	Vermont	478	91
Virginia	550,236	567,972	Massachusetts	1	3
South Atlantic:			St. Lawrence	455,059	329,189
South Carolina	55,469	86,275	Rochester [3]	788,546	730,742
Florida	1,740	323	Buffalo	1,773,241	1,135,642
Mobile	1,251	1,695	Michigan	1,115,162	1,090,000
New Orleans	3,581	1,683	Western:		
Mexican border:			Duluth-Superior and International Falls	12,010	24,222
Arizona	422	270	Dakota	7,431	7,961
El Paso	1,445	3,989	Montana-Idaho	10	451
San Antonio	28	165	Miscellaneous:		
Pacific coast:			Alaska	177	1,327
Washington [1]	4,428	6,276	Puerto Rico	99	17
Los Angeles	16	11	Virgin Islands		1
San Francisco	164	129	Total	10,868,552	9,742,430
San Diego	20	71			
Lake Erie ports: Ohio [2]	6,035,459	5,693,577			

[1] Both rail to Canada and by tide to foreign ports.
[2] Lower lake docks as follows: Toledo, Sandusky, Huron, Lorain, Cleveland, Fairport, Ashtabula, Conneaut, and Erie.
[3] Rail, car ferry, and Lake Ontario.

Imports.—Imports of bituminous coal have been small for many years, amounting to 202,000 net tons in 1935 compared with 180,000 tons in 1934. Canada is the chief source of bituminous imports, supplying 170,000 tons of the total in 1935.

TABLE 9.—*Bituminous coal imported, by countries and districts, 1934–35, in net tons*

[Compiled from records of the Bureau of Foreign and Domestic Commerce]

Country and district	1934	1935	Country and district	1934	1935
COUNTRY			DISTRICT OF ENTRY—contd.		
North America:			Dakota	4,407	3,854
Canada	133,382	170,330	Duluth-Superior	206	212
Mexico	64		Maine and New Hampshire	44,057	68,816
Europe:			Massachusetts	45,835	24,039
Italy	3		Michigan	336	1
United Kingdom	45,834	31,541	Montana-Idaho	47,563	61,973
Asia:			New York		107
Japan	378		Oregon	3	
Total	179,661	201,871	St. Lawrence	56	
DISTRICT OF ENTRY			San Antonio	64	
Alaska	13,797	15,707	Vermont	141	295
Buffalo	12,605		Virgin Islands		7,503
			Washington	10,591	19,364
			Total	179,661	201,871

PRODUCTION BY STATES

With few exceptions all States contributed to produce the increase in national output of bituminous coal in 1935. Slight decreases were registered in Alabama, Michigan, Ohio, Tennessee, and Alaska. Only three of the areas shown in table 10—Iowa, Washington, and Alaska—produced smaller amounts in 1935 than in 1932. The seasonal fluctuations in production are shown in table 11.

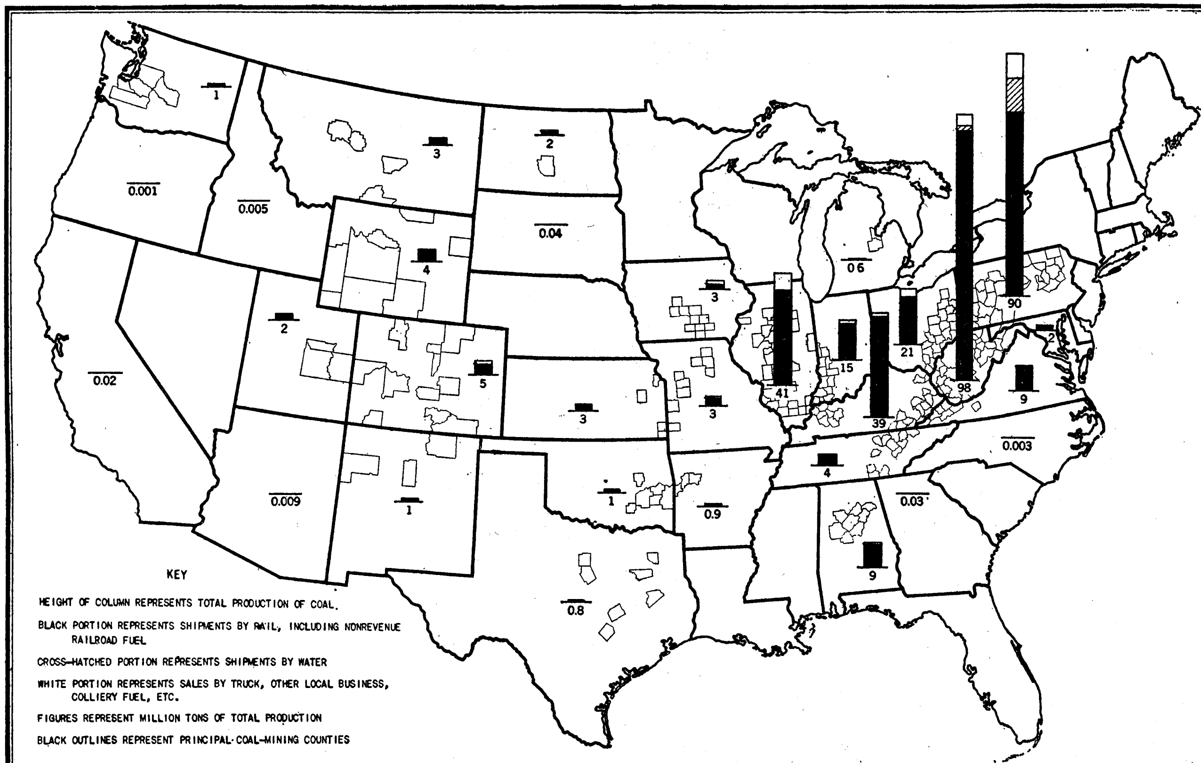

FIGURE 82.—Production of bituminous coal and total rail shipments, by States, in 1934.

TABLE 10.—*Comparison of bituminous coal produced in 1929, 1932, 1934, and 1935, by States*

State	Production (net tons)				Increase or decrease, percent	
	1929	1932	1934	1935 [1]	1929–35	1932–35
Alaska	100, 610	102, 700	107, 508	90, 000	−10. 5	−12. 4
Alabama	17, 943, 923	7, 856, 939	9, 142, 117	8, 412, 000	−53. 1	+7. 1
Arkansas	1, 695, 108	1, 033, 471	856, 432	} 2, 570, 000	−53. 0	+12. 3
Oklahoma	3, 774, 080	1, 255, 466	1, 208, 289			
Colorado	9, 920, 741	5, 598, 721	5, 210, 933	5, 872, 000	−40. 8	+4. 9
Illinois	60, 657, 641	33, 474, 553	41, 272, 384	43, 845, 000	−27. 7	+31. 0
Indiana	18, 344, 358	13, 323, 573	14, 793, 643	15, 440, 000	−15. 8	+15. 9
Iowa	4, 241, 069	3, 862, 435	3, 366, 992	3, 468, 000	−18. 2	−10. 2
Kansas	2, 975, 971	1, 952, 885	2, 508, 254	} 6, 104, 000	−12. 9	+1. 4
Missouri	4, 030, 311	4, 069, 598	3, 352, 283			
Kentucky:						
Eastern	46, 025, 452	25, 759, 534	30, 310, 456	32, 358, 000	−29. 7	+25. 6
Western	14, 437, 148	9, 540, 048	8, 214, 779	8, 120, 000	−43. 8	−14. 9
Maryland	2, 649, 114	1, 428, 937	1, 627, 112	1, 650, 000	−37. 7	+15. 5
Michigan	804, 869	446, 149	621, 741	550, 000	−31. 7	+23. 3
Montana	3, 407, 526	2, 125, 225	2, 565, 702	2, 990, 000	−12. 3	+40. 7
New Mexico	2, 622, 769	1, 263, 386	1, 259, 323	1, 382, 000	−47. 3	+9. 4
North Dakota	1, 862, 130	1, 739, 658	1, 753, 888	} 1, 910, 000	+1. 9	+6. 8
South Dakota	12, 854	49, 074	42, 407			
Ohio	23, 689, 477	13, 909, 451	20, 690, 564	20, 610, 000	−13. 0	+48. 2
Pennsylvania	143, 516, 241	74, 775, 862	89, 825, 875	90, 795, 000	−36. 7	+21. 4
Tennessee	5, 405, 464	3, 537, 882	4, 135, 790	4, 110, 000	−24. 0	+16. 2
Georgia	44, 636	27, 208	32, 716	} 40, 000	−58. 7	+37. 4
North Carolina	52, 180	1, 900	3, 140			
Texas	1, 100, 668	636, 590	759, 289	760, 000	−31. 0	+19. 4
Utah	5, 160, 521	2, 852, 127	2, 406, 183	2, 985, 000	−42. 2	+4. 7
Virginia	12, 748, 306	7, 692, 180	9, 376, 681	9, 915, 000	−22. 2	+28. 9
Washington	2, 521, 327	1, 591, 426	1, 382, 991	1, 575, 000	−37. 5	−1. 0
West Virginia	138, 518, 855	85, 608, 735	98, 134, 393	98, 589, 000	−28. 8	+15. 2
Wyoming	6, 704, 790	4, 170, 963	4, 367, 961	5, 150, 000	−23. 2	+23. 5
Other States	20, 454	23, 196	38, 196	34, 000	+66. 2	+46. 6
Total United States	534, 988, 593	309, 709, 872	359, 368, 022	369, 324, 000	−31. 0	+19. 2

[1] Subject to revision.

TABLE 11.—*Estimated monthly production of coal, by States, in 1935, in thousands of net tons*

[Estimates are based on railroad carloadings and river shipments and are subject to revision on receipt of detailed reports from the operators]

State	Jan.	Feb.	Mar.	Apr.	May	June	July
Alaska	9	6	5	8	8	7	8
Alabama	868	929	992	670	797	795	605
Arkansas and Oklahoma	365	203	123	68	68	97	102
Colorado	641	489	470	328	336	304	266
Georgia and North Carolina	4	3	4	3	3	3	3
Illinois	5, 095	4, 606	5, 112	2, 020	2, 567	3, 066	1, 996
Indiana	1, 785	1, 707	1, 909	714	1, 077	1, 193	672
Iowa	458	382	435	106	240	247	146
Kansas and Missouri	748	592	631	275	346	416	292
Kentucky:							
Eastern	2, 901	2, 863	2, 925	2, 182	2, 507	2, 641	2, 210
Western	1, 032	848	924	385	472	554	381
Maryland	184	172	187	105	90	138	74
Michigan	77	69	73	33	39	39	12
Montana	305	224	256	202	199	182	173
New Mexico	128	107	117	99	104	103	92
North Dakota and South Dakota	302	145	127	81	69	49	55
Ohio	2, 080	2, 015	2, 213	1, 121	1, 746	1, 690	1, 083
Pennsylvania bituminous	8, 533	8, 621	10, 109	5, 639	6, 918	8, 229	5, 928
Tennessee	435	454	460	251	349	323	293
Texas	70	65	64	53	57	53	62
Utah	365	236	256	173	129	144	112
Virginia	843	841	976	647	726	817	665
Washington	195	142	135	119	86	98	85
West Virginia:							
Southern [1]	6, 568	6, 422	6, 913	4, 966	5, 580	6, 413	5, 286
Northern [2]	2, 268	2, 299	2, 851	1, 376	1, 960	2, 135	1, 416
Wyoming	490	391	430	345	375	378	320
Other Western States	3	3	4	1	1	3	2
Total bituminous coal	36, 752	34, 834	38, 701	21, 970	26, 849	30, 117	22, 339
Pennsylvania anthracite [3]	5, 691	4, 505	3, 082	4, 806	4, 919	5, 642	3, 536
Grand total	42, 443	39, 339	41, 783	26, 776	31, 768	35, 759	25, 875

See footnotes at end of table.

TABLE 11.—*Estimated monthly production of coal, by States, in 1935, in thousands of net tons*—Continued

[Estimates are based on railroad carloadings and river shipments and are subject to revision on receipt of detailed reports from the operators]

State	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Alaska	9	9	8	6	7	90
Alabama	690	605	72	431	958	8,412
Arkansas and Oklahoma	177	279	428	332	328	2,570
Colorado	379	457	747	724	731	5,872
Georgia and North Carolina	4	2	3	4	4	40
Illinois	2,427	2,910	4,810	4,182	5,054	43,845
Indiana	905	887	1,530	1,406	1,655	15,440
Iowa	159	208	308	348	431	3,468
Kansas and Missouri	377	452	694	598	683	6,104
Kentucky:						
Eastern	2,473	2,441	3,464	2,998	2,753	32,358
Western	570	643	790	717	804	8,120
Maryland	113	105	172	147	163	1,650
Michigan	8	52	42	48	58	550
Montana	205	234	358	362	290	2,990
New Mexico	106	95	137	154	140	1,382
North Dakota and South Dakota	66	141	334	296	245	1,910
Ohio	1,311	1,400	2,158	1,774	2,019	20,610
Pennsylvania bituminous	6,776	5,728	8,367	7,771	8,176	90,795
Tennessee	340	301	128	369	407	4,110
Texas	65	65	68	71	67	760
Utah	141	179	415	447	388	2,985
Virginia	778	704	1,081	914	923	9,915
Washington	91	106	175	182	161	1,575
West Virginia:						
Southern [1]	6,140	5,163	8,530	6,668	6,285	74,934
Northern [2]	1,527	1,486	2,317	1,886	2,134	23,655
Wyoming	324	385	628	564	520	5,150
Other Western States	3	1	4	5	4	34
Total bituminous coal	26,164	25,038	37,768	33,404	35,388	369,324
Pennsylvania anthracite [3]	2,591	4,172	4,279	3,160	4,620	51,003
Grand total	28,755	29,210	42,047	36,564	40,008	420,327

[1] Includes operations on the Norfolk & Western; Chesapeake & Ohio; Virginian; Kanawha & Michigan; and Buffalo Creek & Gauley; and on the Baltimore & Ohio in Kanawha, Mason, and Clay Counties.
[2] Rest of State, including the Panhandle district and Grant, Mineral, and Tucker Counties.
[3] Includes Sullivan County, washery and dredge coal, local sales, colliery fuel, and coal shipped by truck from authorized operations.

TRUCK MOVEMENT OF COAL

The movement of coal from mines by truck has been increasing rapidly since the beginning of the depression in 1930. In 1933, the first year for which complete figures are available, 15,462,739 net tons of bituminous coal were trucked, or 4.6 percent of the total production. This movement continued to grow in 1934, when 18,739,320 net tons (5.2 percent of total production) were trucked. (See table 12.) The indications are that trucking of coal increased in 1935, the Pennsylvania Department of Mines reporting 3,986,061 tons hauled thus in 1935 compared with 3,846,231 tons in 1934.

TABLE 12.—*Disposal of total output of bituminous-coal mines of the United States, by years, 1915–35*

[As reported by mine operators to the U. S. Bureau of Mines. Prior to 1924, except in 1921, the output of mines producing less than 1,000 tons a year, sometimes referred to as wagon mines, was included in the total annual production of coal reported. These small mines were not canvassed in 1921, a year of decreased demand, and beginning with 1924 the canvass was discontinued]

Year	Loaded at mines for shipment by rail [1]		Loaded at mines for shipment by waterways		Truck or wagon commercial sales [2]		Other sales to local trade, used by employees, or taken by locomotives at tipple [2]		Made into coke at mines [3]		Used at mines for power and heat		Total production
	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total	Net tons
1915	370, 336, 585	83. 7	9, 540, 006	2. 1			12, 353, 708	2. 8	40, 595. 446	9. 2	9, 798. 681	2. 2	442, 624, 426
1916	414, 475, 002	82. 5	9, 191, 683	1. 8			15, 832, 633	3. 2	52, 709, 900	10. 4	10, 310, 464	2. 1	502, 519, 682
1917	459, 167, 199	83. 2	10, 683. 776	2. 0			19, 507, 322	3. 5	50, 315, 107	9. 1	12, 117, 159	2. 2	551, 790, 563
1918	493, 072, 816	85. 1	10, 015, 712	1. 7			18, 681, 757	3. 2	45, 094, 089	7. 8	12, 521, 446	2. 2	579, 385, 820
1919	397, 444, 815	85. 3	11, 703, 939	2. 5			18, 068, 578	3. 9	27, 581, 155	5. 9	11, 061, 571	2. 4	465, 860, 058
1920	490, 122, 556	86. 2	14, 750, 504	2. 6			21, 289, 435	3. 7	30, 608, 233	5. 4	11, 895, 955	2. 1	568, 666, 683
1921	371, 327, 621	89. 3	10, 736, 115	2. 5			16, 135, 621	3. 9	8, 599, 476	2. 1	9, 123, 117	2. 2	415, 921, 950
1922	374, 390, 041	88. 7	9, 287, 366	2. 2			17, 506, 149	4. 1	13, 253, 275	3. 1	7, 831, 268	1. 9	422, 268, 099
1923	488, 974, 496	86. 6	16, 884, 799	3. 0			22, 081, 040	3. 9	27, 859, 316	4. 9	8, 765, 011	1. 6	564, 564, 662
1924	425, 891, 490	88. 1	15, 674, 204	3. 2			21, 111, 004	4. 3	14, 392, 159	3. 0	6, 617, 681	1. 4	483, 686, 538
1925	460, 232, 442	88. 5	16, 940, 370	3. 3			21, 351, 223	4. 1	15, 752, 603	3. 0	5, 776, 103	1. 1	520, 052, 741
1926	506, 987, 738	88. 4	19, 298, 259	3. 4			23, 601, 587	4. 1	17, 751, 549	3. 1	5, 727, 852	1. 0	573, 366, 985
1927	462, 691, 336	89. 3	17, 532, 105	3. 4			21, 889, 884	4. 2	10, 719, 633	2. 1	4, 930, 394	1. 0	517, 763, 352
1928	445, 876, 451	89. 0	21, 471, 464	4. 3			21, 989, 624	4. 4	6, 805, 222	1. 4	4, 602, 209	. 9	500, 744, 970
1929	474, 868, 165	88. 8	23, 066, 289	4. 3			23, 262, 558	4. 3	9, 128, 607	1. 7	4, 662, 974	. 9	534, 988, 593
1930	416, 225, 966	89. 0	21, 172, 603	4. 6			22, 121, 055	4. 7	4, 013, 915	. 9	3, 992, 760	. 8	467, 526, 299
1931	342, 671, 815	89. 7	14, 606, 238	3. 8			19, 878, 462	5. 2	1, 727, 682	. 5	3, 205, 199	. 8	382, 089, 396
1932	276, 142, 037	89. 2	9, 365, 782	3. 0			20, 392, 706	6. 6	1, 028, 458	. 3	2, 780, 889	. 9	309, 709, 872
1933	293, 258, 534	87. 9	13, 021, 131	3. 9	15, 462, 739	4. 6	7, 589, 672	2. 3	1, 440, 736	. 4	2, 857, 721	. 9	333, 630, 533
1934	313, 303, 729	87. 1	15, 127, 968	4. 2	18, 739, 320	5. 2	7, 374, 143	2. 1	1, 647, 805	. 5	3, 175, 057	. 9	359, 368, 022
1935 [4]													[5] 369,324, 000

[1] Includes nonrevenue railroad fuel and coal loaded on electric railways.
[2] Truck or wagon commercial sales were included with other local sales prior to 1933.
[3] Virtually all the coke produced is shipped out in railroad cars as made.
[4] Data on disposition of output for the year 1935 not yet available.
[5] Preliminary.

LONG-TIME TRENDS OF THE INDUSTRY

The history of bituminous-coal mining since the turn of the century is epitomized in figures 83 and 84 and in the accompanying tables. The diagrams indicate three major periods: (1) A pre-war period, 1899 to 1914, marked by rapid and fairly steady expansion; (2) a period of shortage and high prices associated with the World War, congestion of transport, and a series of great strikes extending from 1915 to 1922, which further inflated the capacity of an already overdeveloped industry; and (3) a period of difficult readjustment beginning after

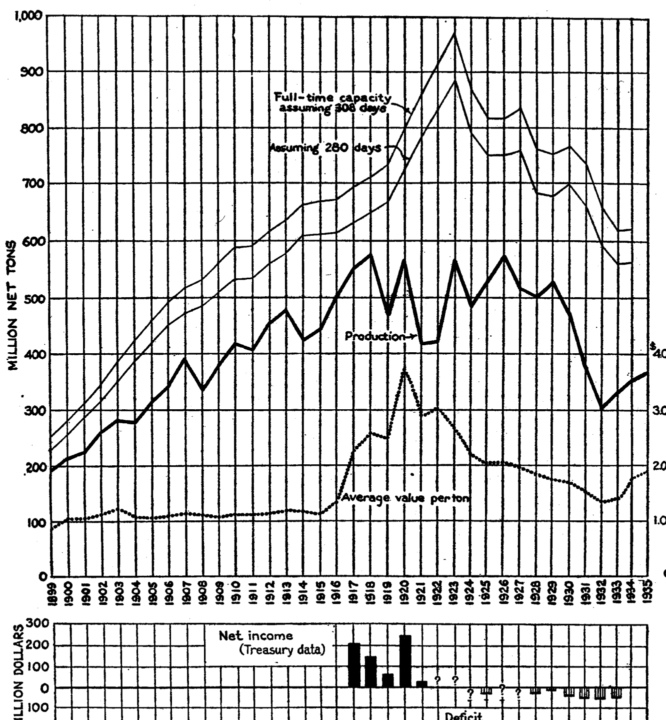

FIGURE 83.—Trends of bituminous-coal production, realization, mine capacity, and net income or deficit in the United States, 1899–1935.

1923, in which a decline in prices, employment, and wages was apparent even before the great depression of 1930, at a time when other industries experienced exceptional prosperity. From 1924 to the adoption of the N. R. A. code in October 1933 Treasury returns indicate that the industry as a whole lost money every year with the possible exception of 1926, when a 9-month strike of the British miners created an exceptional demand for the export of American coal.

What has been the trend since adoption of the code? Wage rates have increased substantially and hours of labor have been reduced to 7 per day. The reduction in working time brought about a parallel reduction in output per man per day in 1934; returns for 1935 are not yet available. After pausing for a time the trend toward mechanization is now apparently being resumed. (See tables 18 to 21.)

Prices have increased—in 1934, by somewhat more than costs; in 1935, apparently by somewhat less than costs. Income-tax returns for 1934 and 1935 have not been published, but other evidence indicates that in 1934 the financial position of the industry improved greatly and the deficits characteristic of preceding years were reduced, though probably not wholly overcome. In 1935 such data as are at

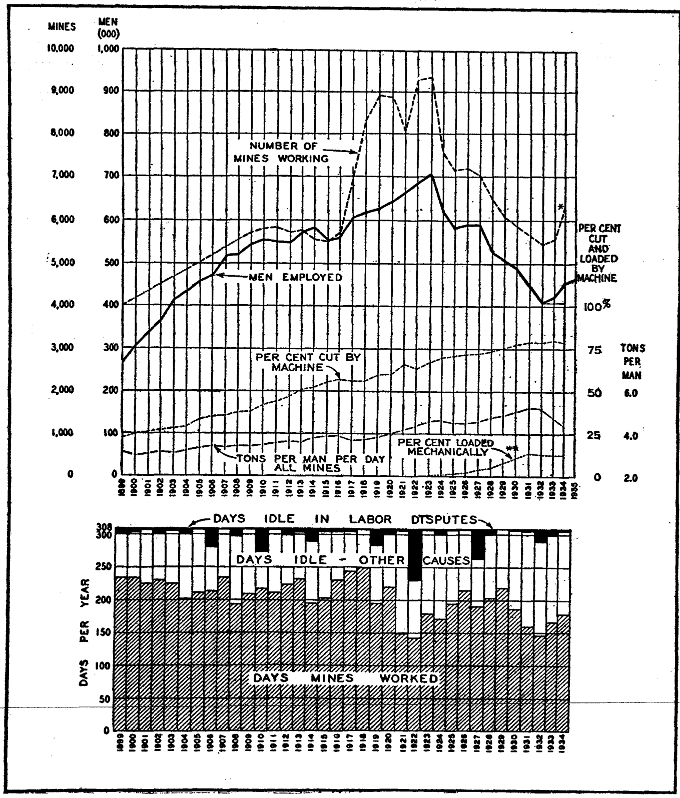

FIGURE 84.—Trends of employment, working time, mechanization, and labor productivity at bituminous-coal mines, 1899–1935.

hand indicate a less favorable showing. Meantime, employment and working time increased in 1934 and again in 1935.

Mine capacity, which had been falling for a decade, increased very slightly in 1934. In 1933 the 308-day capacity of all operating mines was 615,000,000 tons; in 1934 it was 622,000,000 tons.

The number of the operating mines, which has fallen precipitately since 1923, likewise increased. The total number of commercial mines—those producing over 1,000 tons a year—on the books of the Bureau of Mines declined from 9,331 in 1923 to 5,427 in 1932, the low point of the depression. In 1933 it increased slightly, to 5,555. In 1934 the recorded number of mines was much larger. The official count at present stands at 6,258, but the indicated gain of 703 mines is more apparent than real. It consists almost entirely of little truck mines close to the margin of 1,000 tons annual output. This is proved by the size classification of the mines reporting, which is given below:

	Classes 1 to 4 (all mines over 10,000 tons)	Class 5 (mines under 10,000 tons)	Total, all classes
Number of mines:			
1933	2,530	3,025	5,555
1934	2,587	3,671	6,258
Increase	[1] +57	+646	+703
Percent of output:			
1933	97.4	2.6	100.0
1934	97.3	2.7	100.0
Increase	-.1	+.1	

[1] Many of these 57 mines are not new but have happened to pass from under 10,000 tons in 1933 to over 10,000 in 1934 and so are counted in the next higher class.

TABLE 13.—*Bituminous-coal production, realization, and mine capacity in the United States, 1899–1935*

	Production (millions of net tons)	Calculated capacity (millions of net tons)		Value per ton, f. o. b. mines		Production (millions of net tons)	Calculated capacity (millions of net tons)		Value per ton, f. o. b. mines
		At 308 days	At 280 days				At 308 days	At 280 days	
1899	193	254	230	$0.87	1918	579	717	650	$2.58
1900	212	279	255	1.04	1919	466	736	669	2.49
1901	226	309	281	1.05	1920	569	796	725	3.75
1902	260	348	316	1.12	1921	416	860	781	2.89
1903	283	387	350	1.24	1922	422	916	832	3.02
1904	279	425	386	1.10	1923	565	970	885	2.68
1905	315	460	417	1.06	1924	484	871	792	2.20
1906	343	496	451	1.11	1925	520	822	748	2.04
1907	395	520	473	1.14	1926	573	821	747	2.06
1908	333	531	482	1.12	1927	518	835	759	1.99
1909	380	560	510	1.07	1928	501	760	691	1.86
1910	417	592	538	1.12	1929	535	752	679	1.78
1911	406	593	538	1.11	1930	468	770	700	1.70
1912	450	622	566	1.15	1931	382	736	669	1.54
1913	478	635	577	1.18	1932	310	653	594	1.31
1914	423	668	608	1.17	1933	334	615	559	1.34
1915	443	672	610	1.13	1934	359	622	565	1.75
1916	503	673	613	1.32	1935	[1] 369	(2)	(2)	[3] 1.895
1917	552	699	636	2.26					

[1] Preliminary.
[2] No data.
[3] Average sales realization of all commercial operators reporting to the N. R. A. from divisions I and II for January 1935. Final figures for all districts and operations, including captive mines, and for entire year 1935 are not yet available.

Many of the 703 are undoubtedly new mines, the opening of which was encouraged partly by the availability of cheap trucks and the growing network of hard roads and partly by the better prices that resulted from the adoption of the code. But many others—probably more than half the total—are mines that existed before the code was drawn but were not recorded previously in official statistics. The attempt made to fix minimum prices and the task of policing those prices focused attention on a development that had been ignored largely up to that time. Code authorities began to count the little mines and, looking for them, found them by the thousand. State mine departments tightened their inspections of small mines and were more careful to report them. In Pennsylvania the State mining law, which formerly had covered only mines employing 10 men or over, was amended to cover those employing as few as 2 men. The result of this interest and activity was to make the count of small mines more nearly complete than it had been at any time since the war. The Bureau of Mines made a special effort to obtain reports on these little mines in 1934 and has included in its statistics every operation producing 1,000 tons or more as to which it could secure information either direct or through State mine officials and local code authorities. Information was received relative to a great number of mines producing less than 1,000 tons, but these, in conformity with past practice, were not included in the statistics. The count of 1,000 tons and over is still not complete, but the Bureau is satisfied that the omissions, as regards tonnage, are insignificant.

TABLE 14.—*Trends of employment, working time, mechanization, and labor productivity at bituminous-coal mines in the United States, 1899–1935*

Year	Number of men employed (thousands)	Average number of days			Net tons per man per day	Number of commercial mines in operation	Percent of total output cut by machine	Percent of underground output loaded mechanically [3]
		Worked	Idle					
			On account of labor disputes [1]	Other causes [2]				
1899	271	234	8	66	3.05	4,000	22.7	----------
1900	304	234	5	69	2.98	(4)	24.9	----------
1901	340	225	2	81	2.94	(4)	25.6	----------
1902	370	230	7	71	3.06	(4)	26.8	----------
1903	416	225	3	80	3.02	(4)	27.6	----------
1904	438	202	8	98	3.15	(4)	28.2	----------
1905	461	211	2	95	3.24	5,060	32.8	----------
1906	478	213	28	67	3.36	(4)	34.7	----------
1907	513	234	1	73	3.29	(4)	35.1	----------
1908	516	193	11	104	3.34	(4)	37.0	----------
1909	543	209	1	98	(4)	5,775	37.5	----------
1910	556	217	35	56	3.46	5,818	41.7	----------
1911	550	211	2	95	3.50	5,887	43.9	----------
1912	549	223	10	75	3.68	5,747	46.8	----------
1913	572	232	5	71	3.61	5,776	50.7	----------
1914	584	195	19	94	3.71	5,592	51.7	----------
1915	557	203	4	101	3.91	5,502	55.0	----------
1916	561	230	4	74	3.90	5,726	56.5	----------
1917	603	243	4	61	3.77	6,939	55.5	----------
1918	615	249	1	58	3.78	8,319	55.9	----------
1919	622	195	25	88	3.84	8,994	59.2	----------
1920	640	220	6	82	4.00	8,921	59.8	----------
1921	664	149	3	156	4.20	8,038	65.6	----------
1922	688	142	78	88	4.28	9,299	63.2	----------
1923	705	179	2	127	4.47	9,331	66.9	0.3
1924	620	171	7	130	4.56	7,586	69.5	.7
1925	588	195	2	111	4.52	7,144	70.6	1.2
1926	594	215	1	92	4.50	7,177	71.7	1.9
1927	594	191	45	72	4.55	7,011	72.2	3.3
1928	522	203	8	97	4.73	6,450	73.8	4.5
1929	503	219	(5)	89	4.85	6,057	75.4	7.4
1930	493	187	2	119	5.06	5,891	77.5	10.5
1931	450	160	3	145	5.30	5,642	79.1	13.1
1932	406	146	19	143	5.22	5,427	78.8	12.6
1933	419	167	9	132	[6] 4.78	5,555	80.0	12.0
1934	458	178	3	127	[6] 4.40	[7] 6,258	79.2	12.2
1935 [8]	462	(4)	(4)	(4)	(4)	(4)	(4)	(4)

[1] Includes strikes, suspensions, and lockouts.
[2] Includes no market, car shortage, mine breakdowns, and all other causes of lost time except labor disputes.
[3] Mechanical devices were used for loading before 1923, when the record begins, but the tonnages were very small. The figures include coal handled on mobile loaders, scrapers, duckbills, pit-car loaders, and conveyors, except that prior to 1927 no figures were collected for hand-loaded face conveyors. They do not include coal loaded by power shovels in open pits on the surface.
[4] No data.
[5] Less than ½ day.
[6] The indicated decline in output per man in 1933 and 1934 is much affected by the shortening of working hours under the N. R. A. code.
[7] The 1934 figures of number of mines are not fully comparable with preceding years because of more complete coverage of small trucking mines in certain States made possible by cooperation of N. R. A. divisional code authorities.
[8] Preliminary.

The 1934 statistics on number of small mines, therefore, are not comparable with those for former years. The number of mines has increased, but the actual increase is less than the record on its face seems to show.

RELATIVE RATE OF GROWTH OF COAL, OIL, AND WATER POWER, 1899–1935

According to preliminary data, the total supply of energy available in the form of coal, oil, natural gas, and water power in 1935 was 21,443 trillion B. t. u., an increase of 5 percent over the year before.

The figures are expressed in British thermal units because some common denominator is necessary for such unlike quantities as tons of coal, barrels of oil, and cubic feet of gas. Table 15 summarizes the British thermal units equivalent of each of the fuels. Water power is represented by the equivalent of the fuel that would be required to perform the same work, assuming a low thermal efficiency.

TABLE 15.—*Annual supply of energy from mineral fuels and water power in the United States*

[Figures represent trillions of British thermal units. Water power is represented by the British thermal units of coal required to produce the same amount of power, assuming a consumption of 4 pounds of coal per kilowatt-hour, the average performance of central electric stations in 1913. If the present average performance of 1.4 pounds per kilowatt-hour were assumed, the fuel equivalent of water power would be reduced correspondingly]

Year	Anthracite	Bituminous coal	Total coal	Domestic oil (total crude including that refined)	Natural gas (total production)	Imported oil (total crude)	Total oil and gas	Total mineral fuels	Water power, fuel equivalent [1]	Grand total, including water power
1899	1,643	5,065	6,708	342	[2] 240	--------	582	7.291	135	7,426
1909	2,205	9,949	12,155	1,099	517	--------	1,616	13,771	411	14,182
1913	2,490	12,535	15,025	1,491	626	102	2,219	17,243	588	17,831
1918	2,688	15,180	17,868	2,136	775	226	3,137	21,005	837	21,842
1921	2,461	10,897	13,358	2,833	712	752	4,297	17,655	908	18,563
1922	1,487	11,063	12,551	3,345	820	764	4,929	17,480	1,024	18,504
1923	2,539	14,791	17,330	4,394	1,082	492	5,968	23,298	1,136	24,434
1924	2,392	12,672	15,064	4,284	1,227	467	5,978	21,042	1,167	22,209
1925	1,681	13,625	15,306	4,582	1,278	371	6,231	21,537	1,290	22,827
1926	2,297	15,022	17,319	4,625	1,411	362	6,398	23,717	1,492	25,209
1927	2,179	13,565	15,744	5,407	1,553	350	7,310	23,054	1,687	24,741
1928	2,049	13,120	15,169	5,409	1,686	479	7,574	22,743	1,942	24,685
1929	2,008	14,017	16,025	6,044	2,062	474	8,580	24,605	1,929	26,534
1930	1,887	12,249	14,136	5,388	2,089	373	7,850	21,986	1,856	23,842
1931	1,622	10,011	11,633	5,106	1,813	284	7,203	18,836	1,721	20,557
1932	1,356	8,114	9,470	4,711	1,673	268	6,652	16,122	1,900	18,022
1933	1,348	8,741	10,089	5,434	1,672	191	7,297	17,386	1,931	19,317
1934	1,555	9,415	10,970	5,448	1,904	213	7,565	18,535	1,896	20,431
1935 [3]	[4] 1,387	9,676	11,063	5,964	2,016	193	8,173	19,236	2,207	21,443

[1] The fuel equivalent of water power is calculated from the reported horsepower of installed water wheels, assuming a capacity factor of 20 percent for manufactures and mines, and of 40 percent for public utilities. For 1920 to 1934, however, actual reports of the kilowatt-hours produced by water in electric-utility plants have been used as published by the U. S. Geological Survey. A unit consumption of 4 pounds of coal per kilowatt-hour (the average for 1913) is assumed throughout the period.

[2] Based on the amount of coal displaced by gas as estimated by the gas companies at the time.

[3] Preliminary.

[4] The figures for anthracite represent the output from established operations only and do not include an unknown amount of production from unauthorized operations. The latter has been estimated at approximately 4,000,000 net tons a year, which is equivalent to about 8 percent of the production from the legitimate operations. If this additional item of 4,000,000 tons were included, the total energy from anthracite in 1935 would be 1,496 trillion B. t. u.; the total energy from all sources would be 21,552 trillion B. t. u.

It is important to note that the figures for "domestic oil" and "natural gas" represent the entire production of crude petroleum and gas. Most of this product does not come into direct competition with coal. Much of the supply of both oil and gas is used in regions of the country, such as California and portions of the Southwest, where coal is available only at unusually high cost because of heavy transport charges. Nearly half of the natural gas is used in the field for drilling or operating oil and gas wells and pipe lines or for the manufacture of carbon black. More than half the oil is used in the

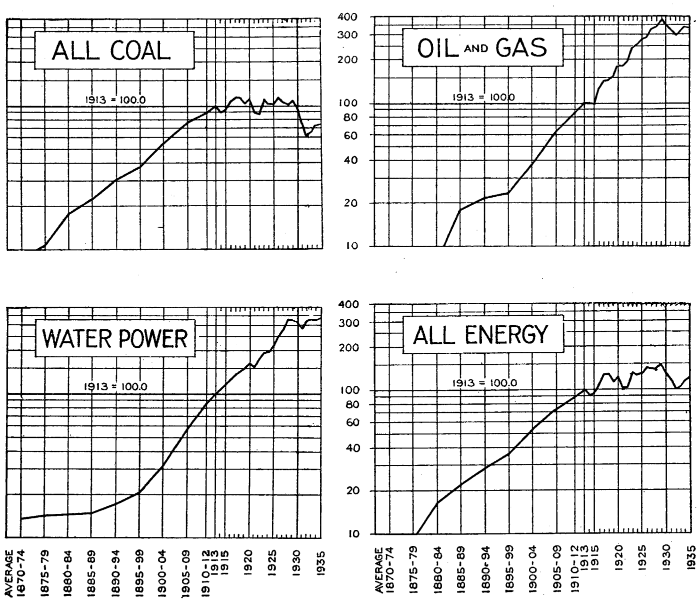

FIGURE 85.—Relative rate of growth of annual supply of coal, oil and gas, and water power in the United States, 1870–1935.

form of gasoline, kerosene, and lubricants, for which purposes coal cannot well compete except at a much higher price. Even these refined products, however, involve a certain measure of indirect competition with coal, for the energy market of the country is becoming more fluid and competitive, and a demand that cannot be met by one source of supply tends to fall back on the others. The purpose of these tables is to measure the total demand for energy.

Coal remained the largest source of energy in 1935, contributing 51.6 percent of the total supply. The water power developed furnished only 10.3 percent of the total, though, of course, a much larger percentage of the electric power produced by central stations. Details are given in table 16.

TABLE 16.—*Percent of total British thermal units equivalent contributed by the several mineral fuels and water power in the United States*

Year	Anthracite	Bituminous coal	Total coal	Domestic oil (total crude including that refined)	Natural gas (total production)	Imported oil (total crude)	Total oil and gas	Water power, fuel equivalent	Grand total, including water power
1899	22.1	68.2	90.3	4.6	3.3	----------	7.9	1.8	100.0
1909	15.5	70.2	85.7	7.7	3.7	([1])	11.4	2.9	100.0
1913	14.0	70.3	84.3	8.3	3.5	0.6	12.4	3.3	100.0
1918	12.3	69.5	81.8	9.8	3.6	1.0	14.4	3.8	100.0
1921	13.3	58.7	72.0	15.2	3.8	4.1	23.1	4.9	100.0
1922	8.0	59.8	67.8	18.1	4.4	4.1	26.6	5.6	100.0
1923	10.4	60.5	70.9	18.0	4.5	2.0	24.5	4.6	100.0
1924	10.8	57.0	67.8	19.3	5.5	2.1	26.9	5.3	100.0
1925	7.4	59.6	67.0	20.1	5.6	1.6	27.3	5.7	100.0
1926	9.1	59.6	68.7	18.4	5.6	1.4	25.4	5.9	100.0
1927	8.8	54.8	63.6	21.9	6.3	1.4	29.6	6.8	100.0
1928	8.3	53.2	61.5	21.9	6.8	2.0	30.7	7.8	100.0
1929	7.6	52.8	60.4	22.8	7.7	1.8	32.3	7.3	100.0
1930	7.9	51.4	59.3	22.5	8.8	1.6	32.9	7.8	100.0
1931	7.9	48.7	56.6	24.8	8.8	1.4	35.0	8.4	100.0
1932	7.5	45.0	52.5	26.1	9.3	1.5	36.9	10.6	100.0
1933	7.0	45.2	52.2	28.1	8.7	1.0	37.8	10.0	100.0
1934	7.6	46.1	53.7	26.7	9.3	1.0	37.0	9.3	100.0
1935 [2]	[3] 6.5	45.1	51.6	27.8	9.4	.9	38.1	10.3	100.0

[1] Less than 0.1 percent.
[2] Preliminary.
[3] If production from unauthorized operations were included, the proportion from anthracite in 1935 would be 6.9 percent.

TREND OF FUEL EFFICIENCY

For many years during and following the World War the fuel-economy movement made rapid strides. The record for recent years, however, clearly indicates a slower rate of advance and in some

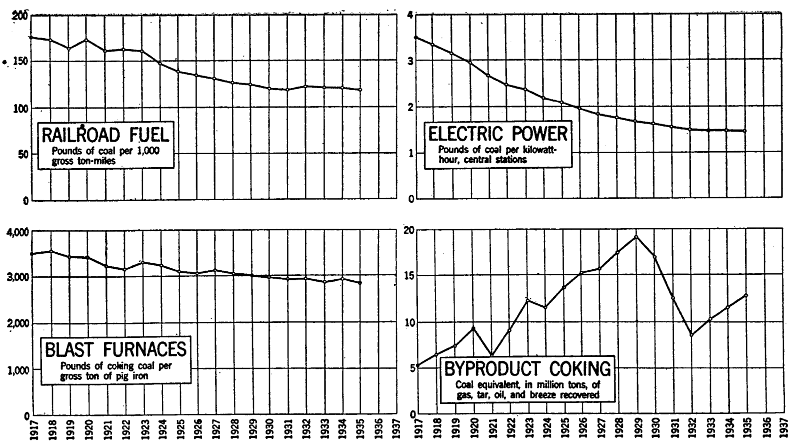

FIGURE 86.—Trends in fuel efficiency in the United States, 1917–35.

instances at least a temporary halting in the progress of efficiency in the use of coal. (See fig. 86.)

Railroad fuel.—The unit of consumption of coal by locomotives in freight service decreased in 1935. The average consumption of coal per 1,000 gross ton-miles by locomotives in freight service was 120 pounds compared with 122 pounds in 1934 and 119 pounds in 1931, the year of best performance. The average consumption of coal per passenger-train car-mile actually increased from 15.2 pounds in 1934 to 15.5 pounds in 1935. This decrease was probably accounted for in part by the running of fewer passenger cars per train.

Electric public utilities.—The number of pounds of fuel consumed by steam-electric stations per kilowatt-hour of electricity generated dropped slightly from 1.47 in 1934 to 1.46 in 1935. Here, too, the rate of improvement in fuel efficiency has decreased in the past 3 years.

Blast furnaces.—The consumption of coal per gross ton of pig iron and ferro-alloys produced has continued to decline steadily for many years, amounting to 2,837.8 pounds in 1935 compared with 2,926.7 pounds in 1934 (table 17).

TABLE 17.—*Indicators of effect of fuel economy on consumption of coal per unit of performance*

Year	Electric public-utility power plants—pounds of fuel consumed by fuel stations per kilowatt-hour	Steam-railroad locomotives—pounds of coal per—		Byproduct coking—coal equivalent of gas, tar, oil, and breeze recovered (thousand tons)	Iron and steel blast furnaces—pounds of coal per gross ton of pig iron and ferro-alloys
		1,000 gross ton-miles freight service	Passenger-train car-mile		
1913	4.5	(1)	(1)	2,600	3,637.2
1914	(1)	(1)	(1)	2,461	3,519.3
1915	(1)	(1)	(1)	3,280	3,351.2
1916	(1)	169	18.5	4,375	3,421.1
1917	3.47	176	19.4	5,432	3,523.6
1918	(1)	174	19.2	6,785	3,577.1
1919	3.22	164	18.1	7,575	3,427.6
1920	3.04	174	18.8	9,316	3,420.8
1921	2.73	162	17.7	6,461	3,236.2
1922	2.51	163	17.9	9,058	3,186.4
1923	2.41	161	18.1	12,417	3,323.4
1924	2.22	149	17.0	11,628	3,248.2
1925	2.07	140	16.1	13,786	3,125.6
1926	1.95	137	15.8	15,394	3,048.4
1927	1.84	131	15.4	15,642	3,093.7
1928	1.76	127	15.0	17,426	3,053.4
1929	1.69	125	14.8	19,262	2,983.5
1930	1.62	121	14.7	16,923	2,978.5
1931	1.55	119	14.5	12,482	2,923.2
1932	1.50	123	14.9	8,572	2,910.8
1933	1.47	121	15.2	10,287	2,875.7
1934	1.47	122	15.2	11,506	2,926.7
1935 [2]	1.46	120	15.5	12,793	2,837.8

[1] No data.
[2] Preliminary.

MECHANIZATION IN 1935

A marked advance was made in the installation of mechanical cleaning and loading equipment at the coal mines of the country in 1935. Complete statistics of the tonnages produced by such devices are not yet available, but the trend is shown by preliminary reports of sales by the manufacturers of equipment.

Mechanical cleaning of bituminous coal.—In 1934 the production of bituminous coal was 359,368,022 tons, of which 11.1 percent (39,826,559 tons) was cleaned mechanically.

In terms of total tonnage mechanically cleaned the important States are Alabama, Illinois, Indiana, Ohio, Pennsylvania, and West Virginia. Other important States, in terms of percentage of total output which cleaned mechanically, are Colorado, Kansas, Michigan, Missouri, and Washington.

At least 38 new installations of mechanical cleaning equipment, including entire plants and additions to existing equipment, were placed in operation in 1935. Although the list of new plants is probably incomplete at this writing, the outlook is promising, particularly in view of the fact that no less than eight additional plants are scheduled to begin operation early in 1936.

A brief review by States (discussed in order of percentage cleaned in 1934) indicates that several installations of wet tables were made in Alabama late in 1934 and in 1935. In Washington two new plants began operating in 1935. In Pennsylvania one plant began operating late in 1934, additions were made to three existing plants in 1935, and three new plants were opened in the middle of the year.

Kansas and Missouri should report an increase in tonnage mechanically cleaned because of a new plant that started operating late in 1934 and another that began in 1935.

West Virginia reports two plants starting to operate in 1934, nine new installations in 1935, and four scheduled for completion early in 1936. West Virginia has more tipples equipped with cleaners than any other State.

No new installations are reported for Colorado, but one wet-table installation is reported for Tennessee. In Ohio one new plant is to be completed in 1936.

Illinois is advancing rapidly to the commanding place in coal washing it held before the war, and Indiana is continuing the growth begun in recent years. The tonnage from Illinois should show a large increase if the one large plant started in 1934 and the six large plants begun in 1935 operated near capacity. In addition, three new plants are to be started in 1936. In Indiana four new installations are reported for 1935.

It appears, therefore, that mechanical coal cleaning had a banner year in 1935, and the prospects for 1936 look favorable.

Mechanical loading.—In 1934 bituminous coal mechanically loaded totaled 41,432,735 net tons, 12.2 percent of all the deep-mined tonnage. In the anthracite region of Pennsylvania 9,284,486 net tons (19.1 percent of the deep-mined tonnage) was mechanically loaded. In 10 major areas the quantity loaded mechanically has exceeded a million tons in recent years—Alabama, Illinois, Indiana, Montana, Ohio, Pennsylvania bituminous, Pennsylvania anthracite, West Virginia, and Wyoming.

Sales of equipment indicate the trend of mechanical loading in 1935. The manufacturers have courteously furnished lists of sales, and the following discussion is based on reports from the sales engineers of 28 companies. The information cannot be revealed in as much detail as might be desirable because the report of each manufacturer is considered confidential. The totals, however, are of great interest.

Table 18 compares sales by identical manufacturers who reported for the 3 years 1933–35. Each of the three major classes of machines listed shows an increase in 1935 over the year before. By far the largest increase was reported in the class of mobile loaders and scrapers. Manufacturers of these types sold 137 units in 1935 as against 89 in 1934, an increase of 53.9 percent.

Sales of conveyors and duckbills likewise gained substantially. These two types of equipment are grouped to obviate disclosure of individual business, and the numerical count is made by reckoning each piece of equipment sold (that is, every entry, room, and face conveyor, shaker drive, or duckbill) as one unit. Sales by identical manufacturers increased from 596 units in 1934 to 661 in 1935, or 10.9 percent. Sales of pit-car loaders increased 7.7 percent in 1935 compared with 1934.

TABLE 18.—*Sales of mechanized loading equipment as reported by identical manufacturers, 1933–35, inclusive, in units of equipment*

[Covers sales to both anthracite and bituminous-coal mines]

	Number of units			Percent change 1935 over 1934
	1933	1934	1935	
Mobile loaders and scrapers	105	89	137	+53.9
Conveyors and duckbills	384	596	661	+10.9
Pit-car loaders	18	26	28	+7.7

Table 19 shows how the number of units sold during 1935 compares with the number in actual use in 1934 and earlier years at the anthracite and the bituminous-coal mines. It will be seen that both the hard- and soft-coal fields added substantially to their existing equipment in 1935, the types of machines selected varying with conditions. Outstanding features of the year were the spread of the heavier types of equipment, especially the mobile loader in the bituminous-coal fields, and the installation of conveyors (and duckbills) in both bituminous and anthracite mines. Of the pit-car loaders sold, 23 went to bituminous mines and 5 to anthracite.

TABLE 19.—*Sales of mechanized loading equipment in 1935 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 in 1935, as reported by 28 manufacturers
	1928	1929	1930	1931	1932	1933	1934	
Bituminous mines:								
Mobile loading machines	397	488	545	583	548	523	534	129
Scrapers	130	126	150	146	128	93	119	
Pit-car loaders	1,040	2,521	2,876	3,428	3,112	2,453	2,288	23
Duckbill and other self-loading conveyors	82	99	140	165	159	132	157	[2] 306
Hand-loaded face conveyors—								
Number of conveyor units	(1)	(1)	(1)	(1)	(1)	525	574	
Number of mines at which used	119	130	142	152	136	114	114	[3] 59
Anthracite mines (Pennsylvania):								
Mobile loading machines	302	350	384	5	11	18	14	8
Scrapers				457	479	455	517	
Pit-car loaders	184	355	421	28	24	19	25	
Duckbill and other self-loading conveyors				1	17	12	13	5
Hand-loaded face conveyors, number of units				547	818	940	1,338	[2] 354

[1] Number of units not reported in these years.
[2] Reported as "conveyors (room, face, and entry)", "shaker drives", and duckbills.
[3] Represents number of bituminous mining companies to whom conveyors were sold in 1935. Of these, 12 companies were mining with conveyors in 1934 and 47 were not.

It should be kept in mind that some of the sales undoubtedly were replacements for worn-out or obsolete machines. Moreover, many of the devices were installed late in the year and will have little effect on the amount of coal mechanically loaded in 1935. This factor, however, is offset to some extent by machinery installed late in 1934 which had the opportunity to operate for a full year in 1935. Another point to be borne in mind is that when mechanical loading is first installed at a mine a certain amount of experimenting must be done and full efficiency is not attained at once.

Sales of loading equipment of one type or another are reported for nearly every coal-mining State. For some States the figures cannot be shown without disclosing individual business, but table 20 gives the sales of mobile loaders and scrapers by groups of States. In 1935 the manufacturers reported selling 77 machines to bituminous operators in the Northern States of Pennsylvania, Ohio, Indiana, and Illinois. In these same States 483 units were in active use during 1934. It appears, therefore, that the sales in 1935 represented an increase of 15.9 percent over the existing installations. The number of machines sold to operators in the Southern States was less—41 units—but these 41 units constituted an increase of 95.3 percent over the number of machines in use in 1934. In addition, 11 machines were sold to operators in the Western States. Over the bituminous field as a whole the sales of mobile loaders and scrapers in 1935 added 19.8 percent to existing equipment. Eight machines of this class were sold to mines in the anthracite region, an increase of 1.5 percent over the existing equipment.

TABLE 20.—*Comparison of mobile loaders and scrapers in actual use in 1934 with sales reported in 1935, by States*

State	In use in 1934			Sales of mobile loaders and scrapers reported in 1935	Indicated increase, percent
	Mobile loaders	Scrapers	Total		
Bituminous					
Northern States:					
Pennsylvania, Ohio, Indiana, Illinois	428	55	483	77	+15.9
Southern States:					
West Virginia, Virginia, Kentucky, Tennessee, Alabama	15	28	43	41	+95.3
Western States:					
Arkansas, Colorado, Montana, New Mexico, North Dakota, Oklahoma, Utah, Wyoming	91	36	127	11	+8.7
Total bituminous	534	119	653	129	+19.8
Pennsylvania anthracite	14	517	531	8	+1.5

A similar comparison of the sales of duckbills and face conveyors by groups of States is given in table 21. In these classes of equipment 354 units were sold to operators in the anthracite region, consisting largely of shaker conveyors and shaker drives. Sales in the bituminous fields totaled 306 units, of which 90 went to the Northern States, 136 to the Southern States, and 80 to the Western States. Ninety-six units were sold in West Virginia, 78 units in the Pennsylvania bituminous mines, and nearly 50 in Wyoming. Because of differences in definition, the figures representing sales are not exactly comparable with those representing number of machines in use in 1934, and the indicated increase in percentage shown in the last column of the table is probably greater than the actual increase. However, it will show the areas in which the new installations have made the greatest proportionate increase in relation to existing equipment. The largest percentage of increase is in the bituminous mines of the Southern States, particularly West Virginia.

TABLE 21.—*Comparison of duckbills and hand-loaded face conveyors in actual use in 1934 with sales reported in 1935, by States* [1]

State	In use in 1934			Sales of duckbills and hand-loaded face conveyors in 1935	Indicated increase, percent
	Duckbills and other self-loading conveyors	Hand-loaded face conveyors	Total		
Bituminous					
Northern States: Pennsylvania, Ohio, Indiana, Illinois, Maryland	15	300	315	90	+28.6
Southern States: West Virginia, Virginia, Kentucky, Tennessee, Alabama	5	178	183	136	+74.3
Western States: Arkansas, Colorado, Montana, Utah, Washington, Wyoming	137	96	233	80	+34.3
Total bituminous	157	574	731	306	+41.9
Pennsylvania anthracite	13	1,338	1,351	354	+26.2

[1] The figures for number in use in 1934 are not exactly comparable with the number sold in 1935 because of uncertainties in defining what constitutes a conveyor. The comparison, however, will indicate regions in which the largest proportionate increases have been made.

It is clear that the output of mechanically loaded coal increased substantially in 1935, and it appears that further gains will be made in 1936.

PENNSYLVANIA ANTHRACITE

The industry in 1935.—In point of demand 1935 was disappointing in the Pennsylvania anthracite region, but in respect to trade organization there were important developments. Early in the year independent anthracite producers launched a selling agency (Independent Coals, Inc.) and elected temporary officers. In June, according to Coal Age (February 1936, p. 43), the members of the Anthracite Institute appointed a coordinator. Under a plan of cooperation it is purposed to stop unfair trade practices and take concerted action on the principal problems of the industry. Prices, terms of sale, and sales policies are filed with the Anthracite Institute by signatory producers. The plan is expected to improve the economic position of the industry.

On the other hand, production of anthracite declined, even though business in general improved in 1935. According to preliminary figures, the total output of the legitimate operations was 51,003,000 net tons, or 10.8 percent less than in 1934, but about 3 percent more than in 1933. (See table 1.)

The net decrease in production during 1935 was 6,165,000 net tons. About 80 percent of the drop took place in the first quarter of the year, when producers' stocks were unusually high. Production in the second quarter was 1,000,000 tons over the corresponding quarter of 1934, but this temporary gain was dissipated in the third quarter, and an additional 1,500,000 tons were lost in the fourth quarter.

These figures of production, it should be noted, do not include the output of unauthorized mines. Exact statistics on the tonnage produced by these mines are not obtainable. The most nearly accurate figures are those of the Anthracite Institute, which has conducted periodic surveys of the tonnage of coal moving over the highways. The latest of these[5] indicates a total of approximately 3,600,000 net tons of unauthorized coal in 1935, which was about 550,000 more than in 1934. These tonnages are in addition to the official statistics of production.

Weather conditions.—About three-fourths of the anthracite produced is used for domestic purposes, and abnormally cold weather

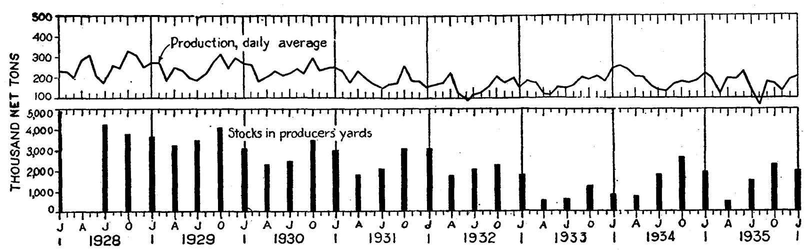

FIGURE 87.—Trends in production and stocks of Pennsylvania anthracite, 1928–35.

is reflected in greater sales of anthracite. In the New England States the temperature in January and February 1935 was below normal, while that in March was above normal. The average temperature for November was 3.9 degrees above normal, but this was almost offset during December. In New York January was cold, February about normal, and March moderately warm. October and the first half of November were above normal in temperature but December was the coldest of any since 1926. In Maryland, Delaware, and the District of Columbia January and February temperatures averaged below normal, October slightly below normal, November 3.6 degrees above normal, December 5.4 below, and the temperature of the year as a whole was 0.4 degree below normal. In the anthracite-consuming territory as a whole temperatures were not abnormally low.

Trend of stocks.—Producers carried unusually high stocks during the first quarter of 1935, the monthly tonnages ranging from 500,000 to 700,000 tons higher than in the corresponding months of 1934 (fig. 87). On the other hand, during the second quarter stocks were consistently lower than in 1934, the monthly decrease being 234,000 tons in April, 460,000 in May, and 571,000 in June. This was true, also, of the third quarter, the monthly tonnages ranging from 307,000 to 439,000 less than 1934 stocks. In October 1935 stocks were 400,000 tons less than in the same month in 1934; in November 300,000 less; and the year closed with 1,911,000 tons on hand, almost exactly the same amount as in December 1934, when stocks were 73.7 percent greater than in 1933.

Stocks on Lakes docks at the beginning of the year (228,000 tons) were about the same as in the previous year, reached the low point of

[5] Anthracite Institute. Report of the 1935 Survey of the Trucking of Anthracite: Feb. 20, 1936 (mimeographed).

161,000 in April, rose to 340,000 tons in November, and at the end of the year amounted to 293,000 tons, almost identical with the 1934 figure.

Stocks held by 250 representative retail dealers at the beginning of the year aggregated 568,000 tons and reached a low in March at 344,000 and a high in October with 742,000; the year closed with 604,000 tons on hand.

Stocks of electric-power utilities throughout 1934 varied very little from 1,250,000 tons, and this was true in the first 7 months of 1935. During each of the next 5 months they aggregated about 1,100,000 tons, and at the end of the year stood at 1,107,000 tons, as against 1,250,000 tons on December 31, 1934.

TABLE 22.—*Statistical summary of monthly developments in the Pennsylvania anthracite industry in 1935*

[All tonnage figures represent thousands of net tons]

	1935													1934 total
	January	February	March	April	May	June	July	August	September	October	November	December	Total	
Production, including mine fuel, local sales, and dredge coal:														
Monthly total	5,691	4,505	3,082	4,806	4,919	5,642	3,536	2,591	4,172	4,279	3,160	4,620	51,003	57,168
Average per working day	219	192	119	192	189	226	136	96	174	165	132	185	168	188
Shipments, breakers and washers only:[1] Monthly total, all sizes	5,071	3,946	2,555	4,168	4,347	4,879	3,032	2,393	3,587	3,681	2,868	4,116	44,643	49,228
Distribution:														
Lake loadings	------	------	40	28	90	66	118	92	17	51	57	(2)	559	607
Receipts at Duluth-Superior	------	------	------	------	35	30	37	29	9	11	31	------	182	229
Shipments from lake docks	68	35	23	27	49	81	35	30	50	55	39	48	540	532
New England receipts—														
By tide (includes imports)	119	99	111	117	125	131	120	88	116	162	83	103	[3] 1,374	[3] 1,590
By rail	426	434	191	430	329	365	315	225	360	376	227	352	4,030	4,382
Exports	130	157	94	135	175	175	98	99	182	134	97	133	1,609	1,298
Imports	57	39	62	34	32	57	49	35	53	60	30	63	571	478
Industrial consumption by—														
Railroads (class I only)	150	136	128	117	122	119	110	103	101	120	118	146	1,470	1,684
Electric-power utilities	160	144	127	129	134	153	153	162	152	168	146	164	1,792	1,724
Stocks at end of period shown:														
Railroads (class I only)	137	128	122	132	161	176	157	201	208	195	184	198	198	132
Electric-power utilities	1,229	1,212	1,187	1,233	1,262	1,258	1,242	1,192	1,118	1,153	1,109	1,107	1,107	1,250
Stocks on lake docks	228	195	174	161	203	213	297	343	329	317	340	293	293	296
Retail stocks, 250 representative dealers	568	518	344	422	467	589	650	622	653	742	690	604	604	714
Producers' stocks	1,415	921	774	456	705	970	1,462	1,758	2,127	2,239	2,244	1,911	1,911	1,921
Prices at mines, average per net ton:[4]														
Company stove	$7.25	$7.25	$7.25	$5.75	$5.75	$6.00	$6.25	$6.50	$6.75	$7.25	$7.25	$7.25	$6.71	$6.98
Company buckwheat no. 1	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25
Retail prices (average New York City):[5]														
Stove	$12.39	$12.39	$12.39	$10.10	$10.10	$10.05	$10.81	(6)	(6)	$11.73	(6)	(6)	(6)	(6)
Chestnut	$12.14	$12.14	$12.14	$9.84	$9.85	$9.79	$10.56	(6)	(6)	$11.48	(6)	(6)	(6)	(6)
Wholesale prices, index numbers (1926=100)	82.3	82.3	81.1	75.5	73.0	74.0	77.0	78.6	80.6	82.5	83.0	82.9	79.7	80.1
Labor conditions:[7]														
Index of employment (1929 average=100)	62.9	64.4	51.4	52.6	53.5	56.8	49.4	38.7	46.0	58.8	46.6	57.3	53.2	59.6
Index of pay-roll totals (1929 average=100)	57.5	64.3	38.9	49.9	49.5	66.0	37.5	28.3	38.2	55.9	28.4	55.4	47.5	55.9

[1] As reported by the Anthracite Bureau of Information.
[2] Less than 500 tons.
[3] Subject to revision.
[4] Quoted by trade journals in New York market.
[5] Bureau of Labor Statistics, white ash, sidewalk delivery.
[6] No data.
[7] Bureau of Labor Statistics index numbers.

Consumption.—The calculated consumption of anthracite in 1935 was 50,000,000 tons, a decline of 5,500,000 tons (9.9 percent) under the 1934 figure. Sales of unauthorized coal, unofficially estimated at about 4,000,000 tons in 1935, have not been included. Calculated consumption is based on production, plus imports, minus exports and the change in producers' stocks at the beginning and end of the year.

Distribution.—Loadings at Lake Erie ports were 559,000 tons, a decline of 8 percent in comparison with 1934 loadings but 31 percent over the 1933 figures (table 22). Receipts at Duluth-Superior declined 20 percent from the 1934 tonnage. Contrary to the general trend, shipments off Lake docks increased slightly over the 1934 tonnage. Tidewater receipts of anthracite in the New England States (including imports) declined 14 percent and receipts by rail 8 percent. Total receipts in New England declined 9.5 percent but were greater than receipts in 1933.

Exports.[6]—For the second year in succession exports to Canada, the principal foreign market, increased satisfactorily. Exports in 1934 were 23.3 percent greater than in 1933 and in 1935 were 25.7 percent greater than in 1934. The greater shipments were due in part to generally improved business conditions in Canada and to lower rail freight rates. Late in 1935 a minimum ocean freight scheme was adopted in Europe on coal and coke from the United Kingdom, Northern Europe, and the Black and Azov Sea ports to the North Atlantic ports. The rates then established were lowered about $0.18 per long ton early in 1936, which may restrict American exports to Canada somewhat.

Imports.[6]—Virtually all of the anthracite imported, almost all of which is received in the New England States, mainly Massachusetts, originates in the U. S. S. R. (Russia) and Great Britain. Of the total imports Russia supplied 69 percent in 1935 compared with 68 percent in 1934, and Great Britain supplied 30 percent in 1935 and 32 percent in 1934. Imports of anthracite in 1935 were about 35 percent of the amount exported, as against 37 percent in 1934. It is possible that the reduction in ocean freight rates mentioned in the preceding section will result in increasing imports.

Imports of coke into North Atlantic ports were unusually high in 1935. Imports into the New England States and New York amounted to 198,041 tons compared with 90,903 tons in 1934. Fuel briquets imported into Massachusetts totaled 16,559 tons. No briquets were received in 1934.

According to Canadian official statistics, imports of anthracite into Canada amounted to 3,447,638 tons in 1935—89,671 tons less than in 1934. In 1934 the United States, Great Britain, Germany, and Belgium supplied the tonnage, and these countries, plus French Indochina, supplied the 1935 tonnage. Of the total tonnage in 1934 and 1935, respectively, the United States supplied 51.0 and 48.3 percent, Great Britain 46.5 and 42.3 percent; Germany 2.0 and 5.9 percent; Belgium 0.5 and 1.9 percent; and French Indochina nil and 1.6 percent.

[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.

In 1934 and 1935 the United States shipped to Quebec 408,915 and 316,562 tons, respectively, and to Central Ontario 1,345,746 and 1,310,721 tons, respectively.

Competitive fuels.—Preliminary figures indicate a continuing increase in the use of competitive fuels for domestic use in 1935. The statistical record on the competition of other fuels with anthracite may be found in the chapter on Coke and Byproducts. (See p. 609.)

Sales of range oil, which is used for domestic heating and cooking, totaled 15,756,000 barrels in 1934, an increase of 53.4 percent over 1933 and more than three times the sales in 1931. Sales in the New England States, New York, and New Jersey accounted for 13,572,000 barrels. Sales of heating oils proper for domestic and commercial purposes amounted to 60,822,000 barrels in 1934, 21.3 percent more than in 1933. Liquefied petroleum gases, mainly propane, are becoming increasingly important for domestic purposes. Sales in 1935 amounted to 509,000 barrels, an increase of nearly 21 percent over 1934. The calorific value of 1935 sales was equivalent to 78,000 tons of anthracite. There are no statistics showing sales of these gases in the particular markets of greatest interest to the anthracite industry.

The use of byproduct coke for domestic purposes continued on an important scale in 1935, 9,161,980 tons having been used, compared with 10,174,114 in 1934. Beehive coke sold for domestic purposes amounted to 264,406 tons, as against 346,181 in 1934.

The production of fuel briquets amounted to 860,707 tons, an increase of 22.1 percent over 1934. In 1934 briquets manufactured in the Eastern States accounted for 37 percent of the total production. The average value per net ton in the Eastern States declined from $5.21 in 1932 to $4.76 in 1933 and to $4.72 in 1934. Imports of briquets in 1935 were 16,778 tons, about 48 percent coming from Belgium and 52 percent from Germany. The production of petroleum coke increased from 1,300,000 tons in 1934 to 1,458,000 in 1935, or by 12.2 percent.

Sales of natural gas to domestic consumers, which includes that used for house heating, increased 7.6 percent over 1934, according to the American Gas Association. Sales in 1935 in New York were 2.6 percent and in Pennsylvania 2.1 percent less than in 1934.

Sales of manufactured gas for domestic cooking, water heating, and lighting again declined, 1935 sales being 2.6 percent less than in 1934. Sales for house heating, on the contrary, jumped 24 percent over the 1934 figures.

Sales of both mechanical stokers and oil burners increased in 1935. Sales of mechanical stokers for residences and apartment houses totaled 44,288, an increase of nearly 74 percent over 1934. Shipments of domestic oil burners in 1935 numbered 110,921, an increase of about 43 percent over 1934.

Prices.—Circular prices of anthracite for the first and last quarters of 1935 averaged about the same as in 1934; however, during the summer months prices were below the 1934 levels. A preliminary estimate based on returns from the larger companies indicates that the average value of shipments, local sales, and colliery fuel in 1935 was $4.07 per ton compared with $4.27 in 1934.

Labor conditions.—The number of men employed at the anthracite mines declined from 106,251 in 1934 to 100,539 in 1935, or 5.4 percent, according to the Pennsylvania Department of Mines. Employment in 1934 was 3.7 percent more than in 1933. No important labor disputes occurred during the year.

Competitive conditions, with little if any prospect of lessening, have prompted if not forced increased mechanization in the anthracite fields of Pennsylvania. Operations in new territory in particular are being mechanized.

The tonnage cut by machines in 1934 represented an increase of 20 percent over 1933, and the tonnage loaded by machines underground was 42 percent greater than in 1933. Complete data for 1935 are not yet available. However, sales of equipment continue to increase. (See tables 19 to 21.) A comparison of the numbers of duckbills and hand-loaded face conveyors in actual use in 1934 and of sales as reported by 28 identical manufacturers in 1934 and 1935

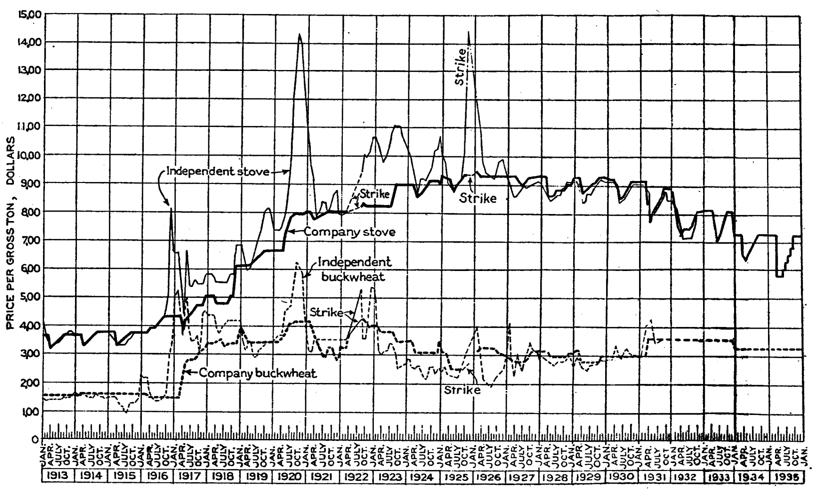

FIGURE 88.—Monthly prices of Pennsylvania anthracite, f. o. b. mine, as quoted by the trade journals, 1913–35. Prices are averages of the range, as quoted on the New York market.

indicates an increase of 26.2 percent in 1935 over 1934. A similar comparison for mobile loaders and scrapers indicates an increase of 1.5 percent over 1934.

Promotional work of the Anthracite Institute.—The institute laboratory continued to supply public information regarding types of heating equipment and fuel. Its bulletins contain lists of approved anthracite-using equipment and give descriptions, capacity ratings, and prices, with illustrations. Equipment that passes the institute's tests satisfactorily is accorded a seal of approval. The institute was granted Patent 2007372 during the year, which covers a firepot for burning anthracite on the underfeed principle.

Reduction in freight rates.—A reduction in freight rates west of Buffalo became effective on April 1, 1933. According to the Anthracite Institute, all-rail shipments of anthracite west of Buffalo were 889,877 tons in the coal year 1932–33, 1,070,952 in 1933–34, and 1,127,578 in 1934–35, an increase of 26.7 percent over 1932–33.

It is reported that effective November 1, 1935, the Canadian National and the Canadian Pacific Railways granted reductions in through-freight rates on anthracite to more than 100 points in Ontario and Quebec.

Prospective increase in prepared sizes.—At various collieries in the region experiments were conducted on two devices for conserving powder and increasing the yield of prepared sizes—one a cylinder and wooden plug and the other a small concrete cylinder grooved along the edge to make room for the firing wires or fuse.

Anthrafilt.—During the year the Pennsylvania State Department of Health gave permanent approval for the use of Anthrafilt at the Bethlehem water purification plant.

WORLD PRODUCTION OF COAL

TABLE 23.—*Coal and lignite produced in the principal countries of the world in the calendar years 1931–35, in thousand metric tons*

[Compiled by R. B. Miller]

Country	1931	1932	1933	1934	1935
North America:					
Canada:					
Coal	8,466	7,507	8,533	9,613	12,578 (Coal and Lignite)
Lignite	2,640	3,142	3,370	2,916	
Greenland	5	5	5	6	(1)
Mexico	922	687	647	782	1,143
United States:					
Anthracite	54,109	45,228	44,943	51,862	46,269
Bituminous and lignite	346,624	280,963	302,663	326,011	335,043
South America:					
Argentina	(1)	(1)	(1)	(1)	(1)
Brazil	461	[2] 450	570	622	757
Chile	1,100	1,080	1,538	1,808	(1)
Colombia	(1)	(1)	(1)	(1)	(1)
Peru	[3] 141	26	30	35	31
Venezuela	3	5	5	6	(1)
Europe:					
Albania: Lignite	3	3	3	(1)	(1)
Austria:					
Coal	228	221	239	251	260
Lignite	2,982	3,104	3,014	2,851	2,855
Belgium	27,042	21,424	25,300	26,389	26,483
Bulgaria:					
Coal	86	98	80	76	(1)
Lignite	1,437	1,663	1,493	1,561	(1)
Czechoslovakia:					
Coal	13,103	10,961	10,532	10,687	10,965
Lignite	17,932	15,858	15,063	15,172	15,217
France:					
Coal	50,011	46,267	46,887	47,607	46,207
Lignite	1,035	1,012	1,093	1,031	902
Germany: [4]					
Coal	118,640	104,741	109,692	124,910	134,124
Lignite	133,311	122,647	126,794	135,995	147,381
Saar [5]	11,367	10,438	10,561	11,318	10,619
Greece: Lignite	105	138	99	104	(1)
Hungary:					
Coal	776	895	800	756	(1)
Lignite	6,111	5,931	5,907	6,199	(1)
Irish Free State	93	82	107	113	115
Italy:					
Coal	236	255	334	295	460
Lignite	364	376	383	409	493
Netherlands:					
Coal	12,901	12,756	12,574	12,341	11,879
Lignite	122	124	97	92	[2] 90
Poland:					
Coal	38,265	28,835	27,356	29,233	28,543
Lignite	41	33	33	26	18
Portugal:					
Coal	201	241	208	203	(1)
Lignite	26	17	11	15	(1)
Rumania:					
Coal	287	188	195	228	(1)
Lignite	1,632	1,464	1,314	1,624	(1)

See footnotes at end of table.

TABLE 23.—*Coal and lignite produced in the principal countries of the world in the calendar years 1931–35, in thousand metric tons*—Continued

Country	1931	1932	1933	1934	1935
Europe—Continued.					
Spain:					
Coal	7,091	6,854	5,999	5,932	7,016
Lignite	341	336	301	299	304
Svalbard (Spitsbergen)	243	266	370	495	660
Sweden	343	333	349	415	(1)
Switzerland [3]	4	4	4	3	4
U. S. S. R. (Russia):					
Coal } Lignite }	50,400	53,600	66,000	71,268	81,000
United Kingdom:					
Great Britain	222,981	212,083	210,436	224,269	226,519
Northern Ireland	----------	----------	----------	1	(1)
Yugoslavia:					
Coal	406	368	379	387	(1)
Lignite	4,580	4,107	3,777	3,926	(1)
Asia:					
British Borneo	48	(1)	(1)	(1)	(1)
China	27,682	[2] 28,000	(1)	(1)	(1)
Chosen	936	1,104	1,307	1,689	(1)
Federated Malay States	409	282	222	327	398
India, British	22,065	20,477	20,107	22,411	23,021
Indochina:					
Coal	1,704	1,691	1,591	1,592	1,610
Lignite	23	23	----------	----------	----------
Iran	(1)	(1)	[2] 9	[2] 9	(1)
Iraq [6]	(1)	(1)	(1)	(1)	(1)
Japan:					
Japan proper:					
Coal	27,807	27,774	32,153	35,925	(1)
Lignite	118	109	116	125	(1)
Karafuto	648	688	889	1,197	(1)
Taiwan	1,422	1,355	1,533	1,521	(1)
Netherland India	1,404	1,050	1,035	1,032	(1)
Philippine Islands	19	18	16	(1)	(1)
Syria: Lignite	(1)	(1)	(1)	(1)	----------
Turkey:					
Coal	1,574	1,594	1,860	1,652	(1)
Lignite	8	14	30	51	(1)
U. S. S. R. (Russia):					
Coal } Lignite } Sakhalin: Coal }	8,200	10,400	10,700	20,763	27,900
Africa:					
Algeria	26	25	30	34	32
Belgian Congo: Coal	86	17	20	5	(1)
Morocco, French	6	15	27	31	53
Nigeria	333	257	239	275	(1)
Portuguese East Africa	(1)	20	16	22	(1)
Southern Rhodesia	587	438	484	643	695
Union of South Africa	10,881	9,921	10,714	12,195	13,574
Oceania:					
Australia:					
New South Wales	6,536	6,893	7,233	8,000	8,838
Queensland	855	855	890	972	(1)
Tasmania	126	114	118	115	126
Victoria:					
Coal	581	439	531	363	(1)
Lignite	2,230	2,654	2,621	2,660	(1)
Western Australia	439	422	466	508	(1)
New Caledonia	----------	----------	----------	----------	(1)
New Zealand:					
Coal	995	943	857	845	(1)
Lignite	1,197	928	993	1,248	(1)
Total, all grades	1,258,000	1,125,000	1,174,000	1,275,000	1,327,000
Lignite (total of items shown above)	183,000	171,000	175,000	187,000	201,000
Bituminous and anthracite (by subtraction)	1,075,000	954,000	999,000	1,088,000	1,126,000

[1] Estimate included in total.
[2] Approximate production.
[3] Includes a small quantity of asphaltite.
[4] Exclusive of mines in the Saar.
[5] Mines under French control until Mar. 1, 1935.
[6] Year ended Mar. 31 of year following that stated.

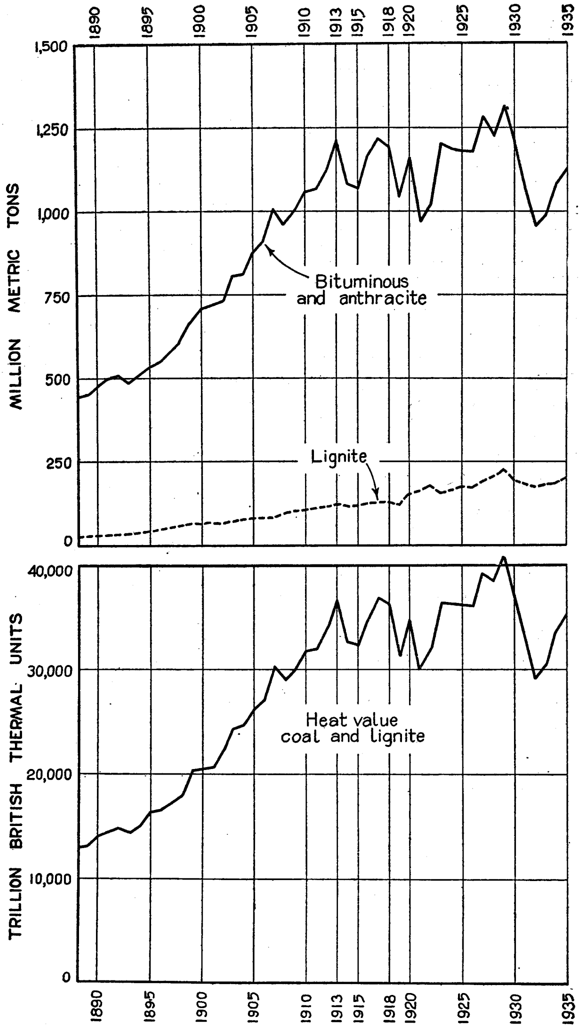

FIGURE 89.—World production of coal and lignite, 1890–1935.

COKE AND BYPRODUCTS

By W. H. Young, H. L. Bennit, and L. N. Plein

SUMMARY OUTLINE

The improvement in the coke industry of the past few years continued in 1935. The total value of all the products of the coke industry in 1935 was $290,408,432, a gain of $27,138,050 (10.3 percent) over 1934. Production of coke was 35,141,261 net tons, an increase of 10.4 percent compared with 1934. Byproduct ovens operated at 54.6 percent capacity compared with 49.2 percent in 1934 and 33.6 percent in 1932.

The average price of byproduct coke increased from $5.05 in 1934 to $5.06 in 1935. The average value of beehive coke increased 3.7 percent, from $3.77 in 1934 to $3.91 in 1935. The average price of coal charged in byproduct ovens increased from $3.70 in 1934 to $3.82 in 1935. The amount of coal needed to make 1 ton of byproduct coke was 1.43 tons, and the cost was $5.46, compared with 1.44 tons costing $5.33 in 1934. The amount of coal needed to make 1 ton of beehive coke was 1.60 tons, and the cost was $2.85 compared with 1.59 tons costing $2.64 in 1934. (See fig. 93.)

The increase of 10.4 percent in coke production is due partly to the increase of 32 percent in pig-iron production. Production of byproduct coke at furnace plants was 23,034,261 net tons, an increase of 19.7 percent over 1934. This directly reflects the increase of pig-iron production in 1935.

Although the total production of coke in 1935 was only 58.7 percent of that for the peak year of production—1929—it is significant to note that the trend has been definitely upward since the low of 1932, when production was only 36.3 percent of the 1929 output. (See fig. 90.)

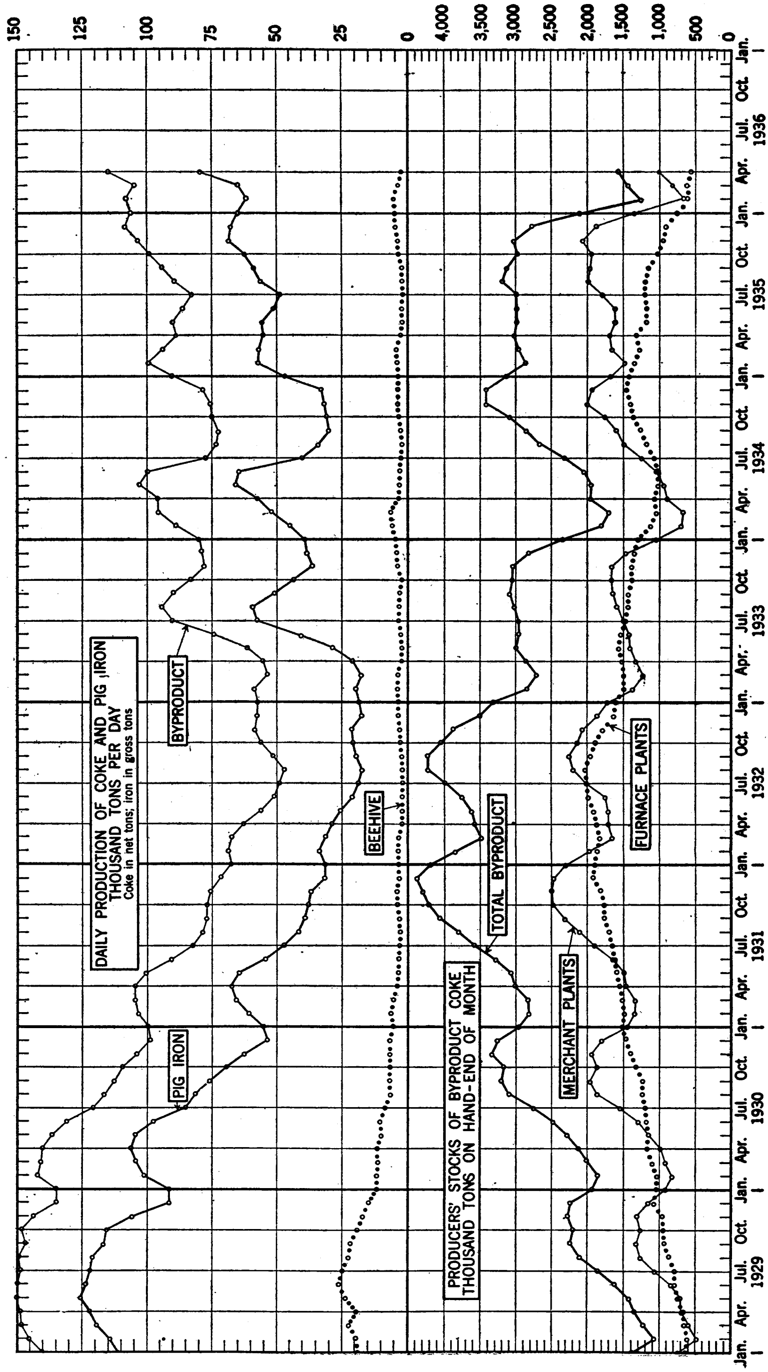

FIGURE 90.—Average daily production of beehive and byproduct coke and of pig iron also producers' stocks of byproduct coke, 1929-36, by months.

In 1935, 594 beehive ovens were abandoned and byproduct coke accounted for 97.4 percent of total production compared with 96.8 percent in 1934.

The total value of products resulting from carbonization of coal in byproduct ovens (coke, byproducts, and breeze) was $286,793,194 compared with $187,173,629, the total cost for coal charged into coke ovens, which represents an enhancement of $99,619,565 in value or 53.2 percent more than the cost of the raw material.

The volume of sales of domestic coke, which have grown steadily and consistently up to and including 1933, remained about the same in 1934 but declined slightly in 1935. Sales declined from 10,520,265 net tons in 1934 to 9,426,386 tons in 1935. Domestic coke at byproduct ovens was $5.83 per ton in 1934 and $5.84 per ton in 1935.

STATISTICAL SUMMARY

TABLE 1.—*Salient statistics of the coke industry in 1935*

	Byproduct	Beehive	Total
Coke produced:			
At merchant plants:			
Quantity net tons	11,189,792		11,189,792
Value	$68,125,643		$68,125,643
At furnace plants:			
Quantity net tons	23,034,261		23,034,261
Value	$105,145,682		$105,145,682
Total:			
Quantity net tons	34,224,053	917,208	35,141,261
Value	$173,271,325	$3,581,810	$176,853,135
Screenings or breeze produced:			
Quantity net tons	2,863,077	32,712	2,895,789
Value	$5,806,163	$33,428	$5,839,591
Coal charged into ovens:			
Quantity net tons	49,045,619	1,468,855	50,514,474
Value	$187,173,629	$2,615,325	$189,788,954
Average value per ton	$3.82	$1.78	$3.76
Average yield in percent of coal charged:			
Coke	69.78	62.44	69.57
Breeze (at plants actually recovering)	5.84	4.87	5.82
Ovens:			
In existence Jan. 1	12,963	14,206	27,169
In existence Dec. 31	12,860	13,674	26,534
Dismantled during year	140	594	734
In course of construction Dec. 31	122		122
Daily capacity of ovens Dec. 31 net tons	170,966	(1)	(1)
Coke used by operator:			
In blast furnaces:			
Quantity net tons	18,461,315		18,461,315
Value	$82,434,533		$82,434,533
For other purposes:			
Quantity net tons	1,651,684	108	1,651,792
Value	$8,942,200	$397	$8,942,597
Disposition of coke:			
Sold for furnace use to affiliated corporations:			
Quantity net tons	1,267,454	48,411	1,315,865
Value	$5,635,907	$276,427	$5,912,334
Merchant sales of furnace coke:			
Quantity net tons	1,086,616	71,025	1,157,641
Value	$5,595,155	$242,172	$5,837,327
Sold for foundry use:			
Quantity net tons	1,299,836	184,617	1,484,453
Value	$9,050,794	$883,326	$9,934,120
Sold for domestic use:			
Quantity net tons	9,161,980	264,406	9,426,386
Value	$53,550,983	$893,203	$54,444,186
Sold for manufacture of water gas:			
Quantity net tons	768,683	33,523	802,206
Value	$4,729,937	$123,565	$4,853,502
Sold for industrial and other use:			
Quantity net tons	1,144,924	288,982	1,433,906
Value	$5,626,162	$1,032,272	$6,658,434

[1] Data not available.

TABLE 1.—*Salient statistics of the coke industry in 1935*—Continued

	Byproduct	Beehive	Total
Disposition of screenings or breeze:			
Used by operator:			
For raising steam:			
Quantity ... net tons	2, 137, 310	17	2, 137, 327
Value	$4, 260, 692	$70	$4, 260, 762
To make producer or water gas:			
Quantity ... net tons	85, 583		85, 583
Value	$327, 213		$327, 213
Other purposes:			
Quantity ... net tons	192, 703	137	192, 840
Value	$349, 982	$575	$350, 557
Sold:			
Quantity ... net tons	693, 349	23, 068	716, 417
Value	$1, 453, 852	$24, 873	$1, 478, 725
Average receipts per ton sold:			
Furnace coke (merchant sales)	$4. 77	$4. 34	$4. 75
Foundry coke	$6. 96	$4. 78	$6. 69
Domestic coke	$5. 84	$3. 38	$5. 78
For manufacture of water gas	$6. 15	$3. 69	$6. 05
Other industrial coke	$4. 91	$3. 57	$4. 64
Screenings or breeze	$2. 10	$1. 08	$2. 06
Stocks on hand on Jan. 1, 1936:			
Furnace ... net tons	697, 699	2, 211	699, 910
Foundry ... do	15, 504	11, 146	26, 650
Domestic and other ... do	2, 070, 544	32, 280	2, 102, 824
Breeze ... do	265, 904	4, 572	270, 476
Exports ... do			613, 975
Imports ... do			317, 379
Calculated consumption ... do			35, 614, 000
Byproducts produced:			
Gas ... M cubic feet	543, 396, 088		543, 396, 088
Wasted ... percent	1. 3		1. 3
Burned in coking process ... do	35. 1		35. 1
Surplus sold or used ... do	63. 6		63. 6
Tar ... gallons	450, 307, 827		450, 307, 827
Ammonium sulphate or equivalent ... pounds	1, 090, 623, 535		1, 090, 623, 535
Crude light oil ... gallons	133, 696, 803		133, 696, 803
Yield of byproducts per ton of coal:			
Gas ... M cubic feet	11. 08		11. 08
Tar ... gallons	9. 18		9. 18
Ammonium sulphate or equivalent ... pounds	22. 59		22. 59
Crude light oil ... gallons	2. 98		2. 98
Value of byproducts sold:			
Gas (surplus)	$62, 715, 048		$62, 715, 048
Tar:			
Sold	$12, 597, 705		$12, 597, 705
Used by producer	$5, 805, 678		$5, 805, 678
Ammonium sulphate or equivalent	$10, 603, 114		$10, 603, 114
Crude light oil and derivatives	$14, 711, 177		$14, 711, 177
Other byproducts [2]	$1, 282, 984		$1, 282, 984
Total value of coke, breeze, and byproducts [3]	$286, 793, 194	$3, 615, 238	$290, 408, 432

[2] Includes naphthalene and tar derivatives.
[3] Includes value of tar used by the coke plants.

Scope of report.—The continuing need for economy in public expenditure impels the Bureau of Mines to confine this report to presenting, through selected tables, the essential facts of the statistical record for the year. If not readily found any derivative figures carried in earlier reports will be furnished by the Bureau upon application.

TABLE 2.—*Statistical trends of the coke industry, 1923 and 1932–35*

	1923	1932	1933	1934	1935
Coke produced:					
Beehive..................net tons..	19,379,870	651,888	911,058	1,028,765	917,208
Byproduct..................do....	37,597,664	21,136,842	26,678,136	30,792,811	34,224,053
Total..................do....	56,977,534	21,788,730	27,589,194	31,821,576	35,141,261
Percent of total from byproduct ovens..................	66.0	97.0	96.7	96.8	97.4
Stocks of producers, end of year, all coke net tons..	[1] 1,221,737	3,524,855	2,865,260	3,598,543	2,829,384
Exports, all coke..................do....	1,237,342	630,151	637,819	942,785	613,975
Imports, all coke [2]..................do....	85,002	117,275	160,873	160,934	317,379
Consumption, calculated, all coke..do....	55,173,457	22,176,708	27,771,843	30,306,382	35,613,824
Disposal of coke (beehive and byproduct):					
Furnace coke (including all coke used by producer)..................net tons..	47,774,408	10,524,496	14,822,568	17,504,745	22,586,613
Foundry coke..................do....	3,600,719	1,054,771	1,004,885	1,262,139	1,484,453
Other industrial (including water gas) net tons..	2,283,888	1,295,290	1,836,987	1,892,595	2,236,112
Domestic coke..................do....	2,733,414	9,630,200	10,491,037	10,520,295	9,426,386
Ovens:					
Beehive, in existence, end of year........	62,349	19,440	16,857	14,206	13,674
Byproduct, in existence, end of year....	11,156	13,053	13,053	12,963	12,860
Byproduct under construction, end of year..................	629	....	....	....	122
Cost of coal charged, byproduct ovens, average per ton..................	$4.76	$3.55	$3.38	$3.70	$3.82
Prices of coke:					
Average spot price of Connellsville furnace coke, f. o. b. ovens..................	$5.33	$2.04	$2.41	$3.77	$3.61
Average realization on byproduct coke sold:					
Furnace coke (merchant sales)........	$6.74	$4.22	$4.00	$5.24	$4.77
Foundry coke..................	$10.54	$5.65	$5.34	$6.38	$6.96
Other industrial (including water gas).	$9.06	$5.26	$5.06	$5.57	$5.41
Domestic..................	$9.05	$5.21	$5.12	$5.83	$5.84
Yield of byproducts per ton of coal charged:					
Tar..................gallons..	8.1	9.84	9.39	9.22	9.18
Ammonium sulphate or equivalent pounds..	21.2	23.06	22.18	22.29	22.59
Light oil..................gallons..	2.7	2.94	2.79	2.90	2.98
Surplus gas sold or used..M cubic feet..	5.9	7.47	7.14	6.98	7.04
Average gross receipts of byproducts per ton of coke produced:					
Tar sold or used..................	$0.51	$0.577	$0.506	$0.520	$0.538
Ammonia and its compounds..................	$0.84	$0.305	$0.269	$0.284	$0.310
Light oil and its derivatives..................	$0.51	$0.445	$0.461	$0.434	$0.435
Surplus gas sold or used..................	$1.37	$2.596	$2.099	$1.924	$1.832
Total byproducts, including breeze......	$3.48	$4.182	$3.549	$3.372	$3.317

[1] Furnace and foundry coke only.
[2] Prior to 1934 the figures represent general imports; beginning with 1934 they represent imports for consumption only.

This report covers only coke made by high-temperature carbonization of coal in beehive and byproduct ovens. However, byproduct coke produced by city gas companies is included. (See fig. 91.) The essential product of these companies is manufactured gas, but in 1935 the production of byproduct coke by city gas companies constituted nearly 10 percent of the national production of byproduct coke. With respect to ownership and accounting these byproduct ovens are part of the gas utility system, and the Bureau of the Census therefore groups them within the manufactured-gas industry under the title "The Gas and Coke Industries." In other respects, however, these ovens form part of the byproduct-coke industry and they are so included in the statistics of the Bureau of Mines. The differences in classification are followed advisedly by the Bureau of the Census and 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. (See table 51.)

Coke is made by other processes not included in this chapter. In 1935 about 1,250,000 net tons of gas-house coke were made by high-temperature carbonization of coal in types of equipment other

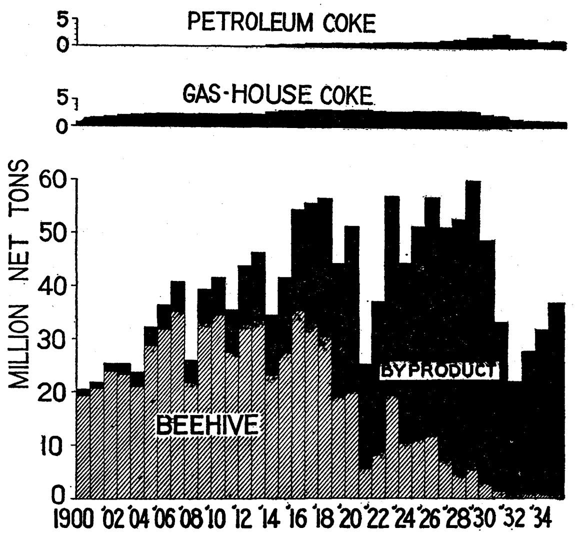

FIGURE 91.—Production of petroleum coke, gas-house coke, and beehive and byproduct coke in the United States, 1900–1935. No figures on production of petroleum coke are available before 1914, when the production was 213,777 tons.

than coke ovens—chiefly horizontal retorts. About 1,458,000 net tons of petroleum coke, a byproduct of petroleum refining, were produced in 1935. The manufacture of coke from coal-tar pitch is established on a commercial basis but the tonnage produced is small. 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.[1] None of these other kinds of coke, however, are discussed in this report. Only coke from byproduct and beehive ovens is adapted to blast-furnace and foundry uses, which consume most of all coke produced. Practically, therefore, the coke trade is concerned only with beehive and byproduct-oven coke (fig. 91).

The standard unit of measurement in the coke industry is the short or net ton of 2,000 pounds, and unless otherwise specified this unit is employed throughout this report.

[1] See discussion of low-temperature carbonization on page 640 of the chapter "Recent Developments in Coal Preparation and Utilization", by A. C. Fieldner.

TABLE 3.—*Summary of coke produced, value, number of ovens, coal charged, and average yield, by States, in 1935*

[Exclusive of screenings or breeze]

State	Byproduct							Beehive						Total	
	Plants in existence	Ovens in existence	Coal used (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens: Total	Value of coke at ovens: Per ton	Ovens in existence	Coal used (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens: Total	Value of coke at ovens: Per ton	Coke produced (net tons)	Value of coke at ovens
Alabama	8	1,248	2,893,995	68.91	1,994,220	$6,388,066	$3.20							1,994,220	$6,388,066
Colorado	1	151	303,302	68.22	206,901	(1)	(1)	378	75,810	64.91	49,209	(1)	(1)	256,110	(1)
Connecticut	1	61	(2)	(2)	(2)	(2)	(2)							(2)	(2)
Illinois	8	910	2,479,401	67.30	1,668,523	9,628,162	5.77							1,668,523	9,628,162
Indiana	6	1,550	5,236,325	71.97	3,768,480	25,484,234	6.76							3,768,480	25,484,234
Kentucky	1	108	(2)	(2)	(2)	(2)	(2)							(2)	(2)
Maryland	1	361	1,283,412	72.43	929,617	(1)	(1)							929,617	(1)
Massachusetts	3	430	1,430,947	70.31	1,006,115	6,048,544	6.01							1,006,115	6,048,544
Michigan	9	614	3,517,980	70.56	2,482,302	14,125,590	5.69							2,482,302	14,125,590
Minnesota	3	196	629,750	68.29	430,082	(1)	(1)							430,082	(1)
Missouri	1	64	(2)	(2)	(2)	(2)	(2)							(2)	(2)
New Jersey	2	239	1,285,369	71.35	917,117	(1)	(1)							917,117	(1)
New York	9	1,024	5,849,001	70.08	4,099,242	24,617,112	6.01							4,099,242	24,617,112
Ohio	15	1,834	7,202,127	70.83	5,100,987	23,088,113	4.53							5,100,987	23,088,113
Pennsylvania	12	3,348	11,908,359	67.84	8,078,175	32,105,648	3.97	9,203	881,499	63.99	564,052	$2,101,002	$3.72	8,642,227	34,206,650
Rhode Island	1	65	(2)	(2)	(2)	(2)	(2)							(2)	(2)
Tennessee	1	24	113,509	69.31	78,668	335,126	4.26	221	6,047	51.25	3,099	17,567	5.67	81,767	352,693
Utah	1	56	192,842	59.78	115,282	(1)	(1)	819	11,808	47.21	5,575	(1)	(1)	120,857	(1)
Virginia								1,288	234,662	58.63	137,587	547,295	3.98	137,587	547,295
Washington	1	20	47,288	60.78	28,744	172,464	6.00	58	3,978	62.22	2,475	13,921	5.62	31,219	186,385
West Virginia	4	362	2,294,324	69.89	1,603,584	4,306,166	2.69	1,707	255,051	60.85	155,211	587,864	3.79	1,758,795	4,894,030
Wisconsin	2	195	(2)	(2)	(2)	(2)	(2)							(2)	(2)
Combined States			2,377,688	72.17	1,716,014	11,448,501	6.69							1,716,014	11,448,501
Undistributed						15,523,599	5.97					314,161	5.73		15,837,760
Grand total, 1935	90	12,860	49,045,619	69.78	34,224,053	173,271,325	5.06	13,674	1,468,855	62.44	917,208	3,581,810	3.91	35,141,261	176,853,135
Grand total, 1934	90	12,963	44,342,998	69.44	30,792,811	155,545,530	5.05	14,206	1,635,294	62.90	1,028,765	3,880,144	3.77	31,821,576	159,425,674
Change in 1935, percent		−0.8	+10.6	+0.5	+11.4	+11.4	+0.2	−3.7	−10.2	−0.7	−10.8	−7.7	+3.7	+10.4	+10.9

[1] Included under "Undistributed."
[2] Included under "Combined States."

Production of coke.—The total production of coke was 35,141,261 tons in 1935 compared with 31,821,576 tons in 1934, an increase of 10.4 percent. The production of byproduct coke was 34,224,053 tons, an increase of 11.4 percent over 1934, and the production of beehive coke was 917,208 tons, a decrease of 10.8 percent from 1934. The leading States, in order of importance in the manufacture of byproduct coke, were Pennsylvania, Ohio, New York, Indiana, and Michigan. The production of each of these States exceeded 2,000,000 tons of byproduct coke in 1935, and their combined output equaled 68.8 percent of the national production of byproduct coke. Pennsylvania and West Virginia lead in the production of beehive coke, their combined output having been 78.4 percent of the total national output of beehive coke.

Byproduct coke produced at plants classified as furnace plants totaled 23,034,261 tons, an increase of 19.7 percent over 1934, but production at merchant byproduct plants declined 3.1 percent. The increase in coke production at furnace plants reflects the larger output of pig iron, which was 32 percent higher in 1935 than in 1934. Nonfurnace or merchant plants enjoy the greater stability of a diversified coke market, and the changes in production each year are not of the same magnitude as at furnace plants when there are widely fluctuating demands for pig iron. Nearly 30 percent of merchant byproduct coke is manufactured at plants owned by city gas companies. The production of coke at gas-company plants is fairly constant each year, and this has a stabilizing effect on the amount of merchant coke produced each year. Furnace-coke production, on the other hand, tends to vary with pig-iron production. Normally, the production of coke at furnace plants is nearly 80 percent of all byproduct coke made. In 1935, 67.3 percent of the byproduct coke was manufactured at furnace plants compared with 53.8 percent in 1932 and 62.5 percent in 1934. Table 10 shows the fluctuations in monthly production of coke at furnace plants compared with the fairly uniform monthly production at other plants.

Monthly production of coke increased from 2,883,700 tons in January to 3,006,300 tons in March. Thereafter there was an almost steady decline to a low of 2,606,600 tons in July, followed by a gradual increase to 3,482,400 in December. The monthly output of byproduct coke showed a similar trend. The production of beehive coke declined sharply during the summer months. (See table 4.)

Value and price of coke.—The value of byproduct coke at the ovens was $173,271,325 in 1935, an increase of 11.4 percent over 1934 values. The value of beehive coke at the ovens was $3,581,810, a decrease of 7.7 percent from 1934. Byproduct coke rose in value from $5.05 per ton in 1934 to $5.06 per ton in 1935 and beehive coke from $3.77 to $3.91. The higher cost of coal charged in ovens ($3.70 in 1934 and $3.82 in 1935) is reflected in the higher price for coke. Values and prices for the various grades of beehive and byproduct coke are shown in tables 28, 29, and 34. Average monthly prices (quoted by Steel) remained fairly uniform throughout the year in the 11 markets given in table 36.

Number and capacity of ovens.—At the end of 1935 there were 12,860 byproduct ovens and 13,674 beehive ovens in existence. During the year 177 new byproduct ovens were completed. In 1935, 140 byproduct ovens and 594 beehive ovens were abandoned. The number of beehive ovens has decreased from 60,432 at the end of 1924 to 13,674 at the end of 1935.

Production of byproduct coke in 1935 was 54.6 percent of the calculated capacity of all byproduct ovens compared with 33.6 percent in 1932 and 49.2 percent in 1934. (See table 17.) If the byproduct coke ovens had been operated at 90-percent capacity, at the end of 1935 their potential output would have been 56,200,000 tons of coke, nearly equaling the 59,883,845 tons of byproduct and beehive coke manufactured in the peak year 1929.

Coal charged in coke ovens.—In 1935, 50,514,474 tons of coal were charged into coke ovens; of this amount, 49,045,619 tons were used in byproduct ovens and 1,468,855 tons in beehive ovens.

The leading States mining coking coal, in order of importance, are Pennsylavnia, West Virginia, and Kentucky. Of the 49,278,890 tons of coal purchased for use at pyproduct plants, 45,044,753 tons (91.4 percent) were mined in these three States.

Coal cleaned mechanically before charging into byproduct ovens represented 23.8 percent in 1935 compared with 21.3 percent in 1934.

Consumption of coke.—The indicated consumption of coke in 1935 was 35,613,824 tons compared with 30,306,382 tons in 1934, iron furnaces using 20,821,286 tons (58.5 percent). (See table 26.) For data on consumption by uses see tables 28 and 29.

Stocks of coke.—On January 1, 1936, there were on hand 2,829,384 tons of coke, 769,159 tons less than on January 1, 1935. Stocks of furnace and foundry coke on January 1, 1936 were 258,123 tons lower than on January 1, 1935, and stocks of domestic and other grades were 511,036 tons lower. With the exception of the month of April, stocks at furnace plants decreased steadily throughout the year. Although stocks at merchant plants were higher than at any time during the corresponding period of 1934 there was but little fluctuation from month to month.

Exports and imports.—Exports of coke in 1935 were 613,975 tons valued at $3,590,143 compared with 942,785 tons valued at $5,419,738 in 1934. Imports were 317,379 tons, an increase of 156,445 tons over 1934, and the value increased from $864,851 to $1,574,578.

Gross value and yield of byproducts.—The gross value of all the byproducts recovered in 1935, not including breeze, was $101,910,028. If breeze also is counted as a byproduct, the total value becomes $107,716,191. The gross value far from represents a profit to the operator, for out of it must come the cost of recovery, but it suggests the large measure of conservation that has resulted from the substitution of the byproduct for the beehive oven in which these values were wasted formerly.

The average yield of byproducts per ton of coal charged has increased notably since the Bureau began to keep records of operating performance. (Fig. 96.) During the depression, the calculated average yields have been affected by the closing down of certain ovens or plants, but the long-time trend is unmistakably upward. Since 1915 the average yield of tar has increased from 7.1 gallons to 9.18 gallons, and the average quantity of surplus gas available for sale or use has increased from 4,325 to 7,040 cubic feet.

Declining prices in the world nitrogen market have diminished the incentive to recover ammonia, and 4 of the 81 byproduct plants active in 1935 produced no ammonia at any time during the year.

The 77 plants continuing to recover ammonia obtained an average yield of 22.6 pounds of sulphate per ton of coal carbonized (table 48).

At the present price of benzol a number of the merchant plants especially find it more profitable to leave their light oil in the gas than to undertake its recovery. This is generally true of plants selling gas for city distribution. Of the 81 plants active in 1935, only 61 recovered light oil. The average yield obtained by these 61 plants was 2.98 gallons per ton (table 49).

Research continues to develop new byproducts of coke-oven operation. The latest addition is sodium phenolate, recovery of which was reported for the first time in 1935. Four plants produced 184,819 gallons valued at $11,016 during the year.

Unit values of byproducts—Gas is the most important byproduct in point of value, followed by light oil and derivative tar, and ammonia in the order named (table 43). The unit value of the surplus gas sold or used by all plants declined from 19.1 cents per M cubic feet in 1934 to 18.2 cents in 1935. The average for all plants, however, is much affected by the relative activity of the furnace and merchant plants. The latter group, especially the plants affiliated with gas-utility systems, obtain much higher prices for their gas than do the furnace group. A better indication of the trend is given by the average values reported for the two groups, which are shown below.

Year	Furnace plants	Merchant plants	Total	Year	Furnace plants	Merchant plants	Total
	Cents	*Cents*	*Cents*		*Cents*	*Cents*	*Cents*
1929	11.6	30.2	16.6	1934	11.8	28.6	19.1
1932	14.2	31.3	23.8	1935	11.3	28.9	18.2
1933	12.0	29.6	20.3				

The shift in relative activity of furnace and merchant plants also affects the computed gross values of the several byproducts per ton of coke, shown in figure 95.

The unit values of crude light oil and light-oil derivatives in general were lower in 1935 than in 1934 (table 43.) The unit values of tar increased slightly while those of ammonia showed little change. However, because of increased production, the total values of all of the principal byproducts were higher in 1935 than 1934, despite the change in unit prices.

COKE AND OTHER DOMESTIC FUELS

Coke for domestic heating.—For domestic heating coke offers certain advantages in cleanliness compared with bituminous coal and in many localities it is cheaper than the prepared sizes of anthracite.

The marketing of domestic coke is not a simple merchandising problem because coke has burning characteristics different from those of either anthracite or bituminous coal. Therefore to introduce coke in any market area successfully and to hold customers after sales are made it is necessary to carry on expensive educational campaigns. Figure 92 shows how the total sales of domestic coke have risen since 1921, even in the depression years that followed the boom of the late twenties. Total sales of domestic coke (byproduct and beehive) amounted to 7,511,023 tons in 1929 and the volume of sales increased an average of 750,000 tons each year until 1933, when 10,491,037 tons were sold; in 1934, sales were 10,520,295 tons, an increase of only 29,258 tons over 1933; and in 1935, sales dropped to 9,426,386 tons, a decline of 1,093,909 tons or 10.4 percent.

A more detailed examination of the trend shows that sales of domestic coke at merchant plants increased from 5,986,373 tons in 1930 to 7,595,108 in 1933 and then declined to 7,238,296 tons in 1934 and dropped still further to 7,012,739 tons in 1935. Sales of domestic coke at furnace plants increased each year from 1,900,059 tons in 1930 to 2,935,818 tons in 1934 but fell to 2,149,241 tons in 1935. The sales trend of domestic beehive coke has been erratic, being as low as 118,665 tons in 1931 and as high as 346,181 tons in 1934. In 1935 beehive sales amounted to 264,406 tons, a decline of 23.6 percent compared with 1934.

What are some of the causes that explain the fact that while sales of domestic coke increased in times of adversity, now, with returning

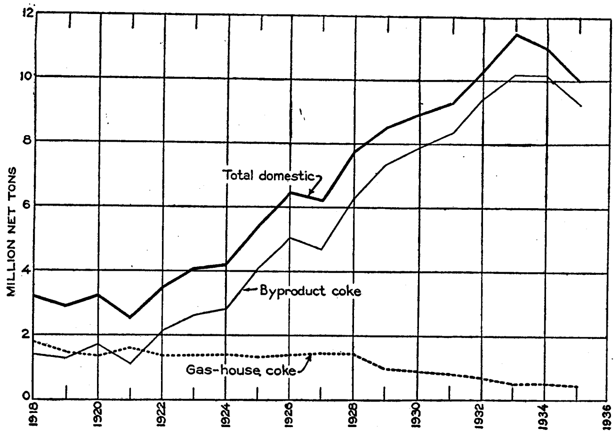

FIGURE 92.—Growth of sales of domestic coke, byproduct coke, and gas-house coke, 1918–35.

prosperity, they show a tendency to decline? A decline in one area may not bear any relation to a decline in another area. Undoubtedly some of the principal factors for the Nation as a whole are as follows: (1) Greater industrial activity (hence coke producers are consuming more of their own product and selling more to other industrial consumers with the result that less coke reaches the domestic market); (2) increasing installations of domestic and commercial stokers with small (and cheaper) stoker coal replacing some coke consumption; (3) increasing competition from natural gas, particularly in the Middle West; (4) declining prices of anthracite; (5) increasing costs of raw coal resulting in higher prices for coke; (6) growing competition from cheap trucked coal, both anthracite and bituminous.

Price trends for domestic fuels.—Figure 94 shows price trends of the various fuels that are competitive in the domestic heating market. In general, all trends have been downward to low points during the years 1931–33. An exception has been the price of natural gas for domestic use, which has moved upward since 1920. Beginning in 1932 trends have been variable for the various fuels. Byproduct coke, low-volatile coal, and fuel oil have had an upward trend while anthracite and natural gas have declined.

Supplies of fuel for domestic purposes.—Less domestic coke was sold in 1935 than in 1934. Statistics for all of the other fuels are not available for 1935, but the trend since 1932 indicates increasing domestic consumption of anthracite, oil, and natural gas. The sale of manufactured gas for house heating has nearly doubled since 1932. (See table 30.)

The introduction of natural gas by long-distance pipe lines into the Middle West has introduced a new competitive fuel in some parts of that area. The amount of natural gas consumed for domestic and commercial heating in the Middle West has been increasing. The amount of coal used in manufacturing gas in coal-gas retorts has been declining in this area. However, the distribution through city mains of gas produced at byproduct ovens in the metropolitan centers of Chicago, St. Louis, Indianapolis, and the Twin Cities apparently has not been affected materially as yet by this inflow of natural gas.

COKE AND COKE BREEZE

MONTHLY AND WEEKLY PRODUCTION

TABLE 4.—*Byproduct, beehive, and total coke produced in the United States, 1932–35, by months, and average per day, in net tons*

Month	1932		1933		1934		1935	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
Byproduct:								
January	2,097,200	67,600	1,782,700	57,500	2,471,800	79,700	2,796,800	90,200
February	1,992,300	68,700	1,636,600	58,500	2,490,800	89,000	2,777,200	99,200
March	2,085,100	67,200	1,663,000	53,600	2,965,600	95,700	2,907,100	93,800
April	1,881,200	62,800	1,651,900	55,100	2,872,500	95,800	2,666,200	88,800
May	1,740,200	56,100	1,914,900	61,700	3,188,800	102,900	2,789,200	90,000
June	1,535,100	51,200	2,236,600	74,600	2,987,000	99,600	2,595,000	86,500
July	1,521,000	49,000	2,793,200	90,100	2,379,800	76,800	2,562,000	82,600
August	1,472,300	47,500	2,920,200	94,200	2,277,700	73,500	2,773,600	89,400
September	1,542,400	51,400	2,707,900	90,300	2,171,300	72,400	2,832,700	94,400
October	1,736,100	56,000	2,579,000	83,200	2,312,400	74,600	3,048,300	98,300
November	1,749,000	58,300	2,341,100	78,000	2,261,500	75,400	3,112,100	103,700
December	1,784,900	57,600	2,451,000	79,000	2,413,600	77,900	3,363,900	108,500
	21,136,800	57,800	26,678,100	73,100	30,792,800	84,400	34,224,100	93,800
Beehive:								
January	73,700	2,800	89,100	3,400	111,200	4,100	86,900	3,200
February	72,300	2,900	91,000	3,800	133,400	5,600	90,700	3,800
March	73,500	2,700	100,800	3,700	166,200	6,200	99,200	3,800
April	47,400	1,800	51,500	2,100	73,700	2,900	65,100	2,500
May	38,400	1,500	52,200	1,900	65,500	2,400	54,900	2,000
June	34,800	1,300	55,500	2,100	62,700	2,400	58,600	2,300
July	32,800	1,300	75,800	3,000	52,200	2,100	44,600	1,700
August	34,800	1,300	78,600	2,900	45,400	1,700	54,500	2,000
September	39,400	1,500	66,800	2,600	57,100	2,300	55,500	2,200
October	57,000	2,200	51,000	2,000	77,800	2,900	88,900	3,300
November	68,400	2,600	101,900	3,900	96,800	3,700	99,800	3,800
December	79,400	3,100	96,900	3,900	86,800	3,500	118,500	4,700
	651,900	2,100	911,100	2,900	1,028,800	3,300	917,200	2,900
Total coke:								
January	2,170,900	70,400	1,871,800	60,900	2,583,000	83,800	2,883,700	93,400
February	2,064,600	71,600	1,727,600	62,300	2,624,200	94,600	2,867,900	103,000
March	2,158,600	69,900	1,763,800	57,300	3,131,800	101,900	3,006,300	97,600
April	1,928,600	64,600	1,703,400	57,200	2,946,200	98,700	2,731,300	91,300
May	1,778,600	57,600	1,967,100	63,600	3,254,300	105,300	2,844,100	92,000
June	1,569,900	52,500	2,292,100	76,700	3,049,700	102,000	2,653,600	88,800
July	1,553,800	50,300	2,869,000	93,100	2,432,000	78,900	2,606,600	84,300
August	1,507,100	48,800	2,998,800	97,100	2,323,100	75,200	2,828,100	91,400
September	1,581,800	52,900	2,774,700	92,900	2,228,400	74,700	2,888,200	96,600
October	1,793,100	58,200	2,630,000	85,200	2,390,200	77,500	3,137,200	101,600
November	1,817,400	60,900	2,443,000	81,900	2,358,300	79,100	3,211,900	107,500
December	1,864,300	60,700	2,547,900	82,900	2,500,400	81,400	3,482,400	113,200
	21,788,700	59,900	27,589,200	76,000	31,821,600	87,700	35,141,300	96,700

TABLE 5.—*Coke shipped from the Connellsville and Lower Connellsville districts, Pennsylvania, 1931–35, by months, in net tons* [1]

Month	1931	1932	1933	1934	1935
January	88,110	43,600	46,900	56,000	50,200
February	84,620	38,300	47,600	58,800	44,600
March	70,820	33,600	51,300	70,600	39,200
April	41,773	19,900	29,800	34,500	24,300
May	35,937	15,200	27,200	19,700	23,900
June	33,760	10,500	32,300	14,500	20,600
July	33,487	10,800	39,800	11,400	13,700
August	32,056	13,400	30,200	12,200	14,400
September	32,227	14,900	14,800	25,200	9,800
October	43,870	26,100	8,900	43,000	27,300
November	44,413	35,600	51,400	46,700	41,800
December	35,890	41,100	56,200	46,100	47,000
	[2] 576,963	303,000	436,400	[3] 438,700	356,800

[1] From the Connellsville Courier. The weekly shipments as reported by the Courier have been prorated on a monthly basis by the Bureau of Mines.
[2] Total revised to 573,730. The Daily Courier, Jan. 12, 1933.
[3] Total revised to 436,000. The Daily Courier, Jan. 2, 1936.

TABLE 6.—*Beehive coke produced in the United States in 1935, by weeks*

[Estimated from railroad shipments]

Week ended—	Net tons	Week ended—	Net tons	Week ended—	Net tons
Jan. 1–5 [1]	12,200	May 18	11,600	Sept. 28	7,200
Jan. 12	21,800	May 25	12,000	Oct. 5	12,100
Jan. 19	26,100	June 1	12,400	Oct. 12	18,800
Jan. 26	15,900	June 8	14,800	Oct. 19	21,400
Feb. 2	15,700	June 15	17,400	Oct. 26	23,700
Feb. 9	16,100	June 22	12,400	Nov. 2	21,100
Feb. 16	25,600	June 29	12,500	Nov. 9	21,200
Feb. 23	25,500	July 6	7,500	Nov. 16	22,100
Mar. 2	27,700	July 13	9,700	Nov. 23	24,100
Mar. 9	21,400	July 20	9,900	Nov. 30	24,600
Mar. 16	23,700	July 27	12,500	Dec. 7	30,800
Mar. 23	22,300	Aug. 3	10,900	Dec. 14	26,600
Mar. 30	22,600	Aug. 10	11,000	Dec. 21	27,500
Apr. 6	15,200	Aug. 17	11,100	Dec. 28	26,100
Apr. 13	16,200	Aug. 24	12,000	Dec. 30–31 [2]	7,300
Apr. 20	15,500	Aug. 31	15,500		
Apr. 27	14,100	Sept. 7	15,600	Total	917,200
May 4	12,700	Sept. 14	16,900		
May 11	13,200	Sept. 21	13,400		

[1] 5 days only.
[2] 2 days only.

TABLE 7.—*Byproduct coke produced in the United States in 1935, by months and by States, in net tons*

[Based on reports from all producers]

State	January	February	March	April	May	June	July
Alabama	148,400	162,000	189,400	177,900	197,300	178,200	164,900
Colorado	10,500	15,400	18,400	12,700	17,800	17,800	22,400
Illinois	155,000	148,000	154,700	129,600	134,500	123,700	119,900
Indiana	286,000	305,600	289,300	314,900	329,000	270,400	250,500
Maryland	81,900	77,200	78,500	82,200	66,600	65,200	67,800
Massachusetts	89,200	75,300	84,300	80,800	83,600	79,700	78,100
Michigan	221,700	197,100	215,600	212,500	221,700	209,200	199,700
Minnesota	37,800	35,000	35,300	34,400	35,900	33,600	30,000
New Jersey	74,900	70,300	76,300	73,400	76,900	73,500	74,300
New York	339,900	330,900	347,400	316,000	328,400	309,500	316,400
Ohio	422,500	429,000	449,200	407,700	394,700	377,400	375,900
Pennsylvania	635,500	662,700	671,000	545,400	609,200	579,200	573,000
Tennessee	6,600	5,900	6,900	6,500	6,500	6,700	6,600
Utah	11,500	9,700	9,900	8,500	8,200	8,500	8,300
Washington	2,000	1,700	2,500	3,000	2,800	2,500	2,500
West Virginia	134,800	125,000	138,700	126,000	133,000	117,200	122,300
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	138,600	126,400	139,700	134,700	143,100	142,700	149,400
Total	2,796,800	2,777,200	2,907,100	2,666,200	2,789,200	2,595,000	2,562,000
At merchant plants	971,400	878,800	962,700	901,400	932,500	891,600	884,000
At furnace plants	1,825,400	1,898,400	1,944,400	1,764,800	1,856,700	1,703,400	1,678,000

TABLE 7.—*Byproduct coke produced in the United States in 1935, by months and by States, in net tons*—Continued

State	August	September	October	November	December	Total
Alabama	141,400	153,500	113,000	123,700	244,500	1,994,200
Colorado	20,500	17,400	18,200	17,000	18,800	206,900
Illinois	123,000	126,200	142,000	145,000	166,900	1,668,500
Indiana	318,400	316,300	348,200	357,300	382,500	3,768,400
Maryland	68,500	84,800	81,400	85,100	90,400	929,600
Massachusetts	81,600	78,900	86,400	93,100	95,100	1,006,100
Michigan	198,400	195,200	207,700	199,800	203,700	2,482,300
Minnesota	32,000	35,300	38,800	39,800	42,200	430,100
New Jersey	72,700	73,800	81,400	83,500	86,100	917,100
New York	340,300	338,200	370,300	370,800	391,200	4,099,300
Ohio	421,800	411,400	445,400	474,200	491,800	5,101,000
Pennsylvania	656,200	701,400	796,900	812,300	835,400	8,078,200
Tennessee	6,800	6,000	6,200	6,800	7,200	78,700
Utah	10,000	10,100	10,100	10,400	10,100	115,300
Washington	2,300	2,300	2,400	2,300	2,500	28,800
West Virginia	131,500	135,800	147,100	145,000	147,200	1,603,600
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	148,200	146,100	152,800	146,000	148,300	1,716,000
Total	2,773,600	2,832,700	3,048,300	3,112,100	3,363,900	34,224,100
At merchant plants	903,500	909,000	972,900	967,400	1,014,600	11,189,800
At furnace plants	1,870,100	1,923,700	2,075,400	2,144,700	2,349,300	23,034,300

TABLE 8.—*Beehive coke produced in the United States in 1935, by months and by States, in net tons*

[Based on railroad shipments]

State	January	February	March	April	May	June	July
Colorado	3,300	3,300	3,300	4,200	3,300	3,300	3,200
Pennsylvania	61,200	62,000	67,600	36,500	33,200	36,500	26,200
Tennessee	400	500	300	400	400	300	100
Utah	700	700	500	200	700	400	300
Virginia	6,300	11,200	13,400	11,900	11,700	11,700	9,600
Washington	200	----------	100	----------	100	----------	100
West Virginia	14,800	13,000	14,000	11,900	5,500	6,400	5,100
Total	86,900	90,700	99,200	65,100	54,900	58,600	44,600

State	August	September	October	November	December	Total
Colorado	3,800	4,000	5,200	5,000	7,300	49,200
Pennsylvania	30,300	27,000	50,700	58,500	74,300	564,000
Tennessee	200	200	100	100	100	3,100
Utah	300	----------	----------	----------	1,800	5,600
Virginia	11,900	10,400	12,500	13,400	13,600	137,600
Washington	300	400	600	700	----------	2,500
West Virginia	7,700	13,500	19,800	22,100	21,400	155,200
Total	54,500	55,500	88,900	99,800	118,500	917,200

PRODUCTION BY FURNACE AND NONFURNACE PLANTS

TABLE 9.—*Number and production of byproduct coke plants connected with iron furnaces and of other byproduct plants, 1913, 1918, and 1933–35*

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
1933	42	43	16, 144, 168	10, 533, 968	60. 5	39. 5
1934	41	42	19, 241, 850	11, 550, 961	62. 5	37. 5
1935	40	41	23, 034, 261	11, 189, 792	67. 3	32. 7

TABLE 10.—*Monthly and average daily production of byproduct coke by plants associated with iron furnaces and by all other plants, 1933–35, in net tons*

Month	1933		1934		1935	
	Furnace plants	Other plants	Furnace plants	Other plants	Furnace plants	Other plants
Monthly production:						
January	896, 800	885, 900	1, 536, 900	934, 900	1, 825, 400	971, 400
February	845, 100	791, 500	1, 583, 000	907, 800	1, 898, 400	878, 800
March	825, 200	837, 800	1, 945, 100	1, 020, 500	1, 944, 400	962, 700
April	853, 300	798, 600	1, 923, 600	948, 900	1, 764, 800	901, 400
May	1, 082, 400	832, 500	2, 202, 300	986, 500	1, 856, 700	932, 500
June	1, 426, 500	810, 100	2, 032, 800	954, 200	1, 703, 400	891, 600
July	1, 957, 300	835, 900	1, 432, 900	946, 900	1, 678, 000	884, 000
August	2, 018, 300	901, 900	1, 343, 700	934, 000	1, 870, 100	903, 500
September	1, 776, 500	931, 400	1, 242, 000	929, 300	1, 923, 700	909, 000
October	1, 591, 500	987, 500	1, 318, 900	993, 500	2, 075, 400	972, 900
November	1, 377, 800	963, 300	1, 269, 400	992, 100	2, 144, 700	967, 400
December	1, 493, 400	957, 600	1, 411, 200	1, 002, 400	2, 349, 300	1, 014, 600
	16, 144, 100	10, 534, 000	19, 241, 800	11, 551, 000	23, 034, 300	11, 189, 800
Average daily production:						
January	28, 900	28, 600	49, 600	30, 100	58, 900	31, 300
February	30, 200	28, 300	56, 600	32, 400	67, 800	31, 400
March	26, 600	27, 000	62, 800	32, 900	62, 700	31, 100
April	28, 500	26, 600	64, 100	31, 700	58, 800	30, 000
May	34, 900	26, 800	71, 100	31, 800	59, 900	30, 100
June	47, 600	27, 000	67, 800	31, 800	56, 800	29, 700
July	63, 100	27, 000	46, 200	30, 600	54, 100	28, 500
August	65, 100	29, 100	43, 400	30, 100	60, 300	29, 100
September	59, 200	31, 100	41, 400	31, 000	64, 100	30, 300
October	51, 300	31, 900	42, 500	32, 100	66, 900	31, 400
November	45, 900	32, 100	42, 300	33, 100	71, 500	32, 200
December	48, 100	30, 900	45, 500	32, 400	75, 800	32, 700
Average	44, 200	28, 900	52, 700	31, 700	63, 100	30, 700

PRODUCTION BY STATES AND DISTRICTS

TABLE 11.—*Byproduct and beehive coke produced, by States, 1918 and 1932–35, in net tons*

State	1918	1932	1933	1934	1935
Byproduct:					
Alabama	2,634,451	1,400,597	1,668,975	2,109,192	1,994,220
Colorado	230,663	92,384	139,722	171,104	206,901
Connecticut	------	(1)	(1)	(1)	(1)
Illinois	2,285,610	1,428,334	1,501,020	1,649,907	1,668,523
Indiana	3,898,215	1,435,405	2,089,100	2,613,437	3,768,480
Kentucky	517,749	(1)	(1)	(1)	(1)
Maryland	474,368	499,502	702,227	784,539	929,617
Massachusetts	556,397	987,106	1,020,255	1,127,632	1,006,115
Michigan	(1)	2,165,109	2,341,081	2,547,747	2,482,302
Minnesota	784,065	385,699	412,037	417,447	430,082
Missouri	(1)	(1)	(1)	(1)	(1)
New Jersey	682,148	805,720	835,125	910,121	917,117
New York	1,069,587	3,130,078	3,426,529	4,089,708	4,099,242
Ohio	5,226,334	2,346,686	3,676,727	4,296,338	5,100,987
Pennsylvania	4,586,981	4,037,810	6,170,240	6,834,362	8,078,175
Rhode Island	------	(1)	(1)	(1)	(1)
Tennessee	124,469	72,529	71,484	70,598	78,668
Utah	------	103,862	66,945	117,401	115,282
Washington	30,129	32,610	31,817	27,199	28,744
West Virginia	603,393	902,872	1,074,002	1,343,914	1,603,584
Wisconsin	(1)	(1)	(1)	(1)	(1)
Combined States	2,293,021	1,310,539	1,450,850	1,682,165	1,716,014
	25,997,580	21,136,842	26,678,136	30,792,811	34,224,053
Beehive:					
Alabama	1,717,721	------	------	------	------
Colorado	758,784	23,560	35,161	37,804	49,209
Georgia	22,048	------	------	------	------
Kentucky	301,036	------	------	------	------
New Mexico	597,072	------	------	------	------
Ohio	138,909	------	------	------	------
Oklahoma	(1)	------	------	------	------
Pennsylvania	22,136,664	506,377	670,179	720,593	564,052
Tennessee	302,637	10,954	11,807	5,993	3,099
Utah	(1)	5,511	10,156	13,203	5,575
Virginia	1,234,256	56,143	70,493	77,960	137,587
Washington	93,659	736	379	1,694	2,475
West Virginia	2,716,613	48,607	112,883	171,518	155,211
Combined States	461,393	------	------	------	------
	30,480,792	651,888	911,058	1,028,765	917,208
Grand total	56,478,372	21,788,730	27,589,194	31,821,576	35,141,261

[1] Included under "Combined States."

TABLE 12.—*Byproduct and beehive coke produced in Pennsylvania in 1935, by districts*

[Number of plants and ovens includes those idle during the year; no new ovens were under construction in 1935]

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 [1]	5	734	2,112,907	69.00	1,457,890	$8,397,779	$5.76
Western Pennsylvania [2]	7	2,614	9,795,452	67.59	6,620,285	23,707,869	3.58
	12	3,348	11,908,359	67.84	8,078,175	32,105,648	3.97
Beehive:							
Allegheny Mountain and Allegheny Valley	3	434	63,104	60.99	38,486	202,235	5.25
Connellsville	17	4,355	149,057	66.64	99,338	385,185	3.88
Lower Connellsville	19	2,576	389,552	64.69	251,984	815,723	3.24
Upper Connellsville	5	580	99,312	63.33	62,894	253,658	4.03
Pittsburgh and other districts [3]	6	1,258	180,474	61.70	111,350	444,201	3.99
	50	9,203	881,499	63.99	564,052	2,101,002	3.72
Grand total	62	12,551	12,789,858	67.57	8,642,227	34,206,650	3.96

[1] Includes plants at Bethlehem, Chester, Philadelphia, Steelton, and Swedeland.
[2] Includes plants at Aliquippa, Clairton, Erie, Johnstown, Midland, Neville Island, and Pittsburgh.
[3] Includes Bedford and parts of Indiana and Westmoreland Counties.

TABLE 13.—*Byproduct coke produced in Ohio in 1935, by districts*

District	Plants	Ovens	Coal used (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens: Total	Value of coke at ovens: Per ton
Canton, Cleveland, and Massillon	5	595	1,838,221	68.88	1,266,160	$5,682,814	$4.49
Youngstown	3	594	1,856,876	69.47	1,289,903	5,548,817	4.30
Other districts [1]	7	645	3,507,030	72.57	2,544,924	11,856,482	4.66
Total	15	1,834	7,202,127	70.83	5,100,987	23,088,113	4.53

[1] Includes plants at Hamilton, Ironton, Lorain, Painesville, Portsmouth, Toledo, and Warren.

NUMBER AND TYPE OF OVENS

TABLE 14.—*Coke ovens completed and abandoned in 1935 and total number in existence at end of year, by States*

State	Plants in existence Dec. 31	Ovens: New: Number	Ovens: New: Capacity per day (net tons of coke)	Ovens: Abandoned during year	Ovens: In existence Dec. 31: Number	Ovens: In existence Dec. 31: Capacity per day (net tons of coke)	Ovens: Under construction Dec. 31: Number	Ovens: Under construction Dec. 31: Capacity per day (net tons of coke)
Byproducts:								
Alabama	8				1,248	14,110		
Colorado	1				151	2,233		
Connecticut	1				61	(1)		
Illinois	8			40	910	12,702		
Indiana	6	[2] 140	[2] 2,121		1,550	21,727		
Kentucky	1				108	(1)		
Maryland	1				361	5,088		
Massachusetts	3				430	4,483		
Michigan	9			60	614	6,962	122	2,900
Minnesota	3				196	2,562		
Missouri	1				64	(1)		
New Jersey	2	37	325		239	2,750		
New York	9				1,024	15,153		
Ohio	15				1,834	24,892		
Pennsylvania	12			40	3,348	45,654		
Rhode Island	1				65	(1)		
Tennessee	1				24	350		
Utah	1				56	1,015		
Washington	1				20	99		
West Virginia	4				362	5,105		
Wisconsin	2				195	(1)		
Undistributed						6,081		
Total byproduct	90	177	2,446	140	12,860	170,966	122	2,900
At merchant plants	44	37	325		3,644	43,482		
At furnace plants	46	140	2,121	140	9,216	127,484	122	2,900
Beehive:								
Colorado	2				378	(3)		
Oklahoma				100				
Pennsylvania	50			291	9,203			
Tennessee	2			200	221			
Utah	1				819			
Virginia	7			3	1,288			
Washington	1				58			
West Virginia	11				1,707			
Total beehive	74			594	13,674	(3)		

[1] Included under "Undistributed."
[2] New ovens replacing an equal number of old ovens that were rebuilt.
[3] Data not available.

TABLE 15.—*Byproduct ovens of each type at end of 1935, by States*

State	Koppers[1]	Semet-Solvay	Wilputte	United Otto	Cambria-Belgian	Roberts[2]	American Foundation	Klönne	All others[3]	Total
Alabama	768	420	60							1,248
Colorado	151									151
Connecticut	61									61
Illinois	662	120	88			40				910
Indiana	1,129	161	260							1,550
Kentucky		108								108
Maryland	361									361
Massachusetts	175		55	200						430
Michigan	131	276	120						87	614
Minnesota	196									196
Missouri	56								8	64
New Jersey	239									239
New York	743	226					55			1,024
Ohio	1,541	293								1,834
Pennsylvania	3,018	88	97		120	25				3,348
Rhode Island	65									65
Tennessee		24								24
Utah	56									56
Washington								20		20
West Virginia	316		46							362
Wisconsin	115	80								195
Total	9,783	1,796	726	200	120	65	55	20	95	12,860
At merchant plants	1,948	1,080	221	200		25	55	20	95	3,644
At furnace plants	7,835	716	505		120	40				9,216

[1] Includes the Koppers-Becker type.
[2] Includes the Robert-Morrissey type.
[3] Includes 8 Piette, 27 Parker-Russell, and 60 improved Equipment Co. ovens.

CAPACITY OF BYPRODUCT OVENS

TABLE 16.—*Estimated annual potential production of coke and coal required for charge of byproduct coke ovens in the United States, 1933–35, when operated at different percentages of maximum capacity, in millions of net tons*

Percent of maximum capacity	1933		1934		1935			
	Ovens completed Dec. 31[1]				Ovens completed Dec. 31		Including ovens under construction	
	Coke	Coal[2]	Coke	Coal[2]	Coke	Coal[2]	Coke	Coal[2]
100	63.1	90.1	62.8	89.7	62.4	89.1	63.5	90.7
90	56.8	81.1	56.5	80.7	56.2	80.2	57.2	81.6
85	53.6	76.6	53.4	76.2	53.0	75.7	54.0	77.1
75	47.3	67.6	47.1	67.3	46.8	66.8	47.6	68.0
50	31.6	45.1	31.4	44.9	31.2	44.6	31.8	45.4

[1] No ovens under construction at end 1933 or 1934.
[2] Coal for charge estimated on basis of 70-percent yield in coke.

TABLE 17.—*Relation (percent) of production to maximum capacity at hyproduct coke plants, 1929 and 1931–35, by months*

Month	1929	1931	1932	1933	1934	1935	Month	1929	1931	1932	1933	1934	1935
January	88.6	59.2	39.0	33.6	46.6	52.5	August	93.6	46.8	27.4	55.0	42.8	52.1
February	91.3	61.5	39.6	34.1	52.0	57.7	September	91.9	45.7	29.7	52.7	42.1	55.0
March	93.0	62.4	38.8	31.3	55.9	54.6	October	92.3	45.8	32.3	48.6	43.5	57.2
April	92.8	62.3	36.2	32.2	56.0	51.7	November	89.0	45.0	33.6	45.6	43.9	60.3
May	94.0	59.9	32.4	36.1	60.1	52.4	December	83.1	42.7	33.2	46.2	45.3	63.1
June	93.9	53.7	29.5	43.5	58.2	50.4							
July	93.0	49.2	28.3	52.6	44.7	48.2	The year	91.4	52.8	33.6	42.7	49.2	54.6

QUANTITY AND COST OF COAL CHARGED

TABLE 18.—*Coal consumed in coke ovens, 1933–35, 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	1933			1934			1935		
	Byproduct	Beehive	Total	Byproduct	Beehive	Total	Byproduct	Beehive	Total
January	2,580,000	144,300	2,724,300	3,574,000	177,000	3,751,000	4,022,600	138,700	4,161,300
February	2,370,700	148,100	2,518,800	3,597,200	211,800	3,809,000	3,993,400	146,300	4,139,700
March	2,407,800	164,400	2,572,200	4,284,700	264,700	4,549,400	4,181,200	159,900	4,341,100
April	2,395,000	82,800	2,477,800	4,155,600	117,400	4,273,000	3,828,100	104,800	3,932,900
May	2,780,100	83,300	2,863,400	4,615,100	103,600	4,718,700	4,007,600	89,700	4,097,300
June	3,250,400	88,200	3,338,600	4,321,500	100,300	4,421,800	3,730,300	95,400	3,825,700
July	4,057,100	120,500	4,177,600	3,403,100	83,200	3,486,300	3,660,000	71,800	3,731,800
August	4,234,800	124,400	4,359,200	3,262,400	71,700	3,334,100	3,961,500	87,600	4,049,100
September	3,926,400	104,800	4,031,200	3,112,300	89,900	3,202,200	4,047,100	87,900	4,135,000
October	3,734,200	79,300	3,813,500	3,315,400	124,500	3,439,900	4,357,300	140,600	4,497,900
November	3,390,600	163,500	3,554,100	3,244,400	154,300	3,398,700	4,448,800	157,700	4,606,500
December	3,553,800	157,700	3,711,500	3,457,300	136,900	3,594,200	4,807,700	188,500	4,996,200
	38,680,900	1,461,300	40,142,200	44,343,000	1,635,300	45,978,300	49,045,600	1,468,900	50,514,500

TABLE 19.—*Total quantity and value at ovens of coal used in manufacture of coke, by States, in 1935*

State	Coal used (net tons)	Cost of coal		Coal per ton of coke	
		Total	Per ton of coal	Net tons	Cost
Byproduct plants:					
Alabama	2,893,995	$6,849,815	$2.37	1.45	$3.44
Colorado	303,302	(1)	(1)	1.47	
Illinois	2,479,401	11,459,806	4.62	1.49	6.88
Indiana	5,236,325	24,411,767	4.66	1.39	6.48
Maryland	1,283,412	(1)	(1)	1.38	
Massachusetts	1,430,947	7,180,549	5.02	1.42	7.13
Michigan	3,517,980	15,054,875	4.28	1.42	6.08
Minnesota	629,750	(1)	(1)	1.46	
New Jersey	1,285,369	(1)	(1)	1.40	
New York	5,849,001	26,742,938	4.57	1.43	6.54
Ohio	7,202,127	26,360,070	3.66	1.41	5.16
Pennsylvania	11,908,359	35,537,132	2.98	1.47	4.38
Tennessee	113,509	423,768	3.73	1.44	5.37
Utah	192,842	(1)	(1)	1.67	
Washington	47,288	224,700	4.75	1.65	7.84
West Virginia	2,294,324	5,054,706	2.20	1.43	3.15
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	2,377,688	10,798,538	4.54	1.39	6.31
Undistributed		17,074,965	4.62		
Total byproduct	49,045,619	187,173,629	3.82	1.43	5.46
At merchant plants	15,841,558	72,989,171	4.61	1.42	6.55
At furnace plants	33,204,061	114,184,458	3.44	1.44	4.95
Beehive plants:					
Colorado and Utah	87,618	251,527	2.87	1.60	4.59
Pennsylvania	881,499	1,530,351	1.74	1.56	2.71
Tennessee	6,047	10,047	1.66	1.95	3.24
Virginia	234,662	423,309	1.80	1.71	3.08
Washington	3,978	12,529	3.15	1.61	5.07
West Virginia	255,051	387,562	1.52	1.64	2.49
Total beehive	1,468,855	2,615,325	1.78	1.60	2.85

1 Included under "Undistributed."

TABLE 20.—*Average cost per net ton of coal charged into byproduct coke ovens, by States, 1929 and 1932–35*

State	1929	1932	1933	1934	1935	State	1929	1932	1933	1934	1935
Alabama	$2.49	$1.95	$1.81	$2.28	$2.37	Pennsylvania	$2.73	$2.86	$2.84	$3.04	$2.98
Illinois	4.29	4.17	4.02	4.49	4.62	Tennessee	3.02	2.96	2.92	3.18	3.73
Indiana	4.61	4.25	4.19	4.48	4.66	Washington	5.26	4.61	4.51	4.60	4.75
Massachusetts	4.70	4.49	4.34	4.81	5.02	West Virginia	2.41	1.76	1.78	2.07	2.20
Michigan	4.29	3.92	3.67	4.13	9.28						
Minnesota	5.04	5.14	4.69	(1)	(1)	United States average	3.50	3.55	3.38	3.70	3.82
New York	4.22	4.17	4.00	4.35	4.57	Cost of coal per ton of coke	5.04	5.18	4.90	5.33	5.46
Ohio	3.31	3.20	3.10	3.49	3.66						

[1] Not at liberty to publish data.

PREPARATION AND SOURCE OF COAL CHARGED

TABLE 21.—*Washed and unwashed coal used in the manufacture of byproduct and beehive coke, by States in which used, in 1935, in net tons*

State	Washed	Unwashed	Total
Byproduct ovens:			
Alabama	2,882,290	11,705	2,893,995
Colorado	303,302		303,302
Illinois	409,736	2,069,665	2,479,401
Indiana		5,236,325	5,236,325
Maryland		1,283,412	1,283,412
Massachusetts	40,721	1,390,226	1,430,947
Michigan		3,517,980	3,517,980
Minnesota		629,750	629,750
New Jersey		1,285,369	1,285,369
New York	1,383,100	4,465,901	5,849,001
Ohio	712,650	6,489,477	7,202,127
Pennsylvania	5,774,524	6,133,835	11,908,359
Tennessee	113,509		113,509
Utah		192,842	192,842
Washington	47,288		47,288
West Virginia		2,294,324	2,294,324
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	24,565	2,353,123	2,377,688
Total	11,691,685	37,353,934	49,045,619
At merchant plants	1,658,917	14,182,641	15,841,558
At furnace plants	10,032,768	23,171,293	33,204,061
Beehive ovens:			
Colorado	75,810		75,810
Pennsylvania	171,098	710,401	881,499
Tennessee	6,047		6,047
Utah		11,808	11,808
Virginia		234,662	234,662
Washington	3,978		3,978
West Virginia		255,051	255,051
Total	256,933	1,211,922	1,468,855

TABLE 22.—*Coal used in manufacture of byproduct coke in 1935, by fields of origin, in net tons*

[Based upon detailed reports from each coke plant. The difference between these totals and those shown in tables 3, 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	2,795,196	Alabama.
Colorado:		
Trinidad	259,585	Colorado.
Crested Butte and Walsen	43,717	Do.
Kentucky:		
Eastern Kentucky:		
Elkhorn	1,769,360	Indiana, Michigan, Kentucky, New York, Missouri, Minnesota, Illinois, and Ohio.
Harlan	2,606,446	Indiana. Illinois, Ohio, Michigan, Minnesota, and Alabama.
Kenova-Thacker [1]	1,306,207	Michigan, Ohio, and Wisconsin.
Miscellaneous Eastern Kentucky.	97,532	Indiana.
Maryland: Upper Potomac	6,872	Pennsylvania.
Pennsylvania:		
Central Pennsylvania, medium and high volatile.	345,812	New York, and Pennsylvania.
Central Pennsylvania, low volatile.	849,435	Pennsylvania, New York, Ohio, and West Virginia.
Connellsville	8,704,229	Pennsylvania, Ohio, West Virginia, and Illinois.
Freeport	1,392,441	West Virginia, Ohio, New York, and Indiana.
Pittsburgh	8,546,033	Pennsylvania, New York, Ohio, Michigan, Minnesota, Illinois, Massachusetts, Wisconsin, and West Virginia.
Somerset	445,933	Pennsylvania, West Virginia, and Ohio.
Westmoreland	595,309	Pennsylvania, Maryland, and New York.
Tennessee	85,132	Tennessee.
Utah: Carbon County	192,842	Utah.
Virginia: [1] [2]		
Southwestern Virginia	325,740	New Jersey, New York, and Massachusetts.
Washington: Pierce County	47,546	Washington.
West Virginia: [2]		
Northern	2,102,909	Ohio, Maryland, Pennsylvania, West Virginia, New Jersey, and New York.
Kanawha and Logan	7,141,418	Ohio, New York, Indiana, Illinois, New Jersey, Pennsylvania, Massachusetts, Michigan, Connecticut, Wisconsin, West Virginia, Rhode Island, Kentucky, Missouri, and Minnesota.
New River and Winding Gulf	1,740,872	Massachusetts, New York, New Jersey, Illinois, Rhode Island, Missouri, Ohio, Indiana, and Pennsylvania.
Pocahontas [2]	7,485,528	Indiana, Ohio, New York, Michigan, Illinois, Maryland, Wisconsin, Pennsylvania, Kentucky, Minnesota, Connecticut, West Virginia, Alabama, and Tennessee.
Coal and Coke, Webster County	392,796	Massachusetts and Pennsylvania.
	49,278,890	

[1] Tonnage from the Grundy field, Buchanan County, Va., is included under Kenova-Thacker (Kentucky).

[2] Coal from the extension of the Pocahontas field in Tazewell County, Va., is included under West Virginia (Pocahontas).

TABLE 23.—*Source of coal used in the manufacture of byproduct coke in 1935, by States where consumed, separating merchant and furnace plants*

State where coal was used	Coal produced in—										Total
	Alabama	Colorado	Kentucky	Maryland	Pennsylvania	Tennessee	Utah	Virginia	Washington	West Virginia	
Alabama:											
Merchant plants	383,255							47,373			430,628
Furnace plants	2,411,941		8,792							3,513	2,424,246
Total	2,795,196		8,792					47,373		3,513	2,854,874
Colorado: Furnace plants		303,302									303,302
Illinois:											
Merchant plants			36,580		104,027					1,192,087	1,332,694
Furnace plants			588,614		362,940					190,851	1,142,405
Total			625,194		466,967					1,382,938	2,475,099
Indiana:											
Merchant plants										692,420	692,420
Furnace plants			2,181,970		150,637			226,484		1,984,814	4,543,905
Total			2,181,970		150,637			226,484		2,677,234	5,236,325
Maryland: Furnace plants					231,613					1,051,799	1,283,412
Massachusetts: Merchant plants					33,962			(1)		1,390,681	[2] 1,424,643
Michigan:											
Merchant plants			557,149		(1)					877,556	[2] 1,434,705
Furnace plants			1,114,327							332,851	1,447,178
Total			1,671,476		(1)					1,210,407	[2] 2,881,883
Minnesota:											
Merchant plants			94,265		193,126					145,331	432,722
Furnace plants			94,764		63,018					39,246	197,028
Total			189,029		256,144					184,577	629,750
New Jersey: Merchant plants								203,831		1,052,977	1,256,808
New York:											
Merchant plants			191,887		1,688,391			111,828		1,528,205	3,520,311
Furnace plants					1,699,304					649,367	2,348,671
Total			191,887		3,387,695			111,828		2,177,572	5,868,982

Ohio:											
Merchant plants								(1)		599, 421	[2] 599, 421
Furnace plants			278, 859		3, 299, 614					2, 872, 344	6, 450, 817
Total			278, 859		3, 299, 614			(1)		3, 471, 765	[2] 7, 050, 238
Pennsylvania:											
Merchant plants					69, 488					681, 557	751, 045
Furnace plants				6, 872	10, 485, 128					811, 419	11, 303, 419
Total				6, 872	10, 554, 616					1, 492, 976	12, 054, 464
Tennessee: Merchant plants						85, 132				28, 377	113, 509
Utah: Furnace plants							192, 842				192, 842
Washington: Merchant plants									47, 546		47, 546
West Virginia:											
Merchant plants					20, 333					488, 198	508, 531
Furnace plants					1, 778, 002					37, 223	1, 815, 225
Total					1, 798, 335					525, 421	2, 323, 756
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin: Merchant plants			428, 688		(1)					1, 939, 429	[2] 2, 368, 117
Undistributed: Merchant plants					699, 609			213, 731			913, 340
Grand total	2, 795, 196	303, 302	5, 575, 895	6, 872	20, 879, 192	85, 132	192, 842	803, 247	47, 546	18, 589, 666	49, 278, 890
Merchant plants	383, 255		1, 308, 569		2, 808, 936	85, 132		576, 763	47, 546	10, 616, 239	15, 826, 440
Furnace plants	2, 411, 941	303, 302	4, 267, 326	6, 872	18, 070, 256		192, 842	226, 484		7, 973, 427	33, 452, 450

[1] Included under "Undistributed."
[2] Excludes items included under "Undistributed."

YIELD OF COKE PER TON OF COAL

TABLE 24.—*Percentage yield of coke from coal in byproduct and beehive ovens, by States, 1932–35*

State	1932		1933		1934		1935	
	Byproduct	Beehive	Byproduct	Beehive	Byproduct	Beehive	Byproduct	Beehive
Alabama	69. 14		68. 94		69. 73		68. 91	
Colorado	68. 19	65. 20	66. 28	64. 54	66. 21	65. 17	68. 22	64. 91
Illinois	66. 05		66. 93		67. 46		67. 30	
Indiana	69. 28		70. 93		71. 42		71. 97	
Maryland	73. 22		72. 25		71. 30		72. 43	
Massachusetts	70. 17		68. 80		71. 21		70. 31	
Michigan	70. 03		69. 97		70. 56		70. 56	
Minnesota	67. 73		68. 18		68. 46		68. 29	
New Jersey	69. 21		70. 26		70. 29		71. 35	
New York	69. 56		69. 06		69. 76		70. 08	
Ohio	68. 26		70. 33		70. 42		70. 83	
Pennsylvania	66. 03	65. 11	67. 21	63. 68	67. 78	64. 08	67. 84	63. 99
Tennessee	71. 75	49. 08	70. 91	47. 42	69. 91	47. 94	69. 31	51. 25
Utah	54. 53	42. 08	53. 94	46. 34	60. 47	52. 49	59. 78	47. 21
Virginia		58. 80		58. 22		59. 39		58. 63
Washington	56. 54	61. 03	56. 00	60. 93	54. 37	63. 07	60. 78	62. 22
West Virginia	67. 35	58. 13	67. 96	60. 77	67. 79	61. 00	69. 89	60. 85
United States average	68. 43	63. 31	68. 97	62. 35	69. 44	62. 90	69. 78	62. 44

COKE BREEZE

TABLE 25.—*Coke breeze recovered at coke plants, by States, in 1935*

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	5.33	154,119	$209,808	107,530	$131,885	6,307	$8,626	41,314	$63,899	1,985	26,067
Colorado	4.75	14,421	(1)	14,421	(1)						
Illinois	7.04	174,654	412,511	159,263	391,553	2,391	5,619	63,031	147,458		15,074
Indiana	5.10	267,177	643,138	165,146	373,057	54,745	114,157	46,823	148,925		20,675
Maryland	6.15	78,943	(1)	62,058	(1)	17,807	(1)	21,982	(1)		12,604
Massachusetts	8.17	116,901	202,131	85,566	130,818	5,942	13,447	27,268	61,543		3,150
Michigan	5.77	203,132	483,942	159,155	457,781	2,292	7,809	156,907	256,256		17,249
Minnesota	7.78	48,990	(1)	35,376	(1)			16,346	(1)		10,339
New Jersey	5.87	75,389	(1)	68,271	(1)			6,648	(1)		4,762
New York	5.02	293,583	737,002	123,418	320,876	67,496	213,150	105,455	229,617		66,811
Ohio	4.94	355,757	700,395	271,713	555,855	44,289	88,365	60,721	99,419	2,161	53,485
Pennsylvania	6.33	753,247	1,159,532	640,901	980,314	42,169	59,331	74,788	124,130	292	14,618
Tennessee	5.53	6,281	9,422	5,213	7,820						1,163
Utah	5.37	10,354	(1)	67	(1)	4,207	(1)				15
Washington	8.04	3,801	16,838	3,967	17,722	86	250				2,583
West Virginia	4.82	110,478	135,187	102,438	133,244	5,166	7,021	5,370	6,906		14,530
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	8.24	195,850	588,089	132,807	369,414	25,389	126,945	66,696	188,190		2,779
Undistributed			508,168		390,353		32,475		127,509		
Total byproduct, 1935	5.84	2,863,077	5,806,163	2,137,310	4,260,692	278,286	677,195	693,349	1,453,852	4,438	265,904
At merchant plants	6.60	1,045,782	2,583,850	727,212	1,815,493	90,467	338,801	439,405	913,784	2,026	101,276
At furnace plants	5.47	1,817,295	3,222,313	1,410,098	2,445,199	187,819	338,394	253,944	540,068	2,412	164,628
Total byproduct, 1934	6.16	2,730,641	5,691,136	1,826,996	3,648,287	270,204	691,093	675,967	1,441,570	5,097	438,447
Change in 1935 ... percent	−5.2	+4.9	+2.0	+17.0	+16.8	+3.0	−2.0	+2.6	+0.9	−12.9	−39.4
Beehive ovens:											
Colorado	[2] 1.72	1,304	(1)					1,304	(1)		
Pennsylvania	[2] 6.64	23,458	18,332					14,073	10,530	13,564	4,353
Utah	[2] 24.06	2,841	(1)					2,841	(1)		194
Virginia	[2] 2.91	4,345	10,531	17	70	137	575	4,191	9,886		
Washington	[2] .63	25	26								25
West Virginia	[2] .95	739	181					659	99	80	
Undistributed			4,358						4,358		
Total beehive, 1935	[2] 4.87	32,712	33,428	17	70	137	575	23,068	24,873	[3] 13,644	4,572

[1] Included under "Undistributed." [2] Yield computed by dividing the production of breeze at the few plants reporting by the quantity of coal charged at these plants.
[3] As reported; quantity produced but not used was undoubtedly greater. See Mineral Resources, 1922, pt. II, pp. 726–727.

CONSUMPTION OF COKE

TABLE 26.—*Quantity of coke consumed in manufacture of pig iron and for other purposes, 1913, 1918, and 1933–35, 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
1933	27,589,194	160,873	637,819	−659,595	27,771,843	13,024,556	46.9	14,747,287	53.1
1934	31,821,576	160,934	942,785	+733,343	30,306,382	16,183,070	53.4	14,123,312	46.6
1935	35,141,261	317,379	613,975	−769,159	35,613,824	20,821,286	58.5	14,792,538	41.5

[1] Production plus imports minus exports, plus or minus the decrease or increase, respectively, of the net changes in stocks.
[2] From Annual Report of American Iron and Steel Institute. Figures include coke consumed in the manufacture of ferro-alloys.
[3] Data not available.

TABLE 27.—*Pounds of coke and coking coal consumed per gross ton of pig iron made in the United States, 1913, 1918, and 1933–35*

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	1934	2,025.3	69.2	2,926.7
1918	2,375.2	66.4	3,577.1	1935	1,975.1	69.6	2,837.8
1933	1,975.6	68.7	2,875.7				

[1] From Annual Statistical Report of American Iron and Steel Institute, 1934. The consumption per ton of pig iron only, excluding the furnaces making ferro-alloys, was 1,935.7 in 1933, 1,989.3 in 1934 and 1,950.6 in 1935.

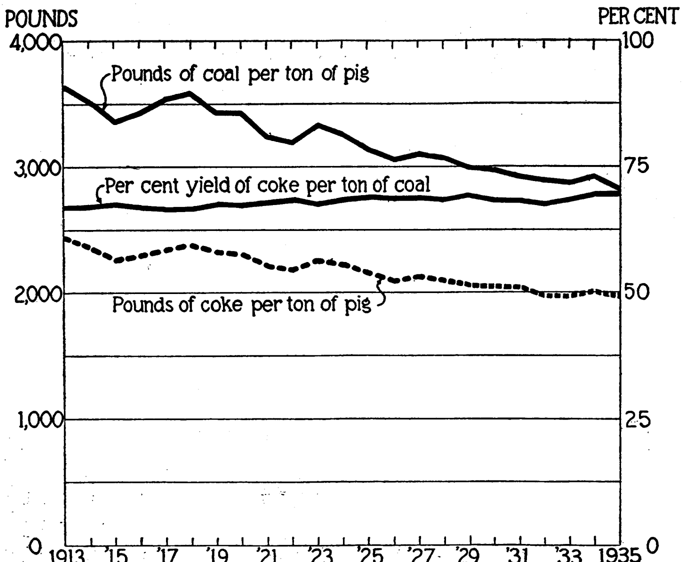

FIGURE 93.—Declining consumption of blast-furnace coke per gross ton of pig iron, 1913–35. The quantity of coke consumed per ton of pig iron has been declining. At the same time, the yield of coke per ton of coal carbonized has increased slightly, so that the consumption of coking coal per ton of pig iron produced has declined from 3,637 pounds in 1913 to 2,838 pounds in 1935.

FURNACE, FOUNDRY, AND OTHER COKE

TABLE 28.—*Byproduct coke produced and sold or used by producer, by States, in 1935*

[Exclusive of screenings or breeze]

State	Produced		Used by producer in blast furnace, etc.[1]		Sold									
					Furnace [2]		Foundry		Domestic use		Industrial and other use (including water gas)[3]		Total	
	Net tons	*Value*	*Net tons*	*Value*	*Net tons*	*Value*	*Net tons*	*Value*	*Net tons*	*Value*	*Net tons*	*Value*	*Net tons*	*Value*
Alabama	1,994,220	$6,388,066	1,642,377	$4,743,905	1,364	$4,956	227,633	$1,170,867	254,678	$871,533	64,309	$200,917	547,984	$2,248,273
Colorado	206,901	(4)	188,879	(4)	---	---	6,505	(4)	1,538	(4)	11,836	(4)	19,879	(4)
Illinois	1,668,523	9,628,162	612,704	3,207,518	---	---	150,912	1,264,295	945,084	5,342,291	58,316	328,637	1,154,312	6,935,223
Indiana	3,768,480	25,484,234	3,270,640	22,669,428	6,997	52,967	84,770	667,227	373,677	1,903,509	23,721	129,524	489,165	2,753,227
Maryland	929,617	(4)	856,369	(4)	---	---	---	---	65	(4)	74,533	(4)	74,598	(4)
Massachusetts	1,006,115	6,048,544	119,885	770,061	---	---	32,517	213,327	838,077	4,963,728	11,804	67,370	882,398	5,244,425
Michigan	2,482,302	14,125,590	482,417	2,763,278	(4)	(4)	18,136	112,082	1,476,528	8,502,770	(4)	(4)	2,013,522	11,445,876
Minnesota	430,082	(4)	14,347	(4)	---	---	187	(4)	372,708	(4)	43,318	(4)	416,213	(4)
New Jersey	917,117	(4)	78,072	(4)	---	---	24,678	(4)	538,773	(4)	269,208	(4)	832,659	(4)
New York	4,099,242	24,617,112	1,035,740	5,881,060	959,140	4,916,759	(4)	(4)	1,685,736	11,017,864	(4)	(4)	3,111,476	19,034,299
Ohio	5,100,987	23,088,113	3,915,758	17,673,593	24,991	91,016	223,559	1,398,688	707,120	2,962,515	266,424	1,125,170	1,222,094	5,577,389
Pennsylvania	8,078,175	32,105,648	6,356,996	23,488,064	749,020	3,042,273	124,748	937,236	740,294	3,962,197	311,121	1,377,121	1,925,183	9,318,827
Tennessee	78,668	335,126	2,167	9,210	---	---	24,852	142,899	22,900	80,150	36,387	135,131	84,139	358,180
Utah	115,282	(4)	79,059	(4)	36,787	(4)	---	---	6,284	(4)	12,289	(4)	55,360	(4)
Washington	28,744	172,464	18,424	110,541	---	---	595	3,570	7,225	43,351	225	1,350	8,045	48,271
West Virginia	1,603,584	4,306,166	1,324,621	3,439,434	(4)	(4)	(4)	(4)	216,348	582,447	19,318	55,193	316,342	995,322
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	1,716,014	11,448,501	114,544	736,905	162,162	763,441	280,671	2,141,150	974,945	6,628,988	158,346	977,652	1,576,124	10,511,231
Undistributed	---	15,523,599	---	5,883,736	413,609	2,359,650	100,073	999,453	---	6,689,640	552,452	5,958,034	---	9,718,395
Grand total, 1935	34,224,053	173,271,325	20,112,999	91,376,733	2,354,070	11,231,062	1,299,836	9,050,794	9,161,980	53,550,983	1,913,607	10,356,099	14,729,493	84,188,938
At merchant plants	11,189,792	68,125,643	1,269,122	7,146,785	794,032	4,240,673	944,943	6,903,956	7,012,739	42,788,258	1,309,713	7,722,432	10,061,427	61,655,319
At furnace plants	23,034,261	105,145,682	18,843,877	84,229,948	1,560,038	6,990,389	354,893	2,146,838	2,149,241	10,762,725	603,894	2,633,667	4,668,066	22,533,619
Grand total, 1934	30,792,811	155,545,530	15,313,135	67,273,561	2,020,452	9,767,610	1,077,216	6,873,908	10,174,114	59,274,945	1,573,483	8,769,822	14,845,265	84,686,285
Change in 1935 ... percent	+11.4	+11.4	+31.3	+35.8	+16.5	+15.0	+20.7	+31.7	−9.9	−9.7	+21.6	+18.1	−0.8	−0.6

[1] 1935 totals include 1,651,684 tons valued at $8,942,200 used for other purposes than in blast furnaces.
[2] 1935 totals include 1,267,454 tons valued at $5,635,907 sold to affiliated corporations and 1,086,616 tons valued at $5,595,155 reported as merchant sales.
[3] 1935 totals include 768,683 tons valued at $4,729,937 sold for manufacture of water gas.
[4] Included under "Undistributed."

TABLE 29.—*Beehive coke produced and sold or used by producer, by States, in 1935*

[Exclusive of screenings or breeze]

State	Produced		Used by producer [1]		Sold									
					Furnace [2]		Foundry		Domestic use		Industrial and other use (including water gas) [3]		Total	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Colorado and Utah	54,784	$314,161	------	------	48,411	$276,427	6,422	$38,014	------	------	------	------	54,833	$314,441
Pennsylvania	564,052	2,101,002	20	$60	54,025	183,760	109,488	523,167	248,537	$836,323	128,153	$436,354	540,203	1,979,604
Tennessee	3,099	17,567	------	------	------	------	2,501	14,607	------	------	187	561	2,688	15,168
Virginia	137,587	547,295	------	------	1,092	3,069	30,221	135,570	1,050	3,129	105,231	405,669	137,594	547,437
Washington	2,475	13,921	------	------	------	------	101	810	604	4,226	1,770	8,885	2,475	13,921
West Virginia	155,211	587,864	88	337	15,908	55,343	35,884	171,158	14,215	49,525	87,164	304,368	153,171	580,394
Total, 1935	917,208	3,581,810	108	397	119,436	518,599	184,617	883,326	264,406	893,203	322,505	1,155,837	890,964	3,450,965
Total, 1934	1,028,765	3,880,144	563	1,604	170,595	726,478	184,923	855,293	346,181	1,163,910	319,112	1,109,053	1,020,811	3,854,734
Change in 1935 ... percent	−10.8	−7.7	−80.8	−75.2	−30.0	−28.6	−0.2	+3.3	−23.6	−23.3	+1.1	+4.2	−12.7	−10.5

[1] No beehive coke was used by the producer in blast furnaces in 1935.
[2] Totals include 48,411 tons valued at $276,427 sold to affiliated corporations and 71,025 tons, valued at $242,172, reported as merchant sales.
[3] Totals include 33,523 tons valued at $123,565 sold for manufacture of water gas.

DOMESTIC COKE

TABLE 30.—*Total supplies of fuels commonly used for domestic purposes in the United States, 1924 and 1932–35*

[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. Data for 1935 are preliminary]

	1924	1932	1933	1934	1935
Solid fuels (net tons)					
Pennsylvania anthracite production:					
Shipments of domestic sizes	56,576,296	29,096,962	27,755,333	33,269,928	
Shipments of buckwheat No. 1 [1]	9,510,508	6,735,313	6,625,755	7,785,412	
Shipments of smaller steam sizes	11,160,695	8,029,388	8,954,321	9,700,982	
Local sales	3,043,939	2,810,337	3,249,552	3,285,936	
Total commercial production	80,291,438	46,672,000	46,584,961	54,042,258	[2] 48,300,000
Anthracite exported	4,017,785	1,303,355	1,034,562	1,297,610	1,609,000
Anthracite imported, chiefly from United Kingdom and U. S. S. R. (Russia)	117,951	607,097	456,252	478,118	571,000
Fuel briquets produced	580,470	470,604	530,430	704,856	860,707
Fuel briquets imported	38	80,288	42,395		16,778
Byproduct coke sold for domestic use	2,812,771	9,422,343	10,215,360	10,174,114	9,161,980
Beehive coke sold for domestic use	139,886	207,857	275,677	346,181	264,406
Coke imported	82,833	117,275	160,873	160,934	317,379
Gas-house coke sold	[2] 1,400,000	[2] 656,000	[3] 498,000	[2] 513,200	[2] 466,000
Petroleum coke produced	761,100	1,789,000	1,580,000	1,300,000	1,458,000
Anthracite and semianthracite produced outside of Pennsylvania	704,513	454,028	350,068	380,055	468,000
Bituminous coal for domestic use	(4)	(4)	(4)	(4)	(4)
Oil (barrels of 42 gallons)					
Oil for heating buildings:					
Range oil [5]	(6)	6,841,000	10,269,000	15,756,000	(6)
Heating oils: [7]					
Domestic heating	5,021,000	44,264,000	50,140,000	60,822,000	(6)
Commercial heating	(6)				
Liquefied petroleum gases, domestic	(6)	386,800	395,900	421,000	509,000
Gas (million cubic feet)					
Natural gas consumed for domestic and commercial use [8]	285,152	385,887	368,774	379,497	[2] 410,000
Manufactured gas sold: [9]					
For domestic use	(6)	258,074	239,298	232,829	226,793
For house heating	(6)	19,440	20,384	28,551	35,420

[1] A considerable part of the buckwheat No. 1 is used for domestic purposes.
[2] Partly estimated.
[3] Based on figures from Census of Manufactures.
[4] Between 56,000,000 and 77,000,000 tons a year.
[5] Range oil is a light distillate used for house heating, hot-water heating, and cooking.
[6] Data not available.
[7] Includes all grades of fuel oil used for heating buildings, both houses and offices, hotels, apartments, schools, hospitals, and other large buildings. Includes classifications formerly reported by the Bureau of Mines as "furnace oil", "domestic-heating oil", and "commercial-heating oil." Separation between domestic and commercial heating not available after 1931. (See U. S. Bureau of Mines Mineral Market Report M. M. S. 415, Nov. 19, 1935.)
[8] Includes gas used for heating offices, hotels, apartments, schools, hospitals, and stores and other large buildings, as well as houses.
[9] American Gas Association.

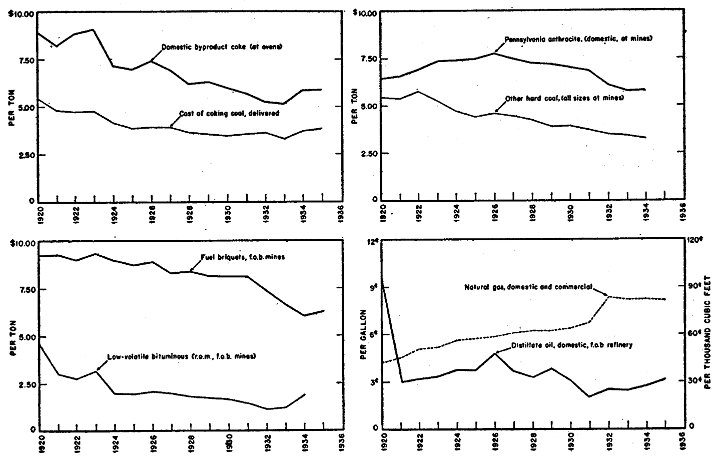

FIGURE 94.—Price trends of domestic fuels, 1920–35. As the figures are not retail prices they do not show comparative costs to the consumer, but they do indicate the general movement of prices. Prices of solid fuels, including anthracite, are all per net ton.

STOCKS OF COKE

TABLE 31.—*Stocks of furnace, foundry, and domestic coke and of breeze on Jan. 1, 1936, by States, in net tons*

[Based on complete reports from all producers]

State	Furnace	Foundry	Domestic and other	Total coke	Breeze
Byproduct plants:					
Alabama	269,101	8,807	34,219	312,127	26,067
Colorado	3,341	240	537	4,118	----------
Illinois	18,323	1,147	206,780	226,250	15,074
Indiana	16,759	125	62,755	79,639	20,675
Maryland	10,549	----------	----------	10,549	12,604
Massachusetts	----------	----------	312,223	312,223	3,150
Michigan	1,909	75	100,932	102,916	17,249
Minnesota	----------	----------	112,762	112,762	10,339
New Jersey	----------	----------	169,186	169,186	4,762
New York	[1] 4,117	(1)	324,481	328,598	66,811
Ohio	75,749	731	82,115	158,595	53,485
Pennsylvania	246,143	2,937	241,399	490,479	14,618
Tennessee	30,894	----------	29,657	60,551	1,163
Utah	588	----------	103	691	15
Washington	----------	----------	2,540	2,540	2,583
West Virginia	19,999	242	45,297	65,538	14,530
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	526	901	345,558	346,985	2,779
Total byproduct	697,998	15,205	2,070,544	2,783,747	265,904
At merchant plants	57,005	11,794	1,815,320	1,884,119	101,276
At furnace plants	640,694	3,710	255,224	899,628	164,628
Beehive plants:					
Colorado	21	----------	----------	21	----------
Pennsylvania	1,060	8,974	28,770	38,804	4,353
Tennessee	----------	525	----------	525	----------
Utah	----------	498	----------	498	194
Virginia	755	303	146	1,204	----------
Washington	----------	----------	25	25	25
West Virginia	375	846	3,339	4,560	----------
Total beehive	2,211	11,146	32,280	45,637	4,572

[1] A small amount of foundry coke is included with furnace.

TABLE 32.—*Summary of total stocks of coke on hand at all byproduct and beehive plants at first of year, 1929 and 1932–36*

	Jan. 1, 1929	Jan. 1, 1932	Jan. 1, 1933	Jan. 1, 1934	Jan. 1, 1935	Jan. 1, 1936
Byproduct plants:						
Furnace	750, 318	1, 376, 902	1, 360, 660	919, 583	922, 108	697, 699
Foundry	24, 426	268, 149	152, 222	64, 552	51, 069	15, 504
Domestic and other	1, 018, 205	2, 734, 219	1, 985, 380	1, 835, 743	2, 584, 481	2, 070, 544
	1, 792, 949	4, 379, 270	3, 498, 262	2, 819, 878	3, 557, 658	2, 783, 747
Beehive plants:						
Furnace	38, 446	25, 239	12, 067	5, 156	3, 133	2, 211
Foundry	8, 020	8, 513	7, 138	10, 979	8, 373	11, 146
Domestic and other	8, 511	12, 687	7, 388	29, 187	29, 379	32, 280
	54, 977	46, 439	26, 593	45, 322	40, 885	45, 637
Total:						
Furnace	788, 764	1, 402, 141	1, 372, 727	924, 739	925, 241	699, 910
Foundry	32, 446	276, 662	159, 360	75, 531	59, 442	26, 650
Domestic and other	1, 026, 716	2, 746, 906	1, 992, 768	1, 864, 930	2, 613, 860	2, 102, 824
	1, 847, 926	4, 425, 709	3, 524, 855	2, 865, 200	3, 598, 543	2, 829, 384

TABLE 33.—*Total stocks of coke on hand at all furnace and nonfurnace byproduct plants on first of each month, 1934 and 1935*

[Includes furnace, foundry, and domestic, but not breeze]

Date	Furnace plants		Other plants		Total	
	1934	1935	1934	1935	1934	1935
Jan. 1	1, 354, 618	1, 553, 300	1, 465, 260	2, 004, 358	2, 819, 878	3, 557, 658
Feb. 1	1, 298, 962	1, 437, 765	1, 047, 655	1, 691, 513	2, 346, 617	3, 129, 278
Mar. 1	1, 120, 558	1, 362, 075	687, 244	1, 498, 111	1, 807, 802	2, 860, 186
Apr. 1	1, 039, 284	1, 292, 238	673, 678	1, 668, 585	1, 712, 962	2, 960, 823
May 1	1, 070, 189	1, 329, 186	893, 554	1, 689, 830	1, 963, 743	3, 019, 016
June 1	1, 021, 398	1, 187, 675	926, 312	1, 603, 031	1, 947, 710	2, 790, 706
July 1	1, 009, 405	1, 175, 600	1, 037, 737	1, 610, 978	2, 047, 142	2, 786, 578
Aug. 1	1, 068, 999	1, 199, 919	1, 242, 651	1, 795, 310	2, 311, 650	2, 995, 229
Sept. 1	1, 166, 446	1, 198, 931	1, 481, 639	1, 992, 957	2, 648, 085	3, 191, 888
Oct. 1	1, 254, 590	1, 154, 927	1, 591, 327	1, 974, 992	2, 845, 917	3, 129, 919
Nov. 1	1, 346, 121	1, 030, 804	1, 735, 125	1, 944, 522	3, 081, 246	2, 975, 326
Dec. 1	1, 405, 409	952, 549	2, 012, 494	2, 073, 643	3, 417, 903	3, 026, 192

VALUE AND PRICE

TABLE 34.—*Average receipts per net ton for coke sold, by States, in 1935*

State	Byproduct				Beehive			
	Furnace [1]	Foundry	Domestic	Other industrial, including water gas	Furnace [1]	Foundry	Domestic	Other industrial, including water gas
Alabama	$3. 63	$5. 14	$3. 42	$3. 12				
Colorado and Utah	7. 11	7. 21	3. 29	3. 57	$5. 71	$5. 92		
Illinois		8. 38	5. 65	5. 64				
Indiana	7. 57	7. 87	5. 09	5. 46				
Maryland and New Jersey		7. 83	6. 51	6. 23				
Massachusetts		6. 56	5. 92	5. 71				
Michigan and Minnesota	5. 29	6. 21	6. 31	6. 09				
New York	5. 13	(2)	6. 54	6. 35				
Ohio	3. 64	6. 26	4. 19	4. 22				
Pennsylvania	4. 06	7. 51	5. 35	4. 43	3. 40	4. 78	$3. 36	$3. 40
Tennessee		5. 75	3. 50	3. 71		5. 84		3. 00
Virginia					2. 81	4. 49	2. 98	3. 86
Washington		6. 00	6. 00	6. 00		8. 02	7. 00	5. 02
West Virginia	3. 44	(2)	2. 69	2. 86	3. 48	4. 77	3. 48	3. 49
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	4. 71	7. 63	6. 80	6. 17				
Undistributed		7. 57						
Average	4. 77	6. 96	5. 84	5. 41	4. 34	4. 78	3. 38	3. 58
At merchant plants	5. 34	7. 31	6. 10	5. 90	(3)	(3)	(3)	(3)
At furnace plants	4. 48	6. 05	5. 01	4. 36	(3)	(3)	(3)	(3)

[1] Includes coke sold to affiliated corporations and merchant sales.
[2] Included under "Undistributed."
[3] Not available.

TABLE 35.—*Average monthly prices per net ton at ovens of spot or prompt Connellsville furnace and foundry coke, 1929 and 1932–35* [1]

Month	Furnace coke					Foundry coke				
	1929	1932	1933	1934	1935	1929	1932	1933	1934	1935
January	$2.75	$2.25	$1.75	$3.60	$3.85	$3.75	$3.50	$2.50	$4.25	$4.60
February	2.90	2.25	1.75	3.50	3.85	3.75	3.50	2.50	4.25	4.60
March	2.98	2.25	1.75	3.50	3.85	3.75	3.50	2.50	4.25	4.60
April	2.78	2.25	1.75	3.85	3.85	3.75	3.50	2.50	4.60	4.60
May	2.75	2.20	1.75	3.85	3.85	3.75	3.10	2.50	4.60	4.60
June	2.75	2.00	1.81	3.85	3.59	3.75	3.00	2.56	4.60	4.15
July	2.75	2.00	2.31	3.85	3.27	3.75	3.00	2.94	4.60	3.88
August	2.73	2.00	2.55	3.85	3.29	3.75	2.90	3.15	4.60	4.00
September	2.65	2.00	2.50	3.85	3.25	3.75	2.75	3.25	4.60	4.00
October	2.65	1.81	3.50	3.85	3.53	3.75	2.75	4.05	4.60	4.20
November	2.65	1.75	3.75	3.85	3.60	3.75	2.75	4.25	4.60	4.25
December	2.64	1.75	3.75	3.85	3.54	3.75	2.69	4.25	4.60	4.10
Average	2.75	2.04	2.41	3.77	3.61	3.75	3.08	3.08	4.51	4.30

[1] Iron Age, Jan. 2, 1936.

TABLE 36.—*Average monthly prices of byproduct foundry coke, in 11 markets, as quoted by Steel*

	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
Birmingham, Ala. (at ovens):													
1932	4.50	4.50	4.50	4.50	4.50	4.50	4.25	4.50	4.50	4.50	4.15	4.00	4.41
1933	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.40	4.50	4.75	4.85	4.85	4.28
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
Buffalo, N. Y. (at ovens):													
1932	8.00	8.00	7.60	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.59
1933	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
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
Chicago, Ill. (at ovens):													
1932	7.50	7.50	7.50	7.50	7.30	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.19
1933	7.00	7.00	7.00	7.00	7.00	7.15	7.50	7.50	8.00	8.00	8.00	8.00	7.43
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
Cincinnati, Ohio, (delivered at consumers' works)													
1934	(1)	(1)	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
Cleveland, Ohio, (delivered at consumers' works):													
1934	(1)	(1)	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
Detroit, Mich. (at ovens):													
1932	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
1933	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
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
Indianapolis, Ind. (delivered at consumers' works):													
1932	8.30	8.30	8.25	8.25	8.25	8.25	8.25	8.25	8.25	8.15	7.75	7.75	8.17
1933	7.75	7.75	7.75	7.75	7.75	7.75	8.05	8.25	8.75	8.75	8.75	8.75	8.15
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
Newark, N. J. (delivered at consumers' works):													
1932	8.76	8.76	8.76	8.76	8.23	8.21	8.21	8.21	8.21	8.21	8.21	8.21	8.40
1933	8.21	8.21	8.21	8.21	8.21	8.21	8.21	8.21	8.51	8.71	8.71	8.71	8.36
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
New England (delivered at consumers' works):													
1932	10.50	10.50	10.50	10.50	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.17
1933	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.30	10.50	10.50	10.50	10.15
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
Philadelphia, Pa. (delivered at consumers' works):													
1932	8.75	8.75	8.75	8.75	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.58
1933	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.63	9.00	9.00	9.00	8.64
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
St. Louis, Mo. (at ovens):													
1932	8.50	8.50	8.50	8.50	8.50	7.95	7.75	7.75	7.75	7.75	7.75	7.75	8.08
1933	7.75	7.75	7.75	7.75	7.75	7.75	7.75	7.75	8.15	8.50	8.75	9.00	8.03
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

[1] Not quoted until March.

SHIPMENTS BY RAIL AND WATER

TABLE 37.—*Beehive coke loaded for shipment on originating railroads in the United States in 1935, by routes, as reported by coke producers* [1]

Route	State	Quantity (net tons) By States	Quantity (net tons) Total	Percent of total
Railroads:				
Baltimore & Ohio	Pennsylvania	25,937	54,251	6.0
	West Virginia	28,314		
Chesapeake & Ohio	do	44,464	44,464	4.9
Denver & Rio Grande Western	Colorado	49,258	57,674	6.4
	Utah	8,416		
Huntingdon & Broad Top Mountain	Pennsylvania	339	339	.0
Interstate	Virginia	117,465	117,465	13.0
Lingonier Valley	Pennsylvania	25,917	25,917	2.9
Louisville & Nashville	Virginia	810	810	.1
Monongahela	Pennsylvania	230,244	230,244	25.4
Nashville, Chattanooga & St. Louis	Tennessee	2,501	2,501	.3
New York Central	West Virginia	80,028	80,028	8.8
Norfolk & Western	Virginia	23,510	23,510	2.6
Northern Pacific	Washington	2,464	2,464	.3
Pennsylvania	Pennsylvania	265,803	265,803	29.3
Pittsburgh & Lake Erie	do	103	103	.0
Total railroad shipments		905,573	905,573	100.0

[1] There were no shipments of beehive coke over waterways during 1935.

EXPORTS AND IMPORTS [1]

TABLE 38.—*Coke exported from the United States, 1933–35, by customs districts*

District	1933 Net tons	1933 Value	1934 Net tons	1934 Value	1935 Net tons	1935 Value
Alaska	1	$6			1	$32
Arizona	52	310	102	$897	28	221
Buffalo	119,360	600,916	313,425	1,792,771	222,953	1,333,256
Chicago	33,104	107,590	58,148	270,709	65,406	353,516
Dakota	7,386	41,093			9,984	71,008
Duluth-Superior	1,569	10,107	1,845	12,879	2,449	16,886
El Paso	7	104	4	65	2	45
Florida	1,101	7,635	7,247	73,261	3,659	31,023
Los Angeles			1	10		
Maine and New Hampshire	35	236			424	3,382
Maryland	144	1,539	2,355	9,510	117	501
Michigan	444,110	1,875,641	492,549	2,853,333	285,201	1,610,521
Mobile	1,816	4,858	5,002	15,580	1,516	22,801
Montana and Idaho			8,623	54,883		
New Orleans	1,388	8,782	7,622	53,888	4,572	33,533
New York	250	3,563	403	6,831	179	3,076
Ohio	22,514	98,445	41,697	223,036	12,551	63,047
Oregon			30	180		
Philadelphia	6	60	2,483	39,398	3,855	37,641
Puerto Rico	21	216	40	467	19	219
Sabine	2,240	21,400				
St. Lawrence	319	1,790	723	7,523	214	1,680
San Antonio	483	2,730	4	74	284	1,983
San Diego	157	1,619	145	1,722	337	3,686
San Francisco	346	2,863	9	130	13	232
Vermont	27	175			63	480
Virginia	231	1,409	320	2,482	147	1,359
Washington	1,152	4,034	8	109	1	15
Total	637,819	2,797,121	942,785	5,419,738	613,975	3,590,143

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

TABLE 39.—*Coke exported from the United States, 1933–35, by countries of destination*

Destination	1933		1934		1935	
	Net tons	Value	Net tons	Value	Net tons	Value
North America:						
Bermuda	13	$178	11	$170	21	$344
Canada	631,820	2,761,433	917,018	5,215,243	599,202	3,453,607
Central America:						
British Honduras	--------	--------	--------	--------	34	570
Costa Rica	8	94	40	617	11	190
Guatemala	18	224	80	1,152	62	825
Honduras	44	629	54	744	43	598
Nicaragua	74	1,221	40	770	43	834
Panama	224	1,085	115	1,869	293	4,161
Salvador	17	215	38	587	50	1,019
Mexico	828	6,261	316	3,589	738	6,950
West Indies:						
British	2	29	--------	--------	--------	--------
Cuba	3,561	13,332	14,034	66,053	6,700	44,219
Dominican Republic	50	746	57	794	27	326
French	200	1,210	20	93	63	564
Haiti	10	178	3	67	--------	--------
Jamaica	--------	--------	--------	--------	28	530
Netherland	--------	--------	18	152	--------	--------
Trinidad and Tobago	--------	--------	--------	--------	120	1,219
South America:						
Bolivia	--------	--------	88	1,446	--------	--------
Brazil	--------	--------	--------	--------	1	15
Chile	--------	--------	2,346	9,559	109	411
Colombia	59	755	120	1,857	47	654
Ecuador	22	280	29	458	30	476
Peru	--------	--------	123	1,680	125	935
Venezuela	17	187	44	733	13	267
Europe:						
Belgium	78	1,040	213	3,000	--------	--------
France	--------	--------	601	9,197	454	6,912
Germany	--------	--------	--------	--------	437	5,216
Hungary	--------	--------	--------	--------	6	111
Italy	359	4,676	6,543	88,362	1,684	25,250
Netherlands	4	19	--------	--------	1,226	10,944
Norway	--------	--------	568	9,139	1,252	14,915
Sweden	--------	--------	30	180	1,108	7,753
United Kingdom	90	865	6	78	44	216
Asia:						
China	--------	--------	31	556	--------	--------
Philippine Islands	321	2,464	199	1,593	4	112
Total	637,819	2,797,121	942,785	5,419,738	613,975	3,590,143

TABLE 40.—*Coke imported into the United States, 1933–35, by customs districts* [1]

District	1933		1934		1935	
	Net tons	Value	Net tons	Value	Net tons	Value
Buffalo	--------	--------	13,027	$229,631	22,439	$390,068
Connecticut	--------	--------	3,298	15,819	116	2,317
Florida	--------	--------	--------	--------	6	26
Hawaii	400	$3,480	426	4,085	1,136	5,166
Los Angeles	15,820	36,904	21,759	72,712	34,210	107,033
Massachusetts	101,096	318,569	77,336	355,573	113,132	487,452
Maine and New Hampshire	2	16	197	1,470	237	1,751
Michigan	--------	--------	579	8,718	139	2,428
Montana and Idaho	--------	--------	7,292	39,473	20,252	103,035
New York	7,393	25,861	--------	--------	80,152	309,815
Oregon	2,107	5,123	2,593	9,009	2,502	10,003
Rhode Island	8,182	25,547	10,036	41,994	3,882	18,025
San Antonio	--------	--------	1,928	8,679	5,937	26,538
San Francisco	21,774	58,273	17,582	61,127	23,092	71,455
Vermont	--------	--------	35	248	76	528
Washington	4,099	9,949	4,846	16,313	10,071	38,938
Total	160,873	483,722	160,934	864,851	317,379	1,574,578

[1] Prior to 1934 the figures represent general imports; beginning with 1934 they represent imports for consumption only.

TABLE 41.—*Coke imported into the United States, 1933–35, by countries of origin* [1]

Country	1933		1934		1935	
	Net tons	Value	Net tons	Value	Net tons	Value
Belgium	9,544	$19,292	1,711	$4,914	60,838	$216,887
Canada			21,130	279,540	46,150	514,711
Germany	44,133	117,786	29,847	128,627	120,340	466,922
Japan	7	31				
Mexico	777	2,464	1,928	8,679	5,937	26,538
United Kingdom	106,412	344,149	106,318	443,091	84,114	349,520
Total	160,873	483,722	160,934	864,851	317,379	1,574,578

[1] Prior to 1934 the figures represent general imports; beginning with 1934 they represent imports for consumption only.

WORLD PRODUCTION

TABLE 42.—*Coke produced in principal countries, 1929 and 1932–35, in metric tons* [1]

[Compiled by M. T. Latus]

Country	1929	1932	1933	1934	1935
Australia:					
New South Wales	471,813	362,217	481,026	699,673	871,644
Queensland	4,144	1,963	15,337	26,067	(2)
Belgium	6,192,960	4,682,860	4,694,130	4,601,950	4,678,400
Bulgaria		566	628	935	(2)
Canada	1,986,532	1,074,895	1,228,246	1,658,691	1,661,760
China (exports)	13,467	4,113	1,709	6,531	(2)
Chosen	(3)	212,489	(3)	(3)	(2)
Czechoslovakia	3,170,629	1,277,810	1,259,381	1,344,786	1,551,100
France	9,080,127	6,049,280	6,788,000	7,293,000	7,056,000
Germany [4]	39,421,033	19,545,920	21,153,744	24,485,000	27,600,000
Saar	2,423,000	1,685,000	1,880,000	2,180,000	(2)
Great Britain [5]	13,637,421	8,616,303	8,919,540	11,697,111	(2)
Hungary	2,092	(3)	(3)	(3)	(2)
India, British [6]	843,504	1,234,019	1,247,451	1,541,487	(2)
Indochina	637	2,150	360	285	(2)
Italy	791,607	714,141	729,966	817,243	(2)
Japan:					
Manufactured coke	(3)	(3)	(3)	(3)	(2)
Natural coke	(3)	279,010	370,785	(3)	(2)
Mexico	493,777	255,595	251,604	275,176	489,047
Netherlands	2,402,566	2,519,656	2,609,373	2,779,378	(2)
Peru	35,899	(3)	(3)	(3)	(2)
Poland	1,858,052	1,090,900	1,170,717	1,333,493	1,386,716
Rhodesia, Southern	100,001	25,514	31,798	55,979	(2)
Spain	768,040	369,352	427,453	485,634	(2)
Sweden	103,778	106,328	103,336	107,370	(2)
U. S. S. R. (Russia)	(3)	8,200,000	10,200,000	14,200,000	(2)
Union of South Africa	99,297	57,347	75,456	72,969	64,782
United States	54,325,427	19,766,300	25,028,365	28,867,897	
Total	144,766,000	79,416,000	90,150,000	106,413,000	(2)

[1] Gas-house coke is not included.
[2] Data not available.
[3] Estimate included in total.
[4] Exclusive of the Saar, which is shown separately.
[5] In Great Britain the production of gas-house coke (including breeze), not included above, is especially important and was as follows: 1931, 12,301,695 tons; 1932, 11,990,229 tons; 1933, 11,657,081 tons; 1934, 12,038,825 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: 1932, 772,430 tons; 1933, 837,393 tons; 1934, 874,901 tons.

COKE-OVEN BYPRODUCTS

SUMMARY OF BYPRODUCTS IN 1935

TABLE 43.—*Byproducts obtained from coke-oven operations in the United States in 1935* [1]

[Exclusive of screenings or breeze]

Product	Production	Sales		
		Quantity	Value	
			Total	Average
Tar .... gallons..	450,307,827	308,705,919	$12,597,705	$0.041
Ammonia:				
Sulphate .... pounds..	923,513,235	985,310,831	9,349,933	.009
Ammonia liquor (NH_3 content) .... do....	41,777,575	43,097,903	1,253,181	.029
	....	....	10,603,114	....
Sulphate equivalent of all forms .... do....	1,090,623,535	1,157,702,443	....	....
Gas:				
Used under boilers, etc .... M cubic feet..	[2] 543,396,088	19,788,904	1,300,371	.066
Used in steel or affiliated plants .... do....		160,811,880	15,222,869	.095
Distributed through city mains .... do....		151,255,723	44,510,704	.294
Sold for industrial use .... do....		13,659,750	1,681,104	.123
	....	345,516,257	62,715,048	.182
Light oil and derivatives:				
Crude light oil .... gallons..	[3] 133,696,803	12,076,030	1,017,328	.084
Benzol, crude and refined .... do....	20,210,207	20,596,355	2,557,626	.124
Motor benzol .... do....	58,379,910	57,542,312	5,120,881	.089
Toluol, crude and refined .... do....	16,026,438	15,960,968	4,388,728	.275
Solvent naphtha .... do....	3,992,338	3,781,720	644,005	.170
Xylol .... do....	3,695,656	3,747,959	860,891	.230
Other light-oil products .... do....	5,235,866	2,426,347	121,718	.050
	[4] 107,540,415	116,131,691	14,711,177	.127
Naphthalene, crude and refined .... pounds..	12,937,277	13,214,108	167,632	.013
Tar derivatives:				
Creosote oil, distillate as such .... gallons..	12,579,639	8,125,449	735,265	.090
Creosote oil in coal-tar solution .... do....	932,724	243,104	21,191	.087
Pitch of tar .... net tons..	112,354	3,129	21,130	6.753
Other tar derivatives	....	....	175,055	....
Phenol .... gallons..	94,310	85,137	26,049	.306
Sodium phenolate .... do....	184,819	167,459	11,016	.066
Other products [5]	....	....	125,646	....
Value of all byproducts sold	....	....	[6] 101,910,028	....

[1] Includes products of tar distillation conducted by coke-oven operators under same corporate name, except, however, phenol and other tar acids produced at Clairton, Pa.
[2] Includes gas wasted and gas used for heating retorts.
[3] Refined on the premises to make the derived products shown, 126,688,359 gallons.
[4] Total gallons of derived products.
[5] Ammonia thiocyanate, carbolates, cyanogen, sludges, pyridine oil, sodium prussiate, spent soda solution, sulphur, and vented vapors.
[6] Exclusive of the value of breeze production, which in 1935 amounted to $5,806,163.

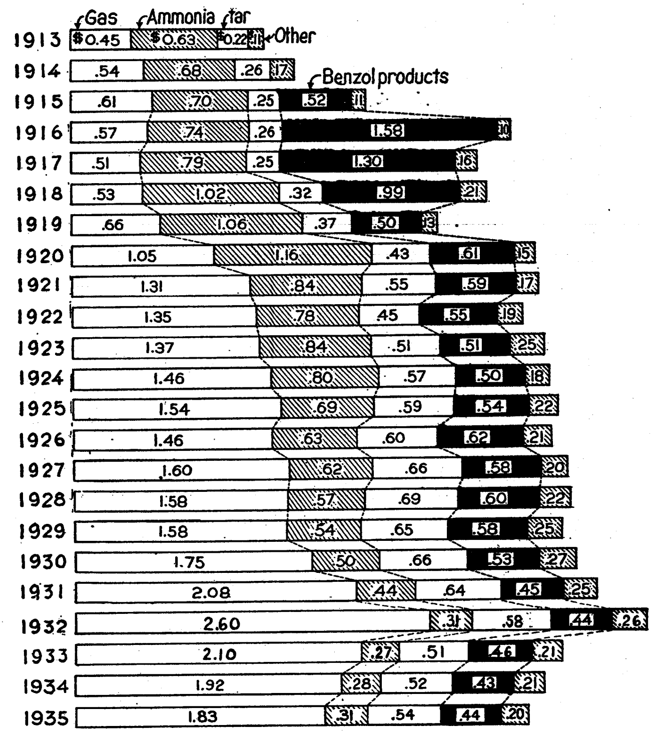

FIGURE 95.—Gross value of the several byproducts per ton of byproduct coke produced, 1913–35.

TABLE 44.—*Coal equivalent of byproducts of byproduct coking, 1913, 1914, 1918, and 1933–35*

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
1933	2,533	276	363,299	96,632	50,660	151,800	54,495	12,562	269,517	10,287,000	25.7
1934	2,731	310	408,710	115,695	54,620	170,500	61,307	15,040	301,467	1,506,000	25.0
1935	2,863	346	450,308	133,697	57,260	190,300	67,546	17,381	332,487	12,690,000	25.1

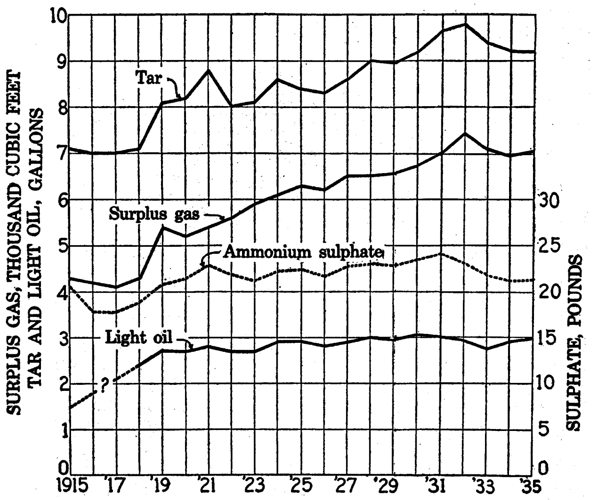

FIGURE 96.—Average yield of principal byproducts per net ton of coal carbonized in byproduct coke ovens, 1915–35. Figures for light oil represent average at plants recovering light oil.

COKE-OVEN GAS

TABLE 45.—*Coke-oven gas produced and sold in the United States in 1935, by States*

State	Number of 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	5	32, 115, 315	14, 103, 985	16, 315, 646	$1, 295, 013	$0. 079	1, 695, 684
Colorado	1	3, 582, 388	1, 983, 696	1, 581, 660	(1)	(1)	17, 032
Illinois	7	25, 732, 829	5, 762, 918	19, 886, 219	4, 484, 864	. 226	83, 692
Indiana	6	57, 304, 114	24, 406, 290	32, 174, 763	4, 879, 221	. 152	723, 061
Maryland	1	12, 580, 144	5, 041, 777	7, 538, 367	(1)	(1)	---------
Massachusetts	3	17, 339, 271	4, 144, 141	13, 139, 535	3, 808, 226	. 290	55, 595
Michigan	8	41, 553, 698	14, 862, 712	26, 664, 727	4, 995, 893	. 187	26, 259
Minnesota	2	6, 973, 900	2, 832, 177	4, 133, 908	(1)	(1)	7, 815
New Jersey	2	14, 867, 959	3, 232, 822	11, 635, 137	(1)	(1)	---------
New York	8	62, 377, 955	13, 527, 485	46, 545, 397	15, 055, 352	. 323	2, 305, 073
Ohio	13	76, 200, 306	31, 668, 885	43, 747, 069	4, 945, 195	. 113	784, 352
Pennsylvania	12	136, 883, 771	55, 373, 905	80, 626, 036	10, 194, 485	. 126	883, 830
Tennessee	1	1, 077, 918	485, 060	592, 858	156, 183	. 263	---------
Utah	1	2, 397, 029	1, 072, 435	1, 313, 294	(1)	(1)	11, 300
Washington	1	570, 520	-----------	507, 848	134, 398	. 265	62, 672
West Virginia	4	25, 399, 750	7, 201, 737	18, 132, 676	1, 527, 742	. 084	65, 337
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	6	26, 439, 221	5, 242, 255	20, 981, 117	6, 298, 021	. 300	215, 849
Undistributed	--------	-----------	-----------	-----------	4, 940, 455	. 189	---------
Grand total, 1935	81	543, 396, 088	190, 942, 280	345, 516, 257	62, 715, 048	. 182	6, 937, 551
At merchant plants	41	176, 238, 954	39, 275, 567	134, 816, 858	38, 932, 440	. 289	2, 146, 529
At furnace plants	40	367, 157, 134	151, 666, 713	210, 699, 399	23, 782, 608	. 113	4, 791, 022
Grand total, 1934	83	493, 581, 751	175, 868, 523	309, 571, 357	59, 258, 839	. 191	8, 141, 871
Change in 1935 ... percent	−2. 4	+10. 1	+8. 6	+11. 6	+5. 8	−4. 7	−14. 8

[1] Included under "Undistributed."

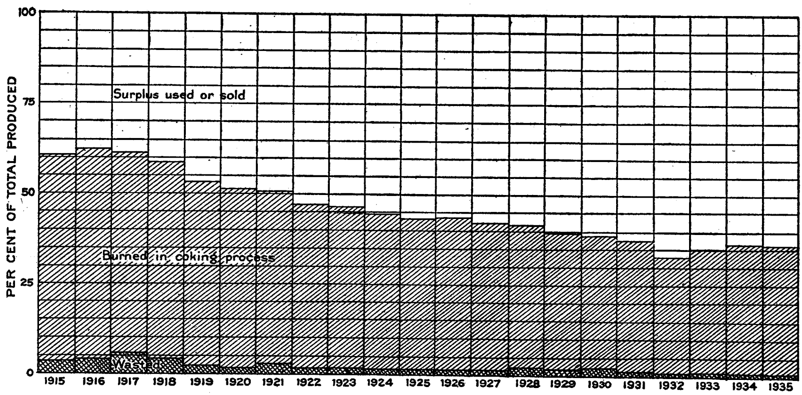

FIGURE 97.—Percent of total production of byproduct oven gas that was wasted, burned in coking processes, or sold or used, 1915–35.

TABLE 46.—*Disposition of surplus coke-oven gas in the United States in 1935, by States*

State	Used by producer					
	Under boilers			In steel or other affiliated plants		
	M cubic feet	Value		M cubic feet	Value	
		Total	Average		Total	Average
Alabama	3,907,649	$206,391	$0.053	8,733,562	$594,425	$0.068
Colorado	----------	----------	----------	1,581,660	(1)	(1)
Illinois	458,851	30,388	.066	2,264,235	313,425	.138
Indiana	492,090	58,332	.119	25,102,034	3,000,137	.120
Maryland	----------	----------	----------	2,854,378	(1)	(1)
Massachusetts	1,563	(1)	(1)	----------	----------	----------
Michigan	2,909,992	234,356	.081	8,472,262	1,007,636	.119
Minnesota	180,459	(1)	(1)			
New York	2,367,923	137,623	.058	9,141,692	957,369	.105
Ohio	1,973,088	156,057	.079	31,267,055	2,960,477	.095
Pennsylvania	6,044,994	368,033	.061	53,716,488	4,380,134	.082
Tennessee	122,950	4,303	.035	----------	----------	----------
Utah	766,143	(1)	(1)	27,120	(1)	(1)
West Virginia	205,893	15,197	.074	17,651,394	1,490,514	.084
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	357,309	(1)	(1)	----------	----------	----------
Undistributed	----------	89,691	.069	----------	518,752	.116
Grand total, 1935	19,788,904	1,300,371	.066	160,811,880	15,222,869	.095
At merchant plants	6,251,607	457,633	.073	3,759,469	391,857	.104
At furnace plants	13,537,297	842,738	.062	157,052,411	14,831,012	.094
Grand total, 1934	29,324,006	2,873,573	.098	119,716,459	11,001,864	.092
Change in 1935 ... percent	−32.5	−54.7	−32.7	+34.3	+38.4	+3.3

[1] Included under "Undistributed."

TABLE 46.—*Disposition of surplus coke-oven gas in the United States in 1935, 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, 459, 672	$471, 199	$0. 136	214, 763	$22, 998	$0. 107
Illinois	17, 163, 133	4, 141, 051	. 241	----------	----------	----------
Indiana	5, 508, 151	1, 609, 088	. 292	1, 072, 488	211, 664	. 197
Maryland	4, 683, 989	(1)	(1)	----------	----------	----------
Massachusetts	13, 106, 121	3, 801, 643	. 290	31, 851	(1)	(1)
Michigan	14, 985, 884	3, 678, 036	. 245	296, 589	75, 865	. 256
Minnesota	3, 953, 183	(1)	(1)	266	(1)	(1)
New Jersey	11, 635, 137	(1)	(1)	----------	----------	----------
New York	33, 380, 909	13, 630, 595	. 408	1, 654, 873	329, 765	. 199
Ohio	6, 923, 391	1, 453, 325	. 210	3, 583, 535	375, 336	. 105
Pennsylvania	17, 185, 562	5, 105, 867	. 297	3, 678, 992	340, 451	. 093
Tennessee	469, 908	151, 880	. 323	----------	----------	----------
Utah	410, 707	(1)	(1)	109, 324	(1)	(1)
Washington	507, 848	134, 398	. 265	----------	----------	----------
West Virginia	----------	----------	----------	275, 389	22, 031	. 080
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	17, 882, 128	5, 974, 588	. 334	2, 741, 680	(1)	(1)
Undistributed	----------	4, 359, 034	. 211	----------	302, 994	. 105
Grand total, 1935	151, 255, 723	44, 510, 704	. 294	13, 659, 750	1, 681, 104	. 123
At merchant plants	116, 036, 743	36, 940, 462	. 318	8, 769, 039	1, 142, 488	. 130
At furnace plants	35, 218, 980	7, 570, 242	. 215	4, 890, 711	538, 616	. 110
Grand total, 1934	144, 308, 149	42, 925, 575	. 297	16, 222, 743	2, 457, 827	. 152
Change in 1935 ......percent	+4. 8	+3. 7	−1. 0	−15. 8	−31. 6	−19. 1

1 Included under "Undistributed."

TAR

TABLE 47.—*Coke-oven tar produced and sold in the United States in 1935, by States* [1]

State	Total produced	Yield of tar per ton of coal coked	Sold				
			For use as fuel [2]	For refining into tar products	Total sold	Value	
						Total	Average
	Gallons	*Gallons*	*Gallons*	*Gallons*	*Gallons*		
Alabama	26, 938, 078	9. 31	8, 393, 932	9, 271, 861	17, 665, 793	$744, 944	$0. 042
Colorado	3, 346, 300	11. 03	1, 209	13, 005	14, 214	(3)	(3)
Illinois	21, 489, 452	8. 67	----------	20, 323. 663	20, 323, 663	807, 758	. 040
Indiana	35, 420, 586	6. 76	817, 057	21, 382, 362	22, 199, 419	983, 045	. 044
Maryland	10, 072, 961	7. 85	----------	10, 186, 661	10, 186, 661	(3)	(3)
Massachusetts	12, 692, 725	8. 87	661, 411	13, 873, 870	14, 535, 281	749, 457	. 052
Michigan	29, 822, 024	8. 48	1, 530, 414	18, 391, 780	19, 922, 194	724, 362	. 036
Minnesota	5, 083, 957	8. 07	----------	5, 107, 770	5, 107, 770	(3)	(3)
New Jersey	9, 771, 890	7. 60	----------	9, 679, 752	9, 679, 752	(3)	(3)
New York	56, 551, 189	9. 67	18, 810, 738	37, 800, 836	56, 611, 574	2, 266, 932	. 040
Ohio	63, 785, 611	8. 86	266, 457	46, 957, 064	47, 223. 521	2, 022, 854	. 043
Pennsylvania	129, 574, 979	10. 88	17, 351, 630	25, 083, 120	42, 434, 750	1, 453, 845	. 034
Tennessee	689, 111	6. 07	----------	689, 698	689, 698	25, 989	. 038
Utah	2, 115, 944	10. 97	----------	2, 172, 337	2, 172, 337	(3)	(3)
Washington	358, 741	7. 59	372, 720	----------	372, 720	17, 719	. 048
West Virginia	24, 167, 915	10. 53	3, 055, 781	17, 844, 661	20, 900, 442	863, 744	. 041
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	18, 426, 364	7. 75	----------	18, 666, 130	18, 666, 130	748, 453	. 040
Undistributed	----------	------	----------	----------	----------	1, 188, 603	. 044
Grand total, 1935	450, 307, 827	9. 18	51, 261, 349	257, 444, 570	308, 705, 919	12, 597, 705	. 410
At merchant plants	137, 395, 329	8. 67	14, 024, 728	123, 180, 574	137, 205, 302	5, 546, 305	. 040
At furnace plants	312, 912, 498	9. 42	37, 236, 621	134, 263, 996	171, 500, 617	7, 051, 400	. 041
Grand total, 1934	408, 710, 314	9. 22	37, 297, 820	236, 465, 919	273, 763, 739	10, 760, 125	. 039
Change in 1935 ......percent	+10. 2	−0. 4	+37. 4	+8. 9	+12. 8	+17. 1	+5. 1

1 This table excludes the quantity of tar "refined at plant", which in 1935 was 40,469,793 gallons.
2 Includes 15,245,508 gallons sold to affiliated corporations and 36,015,841 gallons sold to other purchasers.
3 Included under "Undistributed."

TABLE 47.—*Coke-oven tar produced and sold in the United States in 1935, by States*—Continued

State	Used by producer			On hand Dec. 31
	As fuel under boilers	In open-hearth or affiliated plants	Otherwise	
	Gallons	*Gallons*	*Gallons*	*Gallons*
Alabama		9,539,333	130,476	2,257,115
Colorado			10,482	261,597
Illinois		52,063	8,000	2,111,590
Indiana		12,786,933	336,495	2,878,840
Maryland		4,951		1,329,922
Massachusetts				290,113
Michigan		10,093,355	4,750	1,445,539
Minnesota				218,641
New Jersey				641,449
New York			9,728	3,163,855
Ohio	784,358	12,070,804		4,663,259
Pennsylvania	1,020,325	44,042,858	1,418,297	14,068,268
Tennessee				37,910
Utah		600	2,788	104,352
Washington				20,704
West Virginia		3,040,796		657,560
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin			545	764,961
Grand total, 1935	1,804,683	91,631,693	1,921,561	34,915,675
At merchant plants			18,573	7,659,517
At furnace plants	1,804,683	91,631,693	1,902,988	27,256,158
Grand total, 1934	1,849,842	105,780,051	1,291,129	27,202,174
Change in 1935 percent	−2.4	−13.4	+48.8	+28.4

AMMONIA

TABLE 48.—*Ammonia prooduced at coke-oven plants in 1935, by States, in pounds*

State	Number of active plants	Sulphate equivalent of all forms		Produced as—	
		Total	Per ton of coal coked	Sulphate	Liquor (NH^3 content)
Alabama	5	74,955,720	25.90	72,395,004	640,179
Colorado	1	6,933,110	22.86	6,933,110	
Illinois	7	56,258,976	22.69	56,258,976	
Indiana	6	99,137,767	18.93	89,007,051	2,532,679
Maryland	1	28,048,959	21.85	28,048,959	
Massachusetts	3	33,,904,168	23.69	32,900,800	250,842
Michigan	8	76,314,846	21.69	31,842,870	11,117,994
New Jersey	2	24,514,487	19.07	24,514,487	
New York	8	132,837,761	22.71	105,125,005	6,928,189
Ohio	13	154,972,463	21.52	117,390,343	9,395,530
Pennsylvania	12	296,943,586	24.94	286,071,234	2,718,088
Tennessee	1	2,765,774	24.37	2,765,774	
Utah	1	4,666,735	24.20	4,666,735	
West Virginia	3	45,854,797	22.43	45,854,797	
Connecticut, Kentucky, Minnesota, Missouri, Rhode Island, and Wisconsin	6	52,514,386	20.62	19,738 090	8,194,074
Grand total, 1935	77	1,090,623,535	22.59	923,513,235	41,777,575
At merchant plants	37	333,173,728	22.09	203,236,552	32,484,294
At furnace plants	40	757,449,807	22.81	720,276,683	9,293,281
Grand total, 1934	77	959,820,592	22.29	785,444,684	43,593,977
Change in 1935 percent		+13.6	+1.3	+17.6	−4.2

LIGHT OIL AND ITS DERIVATIVES

TABLE 49.—*Crude light oil produced at coke-oven plants in the United States in 1935, by States, in gallons* [1]

State	Number of active plants	Produced		Refined on premises	Total derived products obtained from refining operations
		Total	Per ton of coal coked		
Alabama	5	8,459,372	2.92	8,483,021	6,890,029
Colorado	1	1,024,075	3.38	1,021,645	764,903
Illinois	5	5,899,789	2.63	2,503,996	2.114,717
Indiana	4	13,384,177	2.88	14,082,387	12,086,124
Maryland	1	4,348,399	3.39	4,329,982	3,856,385
Michigan	3	8,292,930	2.58	4,698,554	3,996,064
New York	7	12,095,263	2.38	19,507,239	16,523,910
Ohio	13	22,145,307	3.07	19,394,171	15,698,233
Pennsylvania	10	38,370,266	3,48	37,153,060	32,880,100
Tennessee	1	278,334	2.45	277,006	207,302
Utah	1	787,045	4.08	789,968	580,861
West Virginia	4	7,685,856	3.35	7,632,481	6,303,159
Kentucky, Massachusetts, Minnesota, Missouri, New Jersey, and Wisconsin	6	10,925,990	2.53	6,814,849	5,638,628
Grand total, 1935	61	133,696,803	2.98	126,688,359	107,540,415
At merchant plants	23	29,074,772	2.41	24,190,333	20,255,129
At furnace plants	38	104,622,031	3.19	102,498,026	87,285,286
Grand total, 1934	62	115,694,748	2.90	108,219,464	94,570,139
Change in 1935 ... percent	−1.6	+15.6	+2.8	+17.1	+13.7

[1] In addition to the quantity refined on the premises, a few plants reported the sale of crude light oil. The total quantity sold in 1935 was 12,076,030 gallons, valued at $1,017,328, or 8.4 cents per gallon.

NAPHTHALENE

TABLE 50.—*Naphthalene sold by byproduct coke operators, 1918 and 1932–35*

Year	Quantity (pounds)			Value	Average receipts per pound (cents)		Receipts per ton of coke (cents)
	Crude	Refined	Total		Crude	Refined	
1918	10,403,758	5,486,689	15,890,447	$650,229	2.8	6.6	2.5
1932	[1] 3,714,604		3,714,604	33,323	[1] .9		.2
1933	[1] 6,523,204		6,523,204	67,472	[1] 1.0		.3
1934	[1] 10,500,285		10,500,285	131,299	[1] 1.3		.4
1935	[1] 13,214,108		13,214,108	167,632	[1] 1.3		.5

[1] Crude and refined not separated.

BYPRODUCT COKE OVENS OWNED BY CITY GAS COMPANIES, INCLUDED BY BUREAU OF THE CENSUS IN MANUFACTURED-GAS INDUSTRY

Reference has been made to the byproduct-coke plants installed by city gas companies, which the Bureau of the Census classifies as a part of the manufactured-gas industry and which the Bureau of Mines includes with the byproduct-coke industry. The difference in classification is maintained by the two offices advisedly in the interest of those who can use the statistics. For some purposes the

Census grouping is more useful while for others the grouping used by the Bureau of Mines is the more significant, particularly design of ovens, technique of manufacture, and supply and demand for coal and coke.

To compare or combine the two sets of figures allowance must be made for the difference in classification, which can be done by means of the data in table 51 prepared for the purpose by the Bureau of Mines. The table shows, in parallel colums, separate figures for the byproduct-coke plants operated by city gas companies (grouped by the Bureau of the Census with the manufactured-gas industry) and for all other byproduct-coke plants. Thus, in 1935 there were 21 active plants in the group owned by city gas companies; they produced 3,260,936 tons of coke, 55,147,494 M cubic feet of gas, 47,007,153 gallons of tar, and 3,832,952 gallons of crude light oil. By subtracting their production from the Census figures for the manufactured-gas industry, anyone interested may arrive at the quantities of the several products produced by gas works proper—that is, coal, oil, and water-gas plants.

The table also shows the operations of the 60 plants not owned by city gas companies which were active in 1935. These plants are covered by the Census classification of "Coke, not including gas-house coke, make in byproduct ovens." The figures are compiled by the Bureau of Mines from the reports of the coke producers and are accepted by the Bureau of the Census as an official record of production in the years covered by the Census of Manufactures.

The totals for both groups of plants given in the last column of the table are for the byproduct-coke industry as defined by the Bureau of Mines and given in the other tables of this report.

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, 1934 and 1935*

Product	1934			1935		
	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities) [1]	Total	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities) [1]	Total
Number of active plants	60	23	83	60	21	81
Coke:						
Production ... net tons	27,423,082	3,369,729	30,792,811	30,963,117	3,260,936	34,224,053
Value	$133,771,616	$21,773,914	$155,545,530	$152,741,222	$20,530,103	$173,271,325
Average value	$4.88	$6.46	$5.05	$4.93	$6.30	$5.06
Screenings or breeze:						
Production ... net tons	2,339,410	391,231	2,730,641	2,523,642	339,435	2,863,077
Sales ... do	627,554	48,413	675,967	660,593	32,756	693,349
Value	$1,315,482	$126,088	$1,441,570	$1,372,941	$80,911	$1,453,852
Average value	$2.10	$2.60	$2.13	$2.08	$2.47	$2.10
Coal charged into ovens:						
Quantity ... net tons	39,326,195	5,016,803	44,342,998	44,242,998	4,802,621	49,045,619
Coke:						
Used by producer:						
Quantity ... net tons	14,658,519	654,616	15,313,135	19,464,976	648,023	20,112,999
Value	$63,116,155	$4,157,406	$67,273,561	$87,373,745	$4,002,988	$91,376,733
Sales:						
Quantity ... net tons	12,299,170	2,546,095	14,845,265	12,029,368	2,700,125	14,729,493
Value	$68,175,065	$16,511,220	$84,686,285	$67,073,154	$17,115,784	$84,188,938

[1] Includes all byproduct ovens built by city gas companies, some of which are operated in conjunction with coal-, oil-, and water-gas plants. Does not include independent byproduct plants, which may sell gas to public utility companies for distribution.

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, 1934 and 1935* —Continued

Product	1934			1935		
	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:						
Gas:						
Production..M cubic feet..	434, 353, 117	59, 228, 634	493, 581, 751	488, 248, 594	55, 147, 494	543, 396. 088
Sales of surplus:						
Used under boilers:						
Quantity.M cubic feet..	29, 204, 285	119, 721	29, 324, 006	19, 669, 508	119, 396	19, 788, 904
Value	$2, 859, 151	$14, 422	$2, 873, 573	$1, 263, 963	$36, 408	$1, 300, 371
Used in steel or affiliated plants:						
Quantity.M cubic feet..	119, 696, 884	19, 575	119, 716, 459	160, 794, 550	17, 330	160, 811, 880
Value	$10, 990, 948	$10, 916	$11, 001, 864	$15, 213, 628	$9, 241	$15, 222, 869
Distributed through city mains:						
Quantity.M cubic feet..	93, 633, 872	50, 674, 277	144, 308, 149	102, 275, 282	48, 980, 441	151, 255, 723
Value	$24, 748, 296	$18, 177, 279	$42, 925, 575	$26, 284, 784	$18, 225, 920	$44, 510, 704
Sold for industrial use:						
Quantity.M cubic feet..	14, 663, 870	1, 558, 873	16, 222, 743	12, 374, 850	1, 284, 900	13, 659, 750
Value	$1, 995, 422	$462, 405	$2, 457, 827	$1, 287, 057	$394, 047	$1, 681, 104
Tar:						
Production..........gallons..	358, 920, 303	49, 790, 011	408, 710, 314	403, 300, 674	47, 007, 153	450, 307, 827
Sales:						
Quantity..........do....	221, 109, 325	52, 654, 414	273, 763, 739	262, 884, 814	45; 821, 105	308, 705, 919
Value	$8, 732, 619	$2, 027, 506	$10, 760, 125	$10, 755, 920	$1, 841, 785	$12, 597, 705
Average value	$0. 039	$0. 039	$0. 039	$0. 041	$0. 040	$0. 041
Ammonia:						
Production (NH_3 equivalent of all forms).pounds..	217, 214, 759	22, 740, 389	239, 955, 148	249, 206, 321	23, 449, 563	272, 655, 884
Liquor (NH_3 content):						
Production.....pounds..	39, 789, 057	3, 804, 920	43, 593, 977	37, 445, 171	4, 332, 404	41, 777, 575
Sales..........do....	37, 919, 092	3, 815, 560	41, 734, 652	38, 850, 459	4, 247, 444	43; 097, 903
Value	$1, 152, 577	$77, 772	$1, 230, 349	$1, 162, 831	$90, 350	$1, 253, 181
Sulphate:						
Production.....pounds..	709, 702, 808	75, 741, 876	785, 444, 684	847, 044, 599	76, 468, 636	923, 513, 235
Sales..........do....	708, 546, 445	68, 569, 346	777, 115, 791	895, 493, 472	89, 817, 359	985, 310, 831
Value	$6, 825, 251	$675, 909	$7, 501, 160	$8, 516, 782	$833, 151	$9, 349, 933
Crude light oil:						
Production..........gallons..	111, 588, 238	4, 106, 510	115, 694, 748	129, 863, 851	3, 832, 952	133, 696, 803
Sales..........do....	8, 546, 301	3, 102, 425	11, 648, 726	9, 223, 127	2, 852, 903	12, 076, 030
Value	$710, 361	$267, 899	$978, 260	$778, 875	$238, 453	$1, 017, 328
Light-oil derivatives:						
Production......gallons..	93, 771, 926	798, 213	94, 570, 139	106, 790, 440	749, 975	107, 540, 415
Sales..........do....	86, 394, 090	799, 728	87, 193, 818	103, 280, 930	774, 731	104, 055, 661
Value	$12, 098, 304	$140, 965	$12, 239, 269	$13, 577, 040	$116, 809	$13, 693, 849
Naphthalene, crude and refined:						
Production.....pounds..	10, 735, 287	8, 184	10, 743, 471	12, 933, 257	4, 020	12, 937, 277
Sales..........do....	10, 492, 101	8, 184	10, 500, 285	13, 210, 088	4, 020	13, 214, 108
Value	$131, 176	$123	$131, 299	$167, 572	$60	$167, 632
All other products, value	$757, 072	$9, 455	$766, 527	$1, 041, 004	$74, 348	$1, 115, 352

RECENT DEVELOPMENTS IN COAL PREPARATION AND UTILIZATION

By A. C. Fieldner

SUMMARY OUTLINE

The first annual review of this series (Minerals Yearbook 1932–33, pp. 433–445) presents the background for the new developments discussed in the subsequent years. Readers unfamiliar with the subject will find it helpful to read this initial review and those following in the 1934 and 1935 Yearbooks.

COMPOSITION, PROPERTIES, AND TESTING

The new American system for classification of coals according to rank has been applied by the Bureau of Mines to 316 typical coals ranging from lignite to anthracite,[1] and by the Illinois State Geological Survey to Illinois coals.[2] British and European petrologists [3] at the Second International Conference for the Study of the Stratigraphy of the Carboniferous Rocks at Heerlen, Netherlands, September 9–12, 1935, accepted with some simplification and modification the principles of the Stopes nomenclature [4] of coal petrography. The most important modification was to apply the term "vitrain" to the glossy, black unstriated bands of coal regardless of whether they do or do not show plant structure under the microscope. In recent books, Stach of the German Geological Survey reviews the nomenclature, methods, and application of studies in the microstructure of coal,[5]

[1] Fieldner, A. C., Selvig, W. A., and Frederick, W. H., Classification Chart of Typical Coals of the United States (Showing B. t. u. per Pound on the Moist, Mineral-Matter-Free Basis, Plotted Against Fixed Carbon on the Dry, Mineral-Matter-Free Basis): Rept. of Investigations 3296, Bureau of Mines, 1935, 22 pp.
[2] Cady, G. H., Classification and Selection of Illinois Coals: Illinois State Geol. Survey Bull. 62, 1935, 354 pp.
[3] Jongmans, W. J., Koopmans, R. G., and Roos, G., Nomenclature of Coal Petrography: Fuel, vol. 15, 1935, pp. 14–15.
[4] Stopes, Marie C., On the Petrology of Banded Bituminous Coal: Fuel, vol. 14, 1935, pp. 4–13.
[5] Stach, E., Textbook of Coal Petrography (in German): Begr. Bernträger, Berlin, 1935, 293 pp.

and Kreulen of the Netherlands discusses the constitution and chemical characteristics of coal.[6]

In continuation of the Bureau of Mines survey of the gas-, coke-, and byproduct-making properties of American coals, chemical and microscopical studies have been made of the various layers of different types of coal that compose the columnar section of the coal bed. Examination of such columns from the Green River bed in Kentucky, Upper Freeport bed in Pennsylvania, Pratt bed in Alabama, and the Pittsburgh and Sewell beds in West Virginia showed in some instances wide variation in composition and properties.[7] Similar studies [8] of prepared sizes of coals from 12 Saar mines showed a concentration of the vitrain, due to its greater friability, in the smaller sizes of coal; on coking, the durains yielded more volatile matter and tar and a coke of lower tumbler index than the vitrains.

The British Coal Survey Laboratory at Leeds has successfully correlated several coal beds over wide areas by a study of the distribution of the bright and dull coal bands and has developed a method of very fine grinding and elutriation whereby substantially pure spore exines and certain other plant remains can be separated from the durain bands of coal, thus affording another means of correlating coal beds.[9]

Petrographic examination of mineral matter separated by float-and-sink methods from finely crushed samples of the Illinois No. 6 bed showed that more than 95 percent of the separable mineral matter consisted of kaolinite, pyrite, and calcite. The distribution of these minerals varied in different layers of the bed.[10] Two informative papers [11] give data on the occurrence and properties of the resins in coal; the distribution of resins in some coals is shown by a bluish fluorescence when exposed to ultraviolet light.

The Chemical Research Laboratory of the British Department of Scientific and Industrial Research found 1 percent of germanium and 0.5 percent of gallium in a sample of flue dust from a gas works. These substances were concentrated in the flue dust and had their origin in the coal burned under the retorts.[12]

Chemical constitution.—The Coal Research Laboratory of the Carnegie Institute of Technology has studied the action of nitric acid,[12a] bromine,[13] and benzene [14] on a Pittsburgh bed coal; the equivalent and molecular weights of humic acids [15] prepared by the oxidation of bituminous coal ranged from 200 to 300, but these are thought

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6 Kreulen, D. J. W., Outline of the Chemistry and Classification of Coals (in German): D. B. Centins Uitgevers Maatschappi N. V. Amsterdam, 1935, 179 pp.

7 Thiessen, R., and Sprunk, G. C., Microscopic and Petrographic Studies of Certain American Coals: Tech. Paper 564, Bureau of Mines, 1935, 71 pp.

8 Hoffman, H., and Kühlwein, F., Constitution and Coking Properties of Saar Coals: Glückauf, vol. 71, 1934, pp. 625–639, 657–665.

9 Wandless, A. M., and Macrae, J. C., The Correlation of the Wheatley Lime and the Middleton Eleven Yards Seams in the West Yorkshire Coal Field: Trans. Inst. Min. Eng., vol. 89, part 2, 1935, pp. 72–92. Macrae, J. C., and Wandless, A. M., The Separation of Plant Remains from Durain by Mechanical Means: Jour. Soc. Chem. Ind., vol. 55, 1936, pp. 15–19T.

10 Ball, C. G., Contributions to the Study of Coal; Mineral Matter of No. 6 Bed Coal at West Frankfort, Franklin County, Ill.: Illinois Geol. Survey Rept. of Investigations 33, 1935, 106 pp.

11 Winter, H., The Resins of Coals: Ztschr. angew. Chem., vol. 48, 1935, pp. 610–614. Steinbrecher, H., The Fossil Resins of Brown Coal: Ztschr. angew. Chem., vol. 48, 1935, pp. 608–610.

12 Gas World, A New Byproduct?: Vol. 103, 1935, p. 509.

12a Juettner, B., Smith, R. C., and Howard, H. C., The Action of Nitric Acid on a Bituminous Coal: Jour. Am. Chem. Soc., vol. 57, 1935, p. 2322.

13 Weiler, J. F., The Reaction of Bromine with a Coking Coal, including a Study of Its Unsaturation.: Fuel, vol. 14, 1935, pp. 190–196.

14 Asbury, R. S., Action of Solvents on Coal; Extraction of Edenborn Coal by Benzene at Elevated Temperatures: Ind. and Eng. Chem., vol. 26, 1934, pp. 1301–1306.

15 Smith, R. C., and Howard, H. C., Equivalent and Molecular Weights of Humic Acids from a Bituminous Coal: Jour. Am. Chem. Soc., vol. 57, 1935, pp. 512–516.

to be low values due to probable breakdown of the humic acid molecules into smaller units after solution in catechol.

Humic acid isolated from Ontario lignite by extraction with alkali had properties similar to those of the so-called humic acid prepared from sucrose by the action of sulphuric acid.[16] Arnold, Lowy, and Thiessen[17] investigated the colloidal characteristics and the chemical nature of the humic acids extracted from peat with 1 percent sodium acetate solution and precipitated with hydrochloric acid. Simek and Ludmila[18] devised a diaphragm cell for the electrochemical extraction of humic acids from brown coal and traced irregularities in the vapor tension-temperature curve when drying brown coals under isobaric conditions to the presence of ferric and aluminum-humic acid complexes; Terres and Rost[19] also found that the ash substance of brown coal contained the salts of inorganic bases with humic acids, whereas bituminous coal contained negligible amounts of organically fixed ash.

Bone[20] and associates, on the basis of benzene pressure extractions and alkaline permanganate oxidation applied to various ranks of coal from peat to anthracite from various countries, confirm their previous conclusions that in great part coal substance has an essentially benzenoid structure. In general, the susceptibility to alkaline potassium permanganate oxidation diminished with increased maturity or rank of the coal. They suggest that this reaction may afford information as to the relative amenabilities of different coals to pressure hydrogenation.

The Bureau of Chemistry and Soils,[21] Washington, D. C., has shown that the water-soluble products from the ammoniation of peat contain urea and other amides. By the simultaneous synthesis of urea and the ammoniation of peat, intimate mixtures of these materials containing up to 60 percent urea were found to be without the disadvantages due to the hygroscopicity inherent in pure urea and suggest the use of ammoniated peat as a carrier for urea in fertilizers.

Plasticity and coking properties.—No basically new methods for the study of the plasticity of coal during coking have been proposed. Methods previously used—that is, those involving (*a*) the dilatometer[22] or penetrometer[23] principle, (*b*) change in resistance to flow of an inert gas,[23] (*c*) torsion,[24] and (*d*) extrusion—have been studied and applied. Undoubtedly some improvement has been made in the measurements themselves, and it may be conceded that the

16 Plunguian, M., and Hibbert, H., Studies on Lignin and Related Compounds. XI. The Nature of Lignite Humic Acid and of the So-Called "Humic Acid" from Sucrose: Jour. Am. Chem. Soc., vol. 57, 1935, pp. 528–535.

17 Arnold, C. L., Lowy, A., and Thiessen, R., The Isolation and Study of the Humic Acids from Peat: Fuel, vol. 14, 1935, pp. 107–111; Rep. of Investigations 3258, Bureau of Mines, 1934, 9 pp.

18 Simek, B. G., and Ludmila, J., The Combination of Water in Humates Prepared from Brown Coal: Chem. Listy., vol. 29, 1935, pp. 145–148, 169–172; Chem. Abs., vol. 29, 1935, p. 7614.

19 Terres, E., and Rost, A., Inorganic Compounds in Coal Ash and True Ash Content of Coal: Gas u. Wasserfach, vol. 78, 1935, pp. 129–135.

20 Bone, W. A., Parsons, L. G. B., Sapiro, R. H., and Groocock, C. M., Researches on the Chemistry of Coal. VIII. The Development of Benzenoid Constitution in the Lignite-Peat-Coal Series: Proc. Roy. Soc. (London), vol. A 148, 1935, pp. 492–522. Bone, Wm. A., and Tei, Louis J., Researches on the Chemistry of Coal. VII. An Investigation of German Brown Coals and Irish Peat: Proc. Roy. Soc. (London), vol. A 147, 1934, pp. 58–67.

21 Pinck, L. A., Howard, L. B., and Hilbert, G. E., Nitrogenous Composition of Ammoniated Peat and Related Products: Ind. and Eng. Chem., vol. 27, 1935, pp. 440–445. Howard, L. B., Pinck, L. A., and Hilbert, G. E., Ammoniated Peat. Mechanism of Formation of Water-Soluble Nitrogenous Constituents: Ind. and Eng. Chem., vol. 27, 1935, pp. 1508–1509. Davis, R. O. E., Scholl, W., and Miller, R. R., A High-Nitrogen Material from Urea-Ammoniated Peat: Ind. and Eng. Chem., vol. 27, 1935, pp. 69–71.

22 Cassan, H., Note on the Swelling of Gas and Coking Coals: Chaleur et industrie, vol. 16, 1935, pp. 495–508.

23 Kaatz, L., and Richter, H. E., A Critical Study of Laboratory Methods for Coal Evaluation and Suggestions for Further Developments: Gas u. Wasserfach, vol. 78, 1935, pp. 221–229.

24 Jung, G., Influence of Weathering on the Plasticity of Coals: Glückauf, vol. 71, 1935, pp. 1141–1148.

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results have contributed somewhat to a better understanding of the mechanism of coking.[25] [26] However, they cannot be used without other information in predicting the practical coking properties of coals.

Lum and Curtis [27] used a "standardized" gas-flow test and found the temperatures of initial softening and maximum resistance to be fairly reproducible; the magnitude of the pressures developed, however, varied in check runs. Bunte, Brückner, and Sandjana[28] determined plastic characteristics, weight loss, and volume of distillation gases in a single apparatus, so that for all properties measured the same heat treatment was insured. They believe that reaction heats while the coal is in the plastic stage influence the degree of plasticity of the coal.

In the extrusion method of testing plastic coal, it has been found [27] [29] that the weight percentages and rates of extrusion ("extrusivity") of molten coal through sized orifices under controlled conditions of temperature and pressure varied greatly with such factors as piston load and degrees of fluidity of the coal. Difficulty in measuring the temperature of the coal at the moment of extrusion complicated correlations of data with other recorded observations.

Warren found that the rate of heating through the preplastic range greatly affects the yields of carbonization products and gas composition, while the rate through the plastic range governs the quality of coke.[30] It must be recognized that heat treatment in the preplastic period is of some importance, for Thiessen and Sprunk [31] have observed changes in the microstructure of specimens of coal wherein the maximum temperatures to which the specimens were heated were much below that of softening.

Russian investigators [32] find that the degree of permeability of the plastic layer to distillation gases depends upon the direction of gas flow and the state of oxidation of the coal and that this permeability is governed by the viscosity and surface tension of the fused mass at the limits of the plastic zone. Measurements of gas pressure within the plastic zone correlated with gas evolution data confirm the view that pressure in the plastic layer is a function of gas production. Kreulin's [33] work on coal bitumen indicates that coking properties are not due primarily to the quantity and nature of the bitumen present but rather to the adsorption relationships between bitumens

[25] Massinon, Jean, A study of Semicokefaction of coal and Its Microscopic Constituents. I. A Theoretical Study of the Processes of Semicokefaction: Bull. Soc. Belge Ind., 1934, 889–924; II. The Influence of the Oxidation of Coal on the Mechanism of Its Semicokefaction: Bull. Soc. Belge Ind., 1934, 989–1016. Mertens, Eng., and Massinon, J., Introduction to the Study of the Mechanism of Coking: 14th Cong. Chem. Ind., Paris, October 1934, vol. 1, sec. 3, 9 pp.

[26] Van Ahlen, A., Influence of the Material Composition of Coals on Their Fusion Characteristics: Glückauf, vol. 71, 1935, pp. 68–70.

[27] Lum, J. H., and Curtis, H. A., Coal Carbonization—The Plastic Stage: Ind. and Eng. Chem., Anal. Ed., vol. 7, 1935, pp. 327–333.

[28] Bunte, K., Brückner, H., and Sandjana, Jal., Indian Bituminous Coals with Particular Reference to Their Coking Behavior: Brenstoff-Chem., vol. 16, 1935, pp. 50–52; Fuel, vol. 14, 1935, pp. 350–364.

[29] Porter, Horace C., Softening of Coal by Heat—Is It a Distinctive and Measurable Characteristic?: Ind. and Eng. Chem., vol. 27, 1935, pp. 962–966.

[30] Warren, Wm. B., Carbonization of Coal. Effects of Variation of Rate of Heating During the Carbonization of a Typical Coking Coal: Ind. and Eng. Chem., vol. 27, 1935, pp. 1350–1354.

[31] Thiessen, R., and Sprunk, G. C., The Effect of Heat on Coal as Revealed by the Microscope: Fuel, vol. 13, 1934, pp. 116–125.

[32] Bakun, N. A., Liberation of Gas During Coking: Coke and Chem. (U. S. S. R.), vol. 4, no. 5–6, 1934, pp. 112–117. Dubner, E. M., Measurements of the Pressure in the Plastic Zone: Coke and Chem. (U. S. S. R.), vol. 3, no. 8, 1933, pp. 6–10.

[33] Kreulin, D. J. W., Composition and Properties of Extracts from Bituminous Coal: Brennstoff-Chem., vol. 16, 1935, pp. 165–169.

and ulmins, which in turn are determined by the degree of coalification of the ulmins.

Altieri's [34] method for predicting the "pushing behavior" of coals when carbonized in coke ovens has been tried at several byproduct coke plants. The consensus of opinion of users appears to be that while the test method is still imperfect, it is the most practical method heretofore proposed.

Physical properties.—The measurement of capillarity of pulverized coal, at the coal-preparation laboratory of the Gutehoffnungshütte, indicates that this property is a constant for a given coal seam, although it varies greatly in beds of different rank; Nashan believes that capillarity studies may be of value in the classification of coal and in problems connected with drying and washing coal. [35] Needham and Hill [36] have developed a formula for calculating the surface area of closely sized fractions of coal particles and give data to support the formula from a study of several coals.

Sampling.—Considerable work on the sampling of coal [37] and coke [38] has been carried out during the year with particular interest in the determination of sample size [39] and in the use of mechanical [40] sampling methods. Morrow and Proctor [41] have published a statistical presentation of the results of sampling some 7,000 cars of coal of various sizes to obtain fundamental data regarding variables connected with coal sampling. They point out the need for a standard on the mechanical crushing and reduction of samples that considers the size-weight ratio and other factors and also advocate the establishment of tolerances in order to properly interpret analytical results.

Testing methods.—Kirner [42] has studied the difficulties involved in the application of Pregl's micromethods to the analysis of solid fuels and has applied certain modifications for the determination of carbon, hydrogen, and oxygen [43] in coal and coal products. Methods

[34] Altieri, V. J., Coal Expansion: Gas-Age Record, vol. 76, 1935, pp. 49–54; Measurement of the Expansion of Coal during Carbonization: Proc. Am. Gas Assoc., 1935, pp. 812–834; Am. Gas. Jour., vol. 143, 1935, p. 43.

[35] Nashan, P., Capillarity of Coal: Glückauf, vol. 71, 1935, pp. 805–812; Iron and Coal Trades Review, vol. 131, 1935, p. 322.

[36] Needham, L. W., and Hill, N. W., The Shape and Specific Surface of Coal Particles: Fuel, vol. 14, 1935, pp. 222–230.

[37] British Standards Institution, Draft of British Standards Methods for Sampling and Analysis of Coal and Coke: Coll. Guard., vol. 151, 1935, pp. 766–768, 805–807, 853–856. Gas und Wasserfach, Instructions for Sampling of Coal at Gasworks; German Standard DIN-DVM3711: Vol. 78, 1935, p. 304.

[38] American Society for Testing Materials, Standard Method of Sampling Coke for Analysis: 1935 Supplement to Book of A. S. T. M. Standards, pp. 197–201 (issued September 1935).

[39] Kassel, L. S., and Guy, T. W., Determining the Correct Weight of Sample in Coal Sampling: Ind. and Eng. Chem., Anal. Ed., vol. 7, 1935, pp. 112–115. Holmes, M. C., Sampling Analysis and Sample Size: Jour. Franklin Inst., vol. 219, 1935, pp. 483–486. Manning, A. B., The Application of the Theory of Sampling to Coal Sampling: Jour. Inst. Fuel, vol. 9, 1935, pp. 132–136.

[40] Lewien, E., Mechanical Sampling in Coal Washeries: Glückauf, vol. 71, 1935, pp. 279–283. Rzezacz, P., Sampling and Sampling Machines: Glückauf, vol. 71, 1935, pp. 701–709. Thorson, A. W., Coal-Sampling Methods of the Detroit Edison Co.: Combustion, vol. 7, October 1935, pp. 10–14. Steam Engineering, The Reduction of Coal Samples for Analysis: Vol. 4, 1935, pp. 152–156, 162. Iron Coal Trade, The Gröppel Automatic Sampler: Vol. 131, 1935, p. 765.

[41] Morrow, J. B., and Proctor, C. P., Variables in Coal Sampling: Am. Inst. Min. and Met. Eng. Tech. Pub. 645, 1935, 45 pp.; Coll. Guard., vol. 151, 1935, pp. 571–575, 620–622, 665–666.

[42] Kirner, W. R., Microchemical Analysis of Solid Fuels: Ind. and Eng. Chem., Anal. Ed., vol. 7, 1935, pp. 294–299. Direct Simultaneous Microdetermination of Carbon, Hydrogen, and Oxygen. IV. Analysis of Bituminous Coals and Derived Products: Ind. and Eng. Chem., Anal. Ed., vol. 8, 1936, pp. 57–61.

[43] Crossley, H. E., Determination of Nitrogen in Coal by the Kjeldahl Method Using Selenium as Catalyst: Jour. Soc. Chem. Ind., vol. 54, 1935, pp. 367–369 T. Täufel, K., Thaler, H., and Starke, K. Determination of Nitrogen and Phosphorus in the Kjeldahl Reaction with Selenium as Catalyst: Ztschr. angew. Chem., vol. 48, 1935, pp. 191–192. Hall, P., Note on the Determination of Nitrogen in Coal: Jour. Chem. Met. and Min. Soc. So. Africa, vol. 36, 1935, pp. 28–31. Illarionov, V. V., and Sgolowewa, N. A. Mechanism of the Catalytic Effects of Selenium and Tellurium in the Sulphuric Acid Digestion of Organic Material Prior to the Kjeldahl Determination of Nitrogen: Ztschr. anal. Chem., vol. 100, 1935, pp. 328–343.

for the determination of nitrogen, arsenic,[44] moisture,[45] and screen[46] analysis of coal have been published.

Studies on the relationship between coal-ash composition[47] and its fusion properties, the application[48] of ash-softening temperature data and the general properties of coal ash slags[49] have been continued. A furnace[50] designed for the specific purpose of determining coal-ash softening temperatures has been developed and installed in a number of laboratories; and a cooperative investigation, initiated by the American Society for Testing Materials, is in progress to compare the results from this furnace with those obtained by the standard gas furnace method.

Definite progress has been made in the development of laboratory methods for estimating the friability of coal[51] and its grindability[52] in connection with the use of powdered coal as fuel. Committee D-5 on Coal and Coke of the American Society for Testing Materials conducted cooperative[53] tests on four methods to compare their relative merits and adopted a ball-mill method (Bureau of Mines) and the Hardgrove-machine method as tentative methods of test for the grindability[54] of coal.

PREPARATION

Substantial gains over previous years in the use of mechanical equipment for face and surface preparation of coal were registered in 1935. Coal-cutting machinery was more generally used for removing impurity bands, but the introduction of mechanized loading into coal fields that formerly employed hand methods and the increase in stripping operations resulted in a greater need for cleaning plants on the surface. New preparation facilities were installed at 90 plants or mines; about one-half of these included some type of mechani-

[44] Hertzog, E. S., Determination of Arsenic in Coal: Ind. and Eng. Chem., Anal. Ed., vol. 7, 1935, pp. 163-165.

[45] van Steenbergen, B., A New Method for Determination of Moisture in Coal by means of the Dielectric Constant: Het. Gas., vol. 55, 1935, pp. 137-139; Chem. Abs., vol. 29, 1935, p. 7044. Büll, R., Physico-Chemical Methods; The Dielectric Constant: Oel u. Kohle, vol. 11, 1935, pp. 499-503. Dummet, G. A., Moisture in Coal: Bull. Coke Oven Managers Assoc., January 1935; Coll. Guard., vol. 151, 1935, p. 299.

[46] American Society for Testing Materials, Tentative Method of Test for Screen Analysis of Coal: Proc. Am. Soc. Test. Mat., part I, vol. 35, 1935, pp. 863-866.

[47] Moody, A. H., and Langan, D. D., Fusion Temperatures of Coal Ash as Related to Composition: Combustion, vol. 6, no. 8, February 1935, pp. 13-20.

[48] Tweedy, S., The Fusibility of Coal and Coke Ash: Gas World, vol. 103, Cok. Sec., 1935, pp. 99-104. Foxwell, G. E., The Fusion Point of Coke Ash: Coal Carbonization, vol. 1, 1935, pp. 114-116.

[49] Endell, K., and Wens, C., The Temperature-Viscosity Relationships of Coal-Ash Slags. I. Methods of Investigation and Results. Rosin, P., and Fehling, R. II. Conclusions Applying to Methods of Firing in Furnaces: Beiheft Z. Ver deut. Chem., no. 12; Ztschr. angew. Chem., vol. 48, 1935, pp. 76-79; Chem. Abs., vol. 29, 1935, p. 2335. Reid, W. T., Control of Forms of Iron in the Determination of Fusion Temperatures of Coal Ash: Ind. and Eng. Chem., Anal. Ed., vol. 7, 1935, pp. 335-338. Jones, D. J., and Buller, E. L., Analyses and Softening Temperatures of Coal Ash from Coals in the Northern Anthracite Field: Ind. and Eng. Chem., Anal. Ed., vol. 8, 1936, pp. 25-27.

[50] Barrett, E. P., A Furnace for the Measurement of Coal-Ash Softening Temperature: Proc. Am. Soc. Test. Mat., part II, vol. 35, 1935, pp. 627-636. Sloman, H. J., and Barnhart, A. C., The Relative Grindability of Coal: Min. and Met. Ind., Carnegie Inst. Technol., and Min. and Met. Adv. Board Coop. Bull. 72, 1935, 19 pp.

[51] Gilmore, R. E., Nicholls, J. H. H., and Connell, G. P., Coal Friability Tests. A Comparative Study of Methods for Determining the Friability of Coal and Suggestions for Tumbler and Drop Shatter-Test Methods: Canada Dept. Mines, Mines Branch Rept. 762, 1935, 102 pp.

[52] Heywood, H., The Resistance to Grinding of Coals: Coll. Guard. vol. 151, 1935, pp. 898-900, 941-944; Jour. Inst. Fuel, vol. 9, 1935, pp. 94-105. Yancey, H. F., and Geer, M. R., Further Investigation of Methods for Estimating the Grindability of Coal: Am. Inst. Min. and Met. Eng., Coal Div., Contrib. 94, 1936, 17 pp. Black, C. G., Investigation of Procedure for Determination of Coal Grindability by the Ball-Mill Method: Am. Inst. Min. and Met. Eng., Coal Div., Contrib. 95, 1936, 23 pp.

[53] Selvig, W. A., Check Determinations of Coal Grindability by Various Methods: Rept. of Investigations (in press), Bureau of Mines.

[54] American Society for Testing Materials, Tentative Methods of Test for Grindability of Coal by the Ball-Mill Method and the Hardgrove-Machine Method: Proc. Am. Soc. Test. Mat., part I, vol. 35, 1935, pp. 854-862.

cal cleaning equipment.[55] Illinois, Indiana, and southern West Virginia led in the number of cleaning plants installed, but other units were placed in operation in Pennsylvania, Kansas, Kentucky, Ohio, Tennessee, and Washington. The chloride washer, installed at two mines in West Virginia, represents the first use in the United States of a true, high-gravity solution (calcium chloride dissolved in water) for the cleaning of coal. This method [56] has been applied in France to the production of unusually pure coal (less than 1 percent ash) for special purposes, such as coke for automotive gas producers, coal-dust motors, hydrogenation, and graphitized coke electrodes. Virtually every type of coal-cleaning device was represented in the new plants, including launders, the newly developed pulsator jigs (modeled after the Richards) for cleaning sized coal, diaphragm jigs, air-pulsation jigs, air-sand cleaners, and pneumatic tables.

Foreign developments in coal preparation have been reviewed by Davies,[57] Schmitz,[58] and Götte.[59]

Dewatering and drying.—The additional equipment installed during the year for dewatering and drying coal consisted principally of horizontal vibrating screens equipped with wedge wire, although centrifugal and heat driers were placed in operation at a few plants. A new type of heat drier, the flash drier, suitable for reducing the moisture content of fine sludge or filter cake from 24 to 4 percent, made its appearance.[60] The Pittsburgh Coal Co.[61] has made detailed studies of the performance of centrifugal driers. Changes in the size-composition and the ash and sulphur contents of the feed and products were recorded. The breakage of the coarser sizes of coal in the feed during passage through the drier was very largely eliminated by screening out the ¼-inch to ⅜-inch material and bypassing it. Operation and maintenance costs ranged from 1.9 to 2.6 cents per ton of discharged product. An excellent review of methods, costs, and advantages of dried coal has been published by The Institute of Mining Engineers.[62]

A rapid method for estimating the surface moisture content of wet coal,[63] suitable for washery control, was brought out by G. A. Dummett. A standard sulphuric acid solution is mixed with a sample of wet coal and the dilution determined after filtration by titration with standard sodium hydroxide solution. The preliminary report of an investigation initiated in Germany indicated a fundamental relationship between the drying and dewatering of various coals and their capillarity.[64] Capillarity values appear to be definite character-

55 Coal Age, Preparation Activities Leave Mark on Equipment and Methods in 1935: Vol. 41, 1936, pp. 66–70. Market Handicap Lifted by Adoption of Wet Preparation for 3 x 0-in. Coal at Fidelity No. 11 Strip Mine: Vol. 40, 1935, pp. 197–200. Stripping and Preparation at New Delta Coal Mining Co. Property Reflect Experience at Other Sinclair Plants: Vol. 40, 1935, pp. 188–190. Preparing Thick Freeport for Meticulous Market at Union Collieries Operation: Vol. 40, 1935, pp. 10–12, 15.

56 Bertrand, Maurice G., Manufacture and Uses of Pure Coal: 14th Cong. Chem. Ind., Paris, October 1934, 16 pp. Pure Coal and Its Applications: Jour. Inst. Fuel, vol. 8, 1935, pp. 328–342; Coll. Guard., vol. 150, 1935, pp. 803–805, 845–848.

57 Davies, D. T., Coal Preparation: Gas World, vol. 102, no. 2649, Annual Coal Suppl., 1935, pp. 13–15.

58 Schmitz, H., Coal and Washery Investigations as Related to Coal Cleaning and Marketing Problems: Glückauf, vol. 71, 1935, pp. 845–856, 881–885, 904–913, 925–938.

59 Götte, A., New Developments in Coal Preparation in 1933 and 1934: Glückauf, vol. 71, 1935, pp. 582–590.

60 Hebley, H. F., Modernization of Coal-Preparation Plants Continues Without Striking Innovations: Min. and Met., vol. 17, 1936, pp. 36–37.

61 Barley, S. B., and Parmley, S. M., Dewatering Coal Receives Greater Stress in Preparation with Rise of Wet Washing: Coal Age, vol. 40, 1935, pp. 407–410.

62 Utilization of Coal Committee, The Drying of Washed Coal: Inst. Ming. Eng., Memo 18, November 1935, 6 pp.

63 Dummett, G. A., Moisture in Coal: Coll. Guard., vol. 151, 1935, p. 299. Büll, R., Physicochemical Methods in the Oil Industry—the Dielectric Constant: Oel u. Kohle, vol. 11, 1935, pp. 499–503.

64 Nashan, P., Coal and Capillarity: Glückauf, vol. 71, 1935, pp. 805–812; Iron and Coal Trades Rev., vol. 131, 1935, pp. 322, 324.

istics of particular coal beds and are also related to the rank of the coal in question.

Dedusting.—Additional equipment was installed at cleaning plants in Pennsylvania and Illinois for dedusting fine sizes of coal, both to increase its marketability and to minimize sludge-or dust- handling difficulties at wet or dry plants. Descriptions of the various types of dedusting and dust-collection equipment, test data, and estimated operating costs have been published.[65] A German investigation showed that when a vibrating screen with 1-mm square mesh is used at a throughput of 2 tons per square meter of screening surface per hour, increase of moisture content of the coal from 4 to 9 percent decreased the efficiency 90 to 10 percent.[66]

Flotation.—Froth flotation continued to be utilized on a small scale for cleaning coal sludge. The Pittsburgh Coal Co.[67] is cleaning 20 tons of fine material per hour from the thickener under flow with two six-cell machines. A description has been published, but no information on performance is given regarding the vacuum-flotation process installed last year to clean dust removed by aspiration.[68]

Flocculation and settlement of solids in washery water.—The use of lime for flocculation and settlement of solids in washing water has been continued at several plants in the United States. Additional auxiliary equipment for preparing and adding flocculating agents to washery water was put into operation at washeries abroad.[69] The various flocculating agents used abroad include sodium silicate, aluminum sulphate, casein, gelatin, glue, boiled starch, frozen starch, sodium hydroxide, potassium hydroxide, and potato flour. Some of these agents are effective flocculators in concentrations as low as 0.0002 percent.

At the Emlyn Anthracite Collieries in Wales [70] a patented process [71] and flocculating agent ("Unifloc") prepared from starch and a neutral metallic salt are in use, which under slightly alkaline conditions yield flocs of agglomerated solids about one-fourth inch in size; 0.4 pound of reagent is used per 1,000 gallons of slurry. In this condition the dewatering of the settled solid material by a drum filter is greatly facilitated. Experiments by the Fuel Research Board of England [72] showed that, in addition to more rapid settling, flocculation gives material that is more amenable to dewatering by filtration. Tests with a conical settling tank 8 feet in diameter, in conjunction with a

[65] Hebley, H. F., The Dedusting of Coal: Trans. Am. Inst. Min. and Met. Eng., vol. 108, 1934, pp. 88–122. Berrisford, S. R., and Allen, R. H., The Pneumatic Dedusting of Coal: Trans. Inst. Min. Eng. (London), vol. 89, part 6, 1935, pp. 298–334. Winspear, A. H., Holmes, C. W. H., Lindley, G., and Slade, A. N. H., The Dedusting of Coal: Yearbook Coke Oven Manager's Assoc., 1935, pp. 239–254.

[66] Prockat, F., and Rammler, E., Investigation of Operation of Vibrating Screens: Glückauf, vol. 71, 1935, pp. 725–36, 755–62.

[67] Crawford, J. T., Importance of Pulp Density, Particle Size, and Feed Regnlation in Flotation of Coal: Am. Inst. Min. and Met. Eng., Coal Div., Contrib. 86, 1935, 11 pp.

[68] Futers, T. Campbell, The "Birtley" Coal-Cleaning Plant at the Rising Sun Colliery of the Wallsend & Hebburn Coal Co., Ltd.: Coll. Guard., vol. 152, 1936, pp. 55–62.

[69] Holmes, C. W. H., The Clarification of Washery Water. II: Coll. Engineering (London), vol. 12, 1935, pp. 80–82, 133–136. Götte, A., Investigations on the Filtering of Coal Slurries and Flotation Concentrates: Glückauf, vol. 71, 1935, pp. 1097–1100. Paul, H., The Dewatering of Coal Slurries and Its Cost with Suction Filter Plant: Glückauf, vol. 71, 1935, pp. 1193–99. Minerals Separation, Ltd., and Williams, P. T., Coal Preparation: British Patent 421890, Dec. 27, 1934. Heckel, Ernst, Vohmann, F., and Trumplemann, E., Apparatus for Clarifying Coal Slurry and the Like: British Patent 345954, Oct. 2, 1935.

[70] Lewis, J. L., The Clarification of Washery Water and the Recovery of Coal Slurry: Coll. Guard., vol. 151, 1935, pp. 895–897.

[71] Samuel, J. O., and Emlyn Anthracite Colliery, Ltd., Improvements Relating to the Treatment of Waste Effluents, Such as Sewage or Coal-Washery Water: British Patent 435126.

[72] Davies, D. T., and Wilkins, E. T., The Flocculation of Slurries. The Continuous Clarification of a Coal-Washery Circuit with Glue: Fuel in Sci. and Practice, vol. 14, 1935, pp. 51–55. Wilkins, E. T., "Sensitization" and Other Observations on Slurry Flocculation (A Physicochemical Study): Jour. Soc. Chem. Ind., vol. 54, 1935, pp. 391–393T.

concentrating table and a classifier, showed that flocculation reduced the solid content of the circulating water from 7 percent when untreated to 1 percent when treated with glue after 24 hours of operation. The glue used amounted to 1.2 pounds per ton of solids in the circulating water.

Dust-prevention treatment.—The use of oil or calcium chloride for dustproofing coal has continued to increase. Domestic and even some industrial consumers prefer to pay the extra cost of this treatment.[73] Van Voorhis [74] considers that the use of petroleum for dustproofing coal has been very successful, but cautions that the oil used should be suited to the particular coal. Complaints are usually due to use of the wrong grade of oil, too much oil, or too poor distribution. He recommends 3 quarts of oil of Saybolt viscosity 100 to 225 seconds at 100° F. Heated and atomized oils are coming into considerable use. Downing [75] states that the use of calcium chloride proved corrosive; the average cost of dustproofing coke with calcium chloride during 3 years' use was about 5 cents per ton; with oil, which has been used 2 years, the cost has averaged about 3 cents per ton of coke treated. Jamieson states that calcium chloride treatment costs 6 to 12 cents per ton of coal, and oil treatment 4 to 10 cents.[76] Doherty[77] reported that the treatment of 394,000 tons of low-volatile coal with calcium chloride solution of 1.21 specific gravity required an average of 3.4 gallons per ton. The treatment increased the ash-fusion temperatures of coals normally fusing below 2,400° F., but the opposite effect was produced upon coal fusing about this point. Tests with a domestic furnace showed no change in burning or clinkering characteristics due to the treatment.

Briquetting.—Briquetting of coal without use of a binder[78] continues to receive attention both in the United States and abroad.

A new process is said to be operated commerically in Belgium,[79] in which fine coal is dried and preheated to 150 to 200° C. in one chamber and then heated to the plastic state in another; it is then removed and compressed into small briquets by a special press at the rate of about 50 tons per day.

COMBUSTION

Domestic stoker studies sponsored by Bituminous Coal Research, Inc., at Battelle Memorial Institute have shown that the larger sizes of small stoker fuel (1 inch or ¾ inch) are reduced in size according to the friability of the coal by the mechanism that conveys the fuel from the hopper to the grate. Hence, the fuel need not be supplied in sizes greater than ¾ or 1 inch.[80] Addition of fluxing agents (borax,

[73] Gilbertson, H. S., Anthracite Industry Finds Theft Its Biggest Problem. Production Drops 12 Percent: Min. and Met., vol. 17, 1936, p. 41.

[74] van Voorhis, M. G., Petroleum Oil Prevents "Coalitosis": Nat. Petrol. News, vol. 27, no. 11, Mar. 13, 1935, p. 116. Meredith, H. J., Dustproofing Coke: Proc. Am. Gas Assoc., 1934, pp. 916–922.

[75] Downing, R. C., Preparation of Dustless Coke by Emulsified Oil Spraying: Gas Age-Rec., vol. 75, 1935, p. 603.

[76] Jamieson, D., Jr., Treatment by Oil or Chemical to Improve Quality. Assoc. Ming. Cong., 1935 Yearbook Coal-Mine Mechanization, pp. 289–293.

[77] Coal Age, Spotlight Fine Coal Cleaning: Vol. 40, 1935, pp. 251–252.

[78] Hall, R. D., Notes from Across the Sea: Coal Age, vol. 40, 1935, p. 422. Fuel Economist, The Colloidal Coal-Briquetting Process: Vol. 10, 1935, p. 950. Romberg, H., The Briquetting of Bituminous Coal without a Binder: Braunkohle, vol. 34, 1935, pp. 617–622. Bierbrauer, E., Recent Advances in Coal Briquetting, with Special Reference to Austrian Coals: Sparwirtschaft, vol. 13, 1935, pp. 33–37. Winkler, G., Briquetting without a Binder: Brennstoff-Chem., vol. 16, 1935, pp. 441–447. Piersol, R. J., Briquetting Illinois Coals without a Binder by Impact: Illinois Geol. Survey Rept. of Investigations 37, 1935, 75 pp.

[79] Fuel Economist, New Process for Up-Grading Fine Coal: Vol. 11, 1935, p. 120.

[80] Sherman, Ralph A., and Kaiser, E. R., The Relation of Size of Bituminous Coals to Their Performance on Small Underfeed Stokers. Part I. The Relation of the Size in the Hopper to That Burned in the Retort: Bituminous-Coal Research, Inc., Tech. Rept. 1, part I, Washington, D. C., 1935, 27 pp.

sodium silicate, portland cement, sodium sulphate, etc.) to a stoker coal to promote clinker formation did not prove practicable.[81]

The Anthracite Institute has continued research on automatic stokers,[82] and progress has been made in the development of low-cost magazine-type water heaters.

About 80 slag-top pulverized-coal-burning furnaces are now in service in American power plants, operating on coals with ash-fusion temperature ranging from 1,900° to 2,500° F. Recent improvements admit the use of coals of even higher ash-fusion temperatures.[83]

Coal-dust engines.—Wahl [84] has made a comprehensive report on the history and development of the coal-dust engine and on recent experiments conducted at Oppau which indicate better control of combustion and reduction of wear of cylinders by selection of coals with very low percentage (1 percent or less) of ash, and nonabrasive forms of ash.

Due to its lower ignition temperature, brown coal is a better fuel than bituminous coal,[85] although low ash is the most important factor, not only because of engine wear but on account of objections to the discharge of large quantities of dust into the air from the engine exhaust.[86]

COMPLETE GASIFICATION

In America the trend of development in water-gas practice is toward high-B. t. u. gas as a supplement to natural gas or natural-manufactured gas mixtures.[87] The gas is made in the usual water-gas set modified to permit vaporization of large amounts of oil and carburetion to form oil gas.[88] One method of increasing the oil-vaporization and carburetion capacity is the refractory-screen oil-gas process,[89] wherein a refractory grating is introduced into the generator or sized refractory pieces are placed in the carburetor, increasing the heated surface. A plant having a capacity of 50,000,000 cubic feet of 1,000-B. t. u. gas per day has been installed in New Orleans.

Excess electrical energy may be utilized in the continuous production of water gas from anthracite and steam. Ten thousand cubic feet of water gas (310 B. t. u.) per hour at 535° was produced with a continuous load of 400 kw.; 18 pounds of anthracite and 0.075 pound of electrodes were consumed per 1,000 cubic feet of gas made.[90]

The Fuel Research Station of Great Britain has made another important contribution to its series on the water-gas process. Operat-

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81 Sherman, Ralph A., and Kaiser, E. R., Clinker Formation in Small Underfeed Stokers. The Use of Addition Agents to Promote Clinkering of Refractory Ashes: Bituminous-Coal Research, Inc., Inf. Bull. 1, Washington, D. C., 1935, 10 pp.

82 Johnson, A. J., Performance Expectancy of Domestic Underfeed Stokers for Anthracite: Am. Inst. Min. and Met. Eng., Technol. Pub. 608, 16 pp.; Coll. Guard., vol. 150, 1935, pp. 650–651.

83 Shellenberger, R., Furnace Bottoms for Tapping Ash in the Molten State: Mech. Eng., vol. 58, 1936, pp. 30–34.

84 Wahl, H., Position, Possibilities of Development, and Prospects of the Pulverized-Fuel Engine: Engine Committee of the Verein Deutscher Eisenhüttenleute, Rept. 56, Stahl u. Eisen, vol. 55, 1935, pp. 409–418. Fuel for Coal-Dust Engines: Brenstoff-Chem., vol. 16, 1935, pp. 201–208. The Coal-Dust Motor: Oel u. Kohle, vol. 11, 1935, pp. 691–693. Wahl, H., Wear in Coal-Dust Motors: Wärme, vol. 58, 1935, pp. 91–96.

85 Schulte, F., Selection of Fuel for a Powdered-Coal Machine: Stahl u. Eisen, vol. 55, 1935, pp. 442–444.

86 Moldenhauer, M., The Problem of Solid Fuels for Explosion Motors: Chem. Ztg., vol. 59, 1935, p. 356. Granthier, C. F., The Coal-Dust Motor: Coll. Guard., vol. 151, 1935, pp. 1082–1083. Campbell, C., Pulverized Coal for Operating Engines: Coll. Guard., vol. 151, 1935, pp. 719–720.

87 Beard, W. K., Water Gas: Rept. of Water Gas Committee, Gas Production Committee Report for 1935, Proc. Am. Gas Assoc., 1935, pp. 753–754.

88 Beard, W. K., The Production of High-B. t. u. Gas in a Carbureted Water-Gas Set with Particular Reference to the Use of Heavy Oil: Gas Production Committee Rept. for 1935, Proc. Am. Gas Assoc., 1935, pp. 768–772.

89 Barclay, Thomas B., Report of Improved Equipment—Russell Engineering Corporation: Gas Production Committee Rept. for 1935, Proc. Am. Gas Assoc., 1935, pp. 782–786.

90 Hole, Ivar., An Electric Gas Generator: Gas World, vol. 103, 1935, p. 122; Gas Industry, vol. 52, 1935, p. 446.

ing an experimental water-gas machine in such a manner that the disturbing effect of clinkers was avoided, it was found that the efficiency of the process was increased by increasing the rate of blowing up to about 45 cubic feet of air per square foot of total grate area and during a flow period of 11 seconds. At this rate the solid particles of coke began to be lifted from the fuel bed. Alteration of the size of coke between the limits of 2- to 3-inch pieces and 0- to 1-inch breeze had only a slight effect upon the thermal efficiency of the process. However, a greater output at the cost of some thermal efficiency can be obtained with the smaller sized coke. The greater reactivity of low-temperature coke did not prove advantageous for water-gas production. The thermal efficiency was slightly less than for high-temperature coke, and the lower density required more frequent charging, which gave less uniform operation.[91]

Continuation of research on water-gas production at Leeds University has given information on a number of practical operating problems.[92]

The treatment of American lignite chars with potassium or sodium carbonate or a titanium dioxide-cupric oxide mixture increases their reactivity with steam and also the percentage of hydrogen in the water gas generated.[93]

At Leninsk, Siberia, an underground gasification experiment was conducted following the principle of the gas producer. The coal was ignited on June 4, the first combustible gas was evident on June 17, and a 220-B. t. u. per cubic foot gas was obtained on August 3. The highest heating value obtained was 380 B. t. u. per cubic foot. However, this operation proved very wasteful, as only 15 percent of the coal was recovered, the remainder being lost as coke, tar, and unburned coal left in the mine.[94]

Subsequent reports indicated that the amount of utilizable gas obtained in these early experiments in which the coal was first broken up underground with explosives was small and had no commercial value.[95] However, a new plan has been started at Gorlovka in which, without previous shattering by explosives, the solid face of the coal bed is to be gasified by the direct action of oxygen-enriched air. Two shafts are sunk from the surface to the coal bed, and a drift is run along the bed connecting the two shafts. According to the Russian report, air enriched with oxygen is blown down one shaft, producer gas is formed at the face of the previously ignited coal bed, and this producer gas combined with some water gas and distillation gases comes back to the surface through the second shaft. Although success is claimed in the Russian accounts of these experiments, none of them give enough detail to convince the practical engineer that any real progress has been made in developing a feasible method for the underground gasification of coal.[96]

[91] King, J. G., Williams, B. H., and Thomas, R. V., Further Experiments on the Water-Gas Process: Dept. of Sci. and Ind. Research, Fuel Research Paper 43, H. M. S. Office, London, 1935, 58 pp.

[92] Dent, F. J., Blackburn, W. H., and Williams, N. H., The Controlled Operation of a Carbureted Water-Gas Plant: II—37th Report of the Joint Research Committee of the Institution and Leeds University, Inst. Gas Eng., Con. 122, 156 pp.; Gas World, vol. 103, 1935, pp. 421–422, 431–438, 541–543; Gas Jour., vol. 212, 1935, pp. 473–475, 693–695.

[93] Brewer, R. E., and Ryerson, L. H., Production of High-Hydrogen Water Gas from Younger Coal Cokes. Effects of Catalysts: Ind. and Eng. Chem., vol. 27, 1935, pp. 1047–1053.

[94] Alekseev, V., and Eikhe, R., Subterranean Gasification of Coal: Ugol Vostoka, vol. 4, 1934, pp. 2–3; 28–30. Grindler, B. F.,The Second Cycle of Experiments for the Subterranean Gasification of Coal in the Kuznetzk Basin: Ugol Vostoka, vol. 5, 1935, pp. 11–14.

[95] Sazonov, N. I., Summary of the First Experimental Results of a Subterranean Gasification of Coals: Khim. Tverdogo Topliva, vol. 6, 1935, pp. 271–279.

[96] Department of Commerce, Russian Economic Notes: Nov. 30, 1935, pp. 6–9.

HIGH-TEMPERATURE CARBONIZATION

Business improvement is reflected in the following coke ovens under construction December 31, 1935:[97] (1) 138 Koppers-Becker ovens for the Carnegie-Illinois Steel Co. at Gary, Ind., having a carbonizing capacity of 1,021,200 tons of coal per annum; (2) 33 Koppers-Becker ovens for the Columbia Steel Co. at Provo, Utah, with a capacity of 207,900 tons of coal per annum; (3) 122 Koppers-Becker ovens for the Ford Motor Co. at Dearborn, Mich., with a carbonizing capacity of 768,600 tons of coal per annum; (4) 16 Knowles sole ovens for the Radiant Fuel Corporation at West Frankfort, Ill., increasing this installation to 26 ovens having a total carbonizing capacity of 300 tons of coal per day.

In the Knowles ovens the horizontal layer of coal 10 inches deep is heated from the bottom only. Therefore, the resulting coke is a mixture of high-temperature and medium-temperature coke. It has greater combustibility and a lower ignition temperature than ordinary high-temperature coke and should have some advantage in this respect for domestic fuel purposes.

Purification of gas.—A new sodium phenolate plant adapted for removal of large amounts of hydrogen sulphide from refinery gases is under construction for the Standard Oil Co. of California. It is designed for treating a maximum of 17,000,000 cubic feet of gas per day, in which the hydrogen sulphide content ranges from 2,700 to 4,800 grains per 100 cubic feet.

Trutnovsky[98] found that 1 pound of nickel turnings heated to 450° to 650° C. purified 3,500 to 8,000 cubic feet of manufactured gas containing 7 to 10 grains of organic sulphur per 100 cubic feet of gas. The H_2S formed was removed with iron oxide and the purified gas contained not over 0.8 grain of sulphur per 100 cubic feet of gas. The catalyst was regenerated by burning off the deposited carbon.

Evolution of H_2S from gas-holder water, due probably to bacterial reduction of sulphates, is an interesting feature of a valuable review of gas-purification problems.[99] Elimination of naphthalene, which has previously acted as a bactericide, is thought to be the cause of this new problem.[1]

The Philadelphia Coke Co. recently has installed an electrical process that removes 98 percent of the nitric oxide from 25,000,000 cubic feet of coke-oven gas per day. The process operates at 20,000 volts (brush discharge), with a stated energy consumption of about 0.03 kw-hr. per 1,000 cubic feet of coke-oven gas.

Jordan, Ward, and Fulweiler,[2] continuing their researches on gum deposits and their prevention, found that sulphided iron oxide has a high capacity for the absorption of NO and recommend a modified oxide box operation, which reduces the NO in the gas to less than 0.0003 grain per 100 cubic feet. Bunte, Brückner, and Haas[3] also

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[97] Steel Equipment Completed and Building in 1935: Vol. 98, no. 1, 1936, p. 86.

[98] Trutnovsky, H., Removal of Organic Sulphur from Manufactured Gas: Gas u. Wasserfach, vol. 78, 1935, pp. 462–465.

[99] Hollings, H., and Hutchison, W. K., Gas Purification: Jour. Inst. Fuel, vol. 8, 1935, p. 296; Chem. and Ind. (London), vol. 54, 1935, pp. 726–732, 752–760.

[1] The Gas Light and Coke Co. and The South Metropolitan Gas Co., Report on the Generation of Hydrogen Sulphide in Water-Sealed Gasholders: Inst. Gas Eng. (London), Communication 117, November 1935, 20 pp.

[2] Jordan, C. W., Ward, A. L., and Fulweiler, W. H., Gum Deposits in Gas-Distribution Systems. Vapor-Phase Gum: Ind. and Eng. Chem., vol. 27, 1935, pp. 1180–1190.

[3] Bunte, K., Brückner, H., and Haas, G. R., Removal of Nitric Oxide from Manufactured Gas by Dry Purification Material: Gas u. Wasserfach, vol. 78, 1935, pp. 754–757.

found that FeS was a stable absorbing agent in the absence of oxygen and recommend using a small box of sulphided purifying material before the usual box series to which oxgyen is admitted. The introduction of fogging oil, containing an inhibitor, into the distribution system is said to be an effective means of combating gum and naphthalene stoppages.[4]

European investigations on the dehydration of gas have included the use of glycerin,[5] silica gel,[6] refrigeration,[7] and compression.[8]

The experimental gas-detoxification plant at Hameln, Germany, has operated satisfactorily during the past year; 90 percent of the organic sulphur is converted to hydrogen sulphide, 75 percent of the hydrocyanic acid and 50 percent of the naphthalene are removed, and the residual carbon nonoxide is reduced to 1 percent.[9] Costs are estimated at 5 to 6 cents per 1,000 cubic feet of finished gas.[10]

F. Schuster [11] has published a book (in German) entitled "Detoxification of Town Gas", which discusses various methods of removing carbon monoxide and the results of the Hameln experiment; 633 references to current technical literature and the citation of hundreds of patents are given. A recent review (in English) discusses various methods and costs of carbon monoxide extraction.[12]

Recovery and purification of light oil.—Further investigation [13] of the Goldschmidt top-canal and the Still internal-tube process for increasing the yields of light oil, using single ovens of a battery connected to separate condensing and scrubbing trains, showed but little effect on yields of light oil due to the top canal. However, the Still method, wherein offtake pipes are introduced into the coking charge, increased the yield of oils boiling under 180° C. about 42 percent. The oil contained three times the amount of unsaturated hydrocabons obtained in normal coke-oven procedure, including a considerable percentage of paraffins and naphthenes. Jenkner and Nettlenbusch [14] also point out that owing to varying carbonizing conditions in different ovens, building top canals into ovens does not always increase the benzol yield. The most favorable conditions are obtained when the top canals are heated independently of the oven chambers.

Wucherer [15] gives the respective costs of recovering light oil by the refrigeration, wash oil, and active carbon methods as 78, 71 to 99, and 78 RM. per metric ton of recovered light oil. At a Belgian coke-

[4] Mathias, H. R., Effect of Oil Fogging on Naphthalene and Gum Deposits: Rept. Am. Gas Assoc. Chemical Committee for 1935, Proc. Am. Gas Assoc., 1935, p. 700; Gas Age-Record, vol. 76, 1935, pp. 151–157.

[5] Fischer, K., A New Method for Drying Gas (Luton Gas Works, England): Chem. Ztg., vol. 59, 1935, pp. 516–517.

[6] Bruckner, Horst, and Ludwig, Walter, Dehydration and Purification of Manufactured Gas with Silica Gel: Gas u. Wasserfach, vol. 78, 1935, pp. 459–462.

[7] Coal Carbonization, Removal of Benzol (and Moisture) from Coke-Oven Gas by Refrigeration: Vol. 1, 1935, pp. 72–74; Trans. from L. Industry Chem. Belge.

[8] Schuster, Fritz, Gas Dehydration: Gas u. Wasserfach, vol. 78, 1935, pp. 82–86.

[9] Bertelsmann, Wilhelm, The Detoxification of Town Gas: Gas Jour., vol. 210, 1935, pp. 815–818. Miller, W. J., The Position of the Problem of the Removal of Poisons from Gas: Oesterr. Chem. Ztg., vol. 38, 1935, pp. 81–86. Rosenthal, Hans, Manufacture of City Gas from Water Gas: Gas u. Wasserfach, vol. 78, 1935, pp. 436–438.

[10] Mezger, Robert, Removal of Carbon Monoxide from Gas: Gas u. Wasserfach, vol. 78, 1935, pp. 573–579, 593–603.

[11] Reviewed in The Gas World, vol. 103, 1935, p. 597.

[12] Gas Age-Record, Carbon Monoxide Extraction from City Gas: Vol. 77, 1936, pp. 225–229.

[13] Litterscheidt, W., and Reerink, W., The Influence of Central and Top Offtakes on the Yield of By-products: Coal Carbonization, vol. 1, 1935, pp. 51–54; Glückauf, vol. 71, 1935, pp. 461–471.

[14] Jenkner, A., and Nettlenbusch, L., Increasing the Yield of Light Spirit: Coal Carbonization, vol. 1, 1935, pp. 6–9, 27–30. Rosendahl, Fritz, Increase of Benzene Yield in a Coke Oven: Petrol. Ztschr., vol. 31, no. 12, 1935, pp. 4–6. Damm, P., Formation and Composition of Coal Tar: Jour. prakt. Chem., vol. 143, 1935, pp. 42–49.

[15] Wucherer, J., Light-Oil Recovery and Gas Purification by Refrigeration: Gas u. Wasserfach, vol. 78, 1935, pp. 118–21.

oven plant[16] 353,000 cubic feet of gas per hour is cooled to —40° C. using a maximum pressure in the refrigerator of 57 pounds per square inch and 700 horsepower. The treated gas is pure and dry and suitable for use in synthetic processes.

A new process for refining benzol applied at Dunkirk[17] consists in washing the oil with naphthalene sulphonic acid dissolved in methanol, 5 pounds of the acid dissolved in 1 gallon of methanol being sufficient for treatment of 100 gallons of benzol. The benzol is refluxed with the refining agent in a lead-lined still for 3 hours. Allowing for a 9-percent refining loss, the increased price obtained for the refined product is said to leave a slight margin of profit. Hoffert[18] has studied the factors influencing the velocity and completeness of the reactions involved in the methanol-soda process for removing CS_2 from benzol and claims that it reduces the CS_2 content to low limits without appreciable losses of benzol.

The addition of cresol to the catechol used in the "inhibitor process" for acid-washing benzol is said to increase the benzol recovery 5 percent.[19]

Coking studies.—Fundamental studies on the mechanism of coking conducted by the Coal Research Laboratory of the Carnegie Institute of Technology have shown that the rate of heating up to and after the plastic range is important, since no direct correlation could be made between effects found and rate of heating through the plastic range alone. Rate of heating through the preplastic range appeared to be of prime importance in determining the yields of carbonization products and gas composition, while coke hardness was determined largely by the rate of heating through the plastic range.[20] The Bureau of Mines has completed a study of the petrographic composition and carbonizing properties of a typical West Virginia gas coal.[21]

On the basis of small crucible tests with Illinois coal, Gilbert Thiessen found that approximately 45 percent of the organic sulphur and 60 percent of the pyritic sulphur in the coal remain in the coke.[22] Comparison of carbonization-test assays using the Geipert apparatus with full-scale results showed that the gas from the Geipert apparatus contained more illuminants and hydrogen and less methane than the commercial equipment gases; moreover, the assay yields of coke averaged about 1.5 percent lower than the plant yields.[23]

A comprehensive comparison of results of small-scale laboratory distillation tests with those from the Bureau of Mines-American Gas Association carbonization test applied to some 20 coals showed that commercial yields cannot be predicted accurately from the appli-

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[16] Coal Carbonization (translation from L'Industrie Chimique Belge), Removal of Benzol and Moisture from Coke-Oven Gas by Refrigeration: Vol. 1, 1935, pp. 72–74.

[17] Tristam, —, A New Process for Refining of Benzol: Paper at 58th Congress of Union Syndicate de L'Industrie Technique du Gas en France, June 3–5, 1935; Gas Jour., vol. 211, 1935, p. 424.

[18] Hoffert, W. H., Claxton, G., Hancock, E. G., The Removal of Carbon Disulphide from Benzols—"The Methanol-Soda Process": Jour Soc. Chem. Ind., vol. 54, 1935, pp. 239T–246T; Coke Oven Managers Yearbook, 1936, pp. 160–172.

[19] Wikner, S. W. A., Gas World, vol. 102, 1935, pp. 705–706.

[20] Warren, Wm. B., Carbonization of Coal. Effects of Variation of Rate of Heating During the Carbonization of a Typical Coking Coal: Ind. and Eng. Chem., vol. 27, 1935, pp. 1350–1354.

[21] Fieldner, A. C., Davis, J. D., Thiessen, R., Kester, E. B., Selvig, W. A., Reynolds, D. A., Jung, F. W., and Sprunk, G. C., Carbonizing Properties and Constitution of Alma Bed Coal from Spruce River No. 4 Mine, Boone Co., W. Va.: Tech. Paper 562, Bureau of Mines, 1935, 41 pp.

[22] Thiessen, Gilbert, Behavior of Sulphur During Coal Carbonization: Ind. and Eng. Chem., vol. 27, 1935, pp. 473–478.

[23] Köhler, H., Comparative Carbonizing Tests with Vertical Retorts and Vertical Chamber Ovens and the Correlation of Tests with Geipert Apparatus with Plant Operation: Gas u. Wasserfach, vol. 78, 1935, pp. 805–810.

cation of average factors to the results of the laboratory tests, although a rough approximation may be obtained.[24]

Properties of coke.—British investigators continuing their studies of the properties of cokes and their improvement find (1) that fine crushing (90 percent through ⅛-inch screen) of blends of caking and noncaking coals results in cokes that are more resistant to shatter and abrasion[25] and permits the admixture of a greater proportion of noncoking coal to the blend without weakening the coke; (2) that at medium carbonization temperatures (700° to 800° C. flue temperatures) as much as 40 percent of a noncaking Leicestershire coal could be blended with a strongly caking Durham coal and yet make a satisfactorily strong coke, the densest coke being obtained with 20 percent of noncaking coal;[26] (3) that under the same conditions, addition of coke breeze to the same Durham coal increased the size of the coke pieces but also markedly increased their abradibility with additions of more than 10 percent breeze;[27] (4) that the addition of 10 percent finely ground (through 60-mesh) coke dust to a high-rank Yorkshire coal increased the resistance to shatter and abrasion,[28] (however, small additions of coke dust[28] or fusain[29] to low-rank coals is undesirable) and (5) that the admixture of small quantities of iron oxide, sodium or potassium carbonate, and in some cases hydrated lime to the coal charge increased the reactivity of the coke, the greatest effect being obtained with 3 to 5 percent of sodium carbonate.[30] [31]

By direct measurement of loss of weight of the powdered sample suspended from a spring balance in a tube furnace, Oshima and Fukuda[32] found that the addition of 5 percent of various salts of potassium, sodium, lithium, zinc, manganese, and lead to carbon black greatly lowered the ignition temperatures and increased the reactivity to carbon dioxide, the most effective being potassium hydroxide, lead acetate, potassium tartrate, potassium carbonate, lithium acetate, potassium acetate, and sodium hydroxide, in the order given.

The Bureau of Mines, comparing the hygroscopicity,[33] electrical conductivity[34] reactivity,[35] ignition temperature,[36] and minimum air flow required to sustain combustion[36] of a series of cokes made at various carbonization temperatures ranging from 500° to 1,100° C., found that these properties were closely related and varied in most

[24] Selvig, W. A., and Ode, W. H., Determination of Gas, Coke, and Byproducts of Coal. Evaluation of Laboratory Assay Tests: Ind. and Eng. Chem., Anal. Ed., vol. 7, 1935, pp. 88–93.

[25] Midland Coke Research Committee, University of Sheffield, Sheffield, England, Report of Progress During 1935: Fuel, vol. 15, 1936, pp. 87–91.

[26] Department of Scientific and Industrial Research, Report of the Fuel Research Board for the Year Ended 31st March 1935: H. M. S. Office, pp. 70–90.

[27] Thiessen, Gilbert, Fusain Content of Coal Dust from an Illinois Dedusting Plant: Am. Inst. Min. and Met. Eng. Tech. Pub. 664, 1936, p. 11.

[28] See footnote 25.

[29] See footnote 27.

[30] Northern Coke Research Committee, Annual Report for 1935, Armstrong College, Newcastle, England: Coll. Guard., vol. 150, 1935, pp. 1130–1131.

[31] Askey, P. J., and Doble, S. M., The Activation of Fuels by Sodium Carbonate— I: Fuel, vol. 14, 1935, pp. 197–201.

[32] Oshima, Y., and Fukuda, Y., On the Combustibility and Reactivity of Carbon: Jour. Fuel Soc. Japan, vol. 14, 1935, pp. 91–94; Effect of Ash on Combustion Characteristics of Carbons: Ind. and Eng. Chem., vol. 27, 1935, pp. 212–217.

[33] Reynolds, D. A., Hygroscopicity of High- and Low-Temperature Cokes: Ind. and Eng. Chem., vol. 26, 1934, pp. 732–733.

[34] Davis, J. D., and Auvil, H. S., Electrical Conductivity of Coke: Ind. and Eng. Chem., vol. 27, 1935, pp. 1196–1200 .

[35] Reynolds, D. A., and Davis, J. D., The Reactivity of Coke. An Improved Method for Determining the Reactivity of Coke in Carbon Dioxide: Ind. and Eng. Chem., Anal. Ed., vol. 8, 1936, pp. 33–36.

[36] Holmes, C. R., and Davis, J. D., Kindling Properties of Coke; Ignition Temperature of Coke and Air Required to Support Combustion: Ind. and Eng. Chem., vol. 28, 1936, pp. 484–488; Gas Jour. (London), vol. 211, 1935, p. 519.

cases with the carbonizing temperature.[37] Electrical conductivity and ignition temperature increased while hygroscopicity and reactivity decreased with increase of carbonizing temperatures. Bunte and Windorfer [38] likewise found a general relation between ignition temperature and reactivity in a series of high-temperature cokes.

Mott [39] recognizes the importance of specific reactivity and ignition temperature in assessing the ease of ignition of a domestic coke but believes that erroneous deductions regarding the practical combustibility of different cokes may be made if coke under one-eighth inch in size is used in laboratory tests. This error is due to the fact that some combustion takes place in the pores under the surface of the coke to a depth of about one-eighth inch. He recommends a minimum size of one-half inch for combustibility tests.

Gas as motor fuel.—The use of compressed manufactured gas and methane as motor fuel for trucks and busses is increasing in Europe.[40] Seven supply stations are now operating in France. Tests at Wallasey, England, showed that 270 cubic feet of 470-B. t. u. gas were equivalent to 1 imperial gallon of gasoline.[41] However, under present conditions it is believed that gas cannot compete with heavy oil.[42]

A trial motorbus run of 1,480 miles was successfully made in Germany with compressed coke-oven gas.[43] Progress is being made in the development of light-weight cylinders of wire-wound construction and of magnesium-aluminum alloys.[44]

LOW-TEMPERATURE CARBONIZATION

Definite progress has been made during the past year in the commercial production of an easily ignitible and combustible smokeless fuel by low- and medium-temperature [45] carbonization of bituminous coal.

Foreign developments.—In England, the three plants of Low-Temperature Carbonization, Ltd., continued profitable operation, the total sales of coke for the year being 375,725 tons, an increase of 14 percent over the previous year.[46] The low-temperature tar from these plants is being sold to Imperial Chemical Industries, Ltd., at Billingham, where it is being converted to gasoline by the hydrogenation process.[47] A 50-ton-per-day Salermo plant erected at the Southall station of the Gas Light & Coke Co., London, has continued in operation, and a similar plant is being erected in South Africa for distilling torbanite.[48]

[37] Davis, J. D., and Fieldner, A. C., Relation of Carbonizing Temperature and Rank of Coal to the Reactivity, Electrical Conductivity, and Hygroscopicity of Coke: Proc. Am. Gas Assoc., 1935, pp. 636–657.
[38] Bunte, K., and Windorfer, K., Relation Between Ignition Temperature and Reactivity of High-Temperature Coke: Gas u. Wasserfach, vol. 78, 1935, pp. 697–701, 720–725, 737–743.
[39] Mott, R. A., The Combustion of Coke: Gas World, vol. 102, Coking Sec., 1935, pp. 37–43; Coke Oven Managers' Yearbook, 1936, pp. 250–270.
[40] Traenckner, J., Gas as Motor Fuel: Gas u. Wasserfach, vol. 78, 1935, pp. 677–683.
[41] Booth, F. N., and Fletcher, J., Wallasey Compressed Coal Gas and Its Uses: Gas World, Indust. Gas Suppl., vol. 8, Nov. 16, 1935, pp. 106–110.
[42] Cook, R., Compressed Gas as a Fuel for Motor Transport: Jour. Inst. Fuel, vol. 9, 1935, pp. 125–131; Coll. Guard., vol. 151, 1935, pp. 1178–1179.
[43] Glückauf, Long-Distance Motor Run on Coke-Oven Gas: Vol. 71, 1935, p. 715.
[44] Brunkaus, J. H., Light-Weight Gas Cylinders: Gas u. Wasserfach, vol. 78, 1935, pp. 546–548. Bocande, M., Light Metal Bottles for Transport of Compressed Gas: Rev. de l'Aluminum, vol. 12, 1935, pp. 2701–2704.
[45] Roberts, John, Present Position of Medium-Temperature Carbonization and Future Prospects. Manufacture of Smokeless Open-Grate Fuels: Iron and Coal Trades Rev., vol. 132, 1936, pp. 101–102.
[46] Times (London), Dec. 16, 1935.
[47] Chemical Age, Low-Temperature Carbonization, Beneficial Effect of the Hydrogenation Process: Vol. 33, 1935, p. 40.
[48] Coal Carbonization, Modern Applications of the Salermo Retort: Vol. 2, 1936, pp. 53–56.

The McLaurin low-temperature carbonization plant at the Dalmarnock gas works has been dismantled and sold; this plant, which was of the gas-producer type, has not been operated for over 2 years; [49] a similar plant at the Nuneaton gas works is still in operation. The 40-ton-per-day experimental Hird plant at the Nostall colliery, Wakefield, Yorkshire,[50] and the various experimental installations (Knowles,[51] Mitford,[52] and Stephenson [53] processes) for carbonizing mixtures of coal and oil [54] have continued intermittent operations during the year.

Despite the failure of previous attempts, experiments are again being made to extract gas and liquid products from power-plant fuel. A novel scheme is proposed in which red-hot coke from a traveling-grate stoker operating at three times the normal rate is mixed with raw coal in the proportion of 2:1 or 3:1 in a rotary mixer where the coal is said to be carbonized in about 15 minutes.[55]

Medium-temperature carbonization by the H. Koppers Carbolux process continues to progress in continental Europe. The capacity of the original plant at the Mines de Bruay, France, has been increased from 400 to 515 tons per day by increasing the number of ovens from 25 to 42.[56] The new ovens are 11 feet 6 inches high, 13¾ inches wide, and 36 feet long. Another 29-oven plant with a daily capacity of 350 tons of dry coal has been built at the Borsinghausen colliery near Hanover, Germany.[57] To decrease the carbonizing time the ovens are of unusually narrow construction, being 8¼ inches wide, 12 feet high, and 36 feet long. In France the Lecocq process at the Montrambert mines is said to have achieved commercial success.[58] Other experimental processes and the status of low-temperature work in Germany [59] have been described.[60]

At the Eian works of the Chosen Nitrogenous Fertilizer Co., Ltd., 300 tons per day of brown coal is being subjected to low-temperature carbonization, including complete recovery of byproducts.[61] Other plants are being subsidized by the Government.[62]

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[49] Gas Journal, McLaurin Low-Temperature Carbonization Plant: Vol. 210, 1935, p. 30; Coll. Guard., vol. 150, 1935, p. 1063.

[50] Hird, H. P., Low-Temperature Carbonization in Relationship to the Problem of Coal Versus Oil: Coll. Guard., vol. 151, 1935, pp. 722–723.

[51] Coal Carbonization (supplement to Colliery Engineering), New Adaptations of Old Distillation Processes, with Special Reference to the Knowles Oven: Vol. 1, 1935, pp. 3–5. New Coking Plant at Corby: Vol. 1, 1935, pp. 123–126.

[52] Colliery Guardian, Notes from the Coal Fields: Vol. 151, 1935, p. 700. Strevens, J. L., Brocklebank, E. W., and Mitford, W. B., Improvements in or Relating to the Production of Coherent Cokes from Non-caking Carbonaceous Materials: British Patent 437730, Nov. 5, 1935; *see also* Morrell, J. C., Treatment of Hydrocarbon Oils and Coal: U. S. Patent 1972944.

[53] Iron and Coal Trades Review, The National Coke & Oil Co., Ltd., Tipton Works: Vol. 131, November 1935, pp. 724–725. Coll. Guardian, Coal in Oil: Vol. 151, 1935, p. 1017. Fuel Economist, Progress at the New Oil-from-Coal Plant at Tipton: Vol. 10, 1935, pp. 1010–1012.

[54] Brownlie, David, Carbonization of Coal-Oil Mixtures: Gas-Age Record, vol. 76, 1935, pp. 559–562, 570. Gas Times, The Carbonization of Coal Suspended in Oil: Vol. 3, 1935, pp. 21–24. Steam Engineer, vol. 5, 1935, pp. 137–139. Iron and Coal Trades Review, Carbonization of Coal-Oil Mixtures, A Review of Processes Operating under Pressure Conditions: Vol. 132, 1936, pp. 98–100.

[55] Brownlie, David, Combined Low-Temperature Carbonization and Combustion. The New Morgan Process: Steam Engr., vol. 4, 1935, pp. 465–468.

[56] Coal Carbonization, vol. 1, p. 96.

[57] Fitz, W., The Carbolux Process for Distillation of Bituminous Coals: Brenstoff-Chem., vol. 16, 1935, pp. 345–349; Fuel Economist, vol. 11, 1936, p. 149; Iron and Coal Trades Rev., vol. 130, 1935, p. 598; Coll. Guard., vol. 150, 1935, p. 613.

[58] Berthelot, Chas., The Present State of Development of Low-Temperature Carbonization of Lignites and Coal: Proc. 15th Cong. Chem. Ind., Brussels, Sept. 23–25, 1935.

[59] Thau, A., Low-Temperature Carbonization and Gas Production for Synthetic Motor Fuels: Brennstoff u. Wärmewirtschaft, vol. 17, 1935, pp. 167–176.

[60] Berthelot, Chas., Manufacture of Artificial Anthracite: Génie civil, vol. 105, 1934, pp. 363–365. The Treathra Low-Temperature Carbonization Process: Fuel Economist, vol. 10, 1935, p. 820.

Rosskothen, A., A New Way for Coal Distillation: Ztschr. Oesterr. Ver. Gas u. Wasserfach, vol. 75. 1935, pp. 39–48.

Naphtole, M., Low-Temperature Bituminous-Coal Tar: Brennstoff-Chem., vol. 16, 1935, pp. 67–72.

[61] Journal of the Fuel Society of Japan, Low-Temperature Carbonization Plant: Vol. 14, 1935, p. 20.

[62] Journal of the Fuel Society of Japan, Low-Temperature Carbonization Plant to be Subsidized in Karafuto: Vol. 14, 1935, p. 46.

American developments.—The Pittsburgh Coal Carbonization Co. has put into commercial operation a second unit of the modified[63] Wisner process for the production of Disco from byproduct fine coal of the preparation plant. The first rotary carbonizer, installed in 1933[64] at Champion near Pittsburgh, Pa., is 6 feet in diameter and 90 feet in length. The second unit is 8 feet in diameter and 130 feet in length. Disco is the trade name of the lump smokeless fuel produced. It contains about 16 percent volatile matter, is dense, and by the standard shatter test is as strong as the average high-temperature coke. It is generally of a rounded, spherical shape ranging from ½ to 6 inches in diameter and is marketed in one size, approximately the run of retort output passing over a 1-inch screen. Depending on the character of the raw feed, the tar yield ranges from 16 to 20 gallons per ton of product and is stored, distilled, refined, and variously prepared for market by the Pittsburgh Coal Carbonization Co., largely as road tar, at a location immediately adjacent to the Disco plant.

The plants of the Coal Carbonization Co. (Hayes process) at Moundsville, W. Va., and the Lehigh Briquetting Co. (Lurgi process) near Dickinson, N. Dak., operated intermittently during 1935, the latter producing about 20,000 tons of briquets and 150,000 gallons of creosote oil.

A small experimental plant using the Record-Louttit process[65] of internal heating with superheated steam is operated by the Colene Co. of Tacoma, Wash. Superheated steam also is proposed for the carbonization of noncaking coals from Utah and Wyoming.[66]

HYDROGENATION AND LIQUEFACTION

The coal-hydrogenation plant of Imperial Chemical Industries at Billingham, England,[67] was reported to be operating at 40 percent of capacity on November 9, 1935.[68] Of the total output of 150,000 tons of gasoline per year, 10,000 tons is made from low-temperature tar, 40,000 tons from creosote oil, and 100,000 tons from coal. The hydrogen used is made by the water-gas process. The over-all consumption of coal at Billingham for the 100,000 tons of gasoline made from coal is 500,000 tons or 5 tons of coal per ton of gasoline. The ash of the coal to be hydrogenated is reduced to less than 2.5 percent, the Chance sand process being used for cleaning the coal. Hydrochloric acid is added to neutralize the alkalinity of the remaining coal ash. Volatile organic tin compounds are used as catalysts. The total capital investment of the Billingham plant is given as £5,500,000.[69]

[63] Pittsburgh Coal Carbonization Co. (assigned by Lesher, C. E.), Low-Temperature Carbonization Plant: British Patent 427849, May 1, 1935; French Patent 775623, Jan. 5, 1935.

[64] Coal Age, Preparation Activities Leave Mark on Equipment and Methods in 1935: Vol. 41, 1936, pp. 66–70.

[65] Louttit, J. E., Low-Temperature Thermal-Chemical Treatment of Coal by the Records-Louttit Process: Gas Journal, vol. 211, 1935, p. 519.

[66] Jacobsen, S. C., and Carter, G. W., Solid Smokeless Fuel. Its Production by Carbonization of Utah and Wyoming Coals: Mech. Eng., vol. 57, 1935, pp. 305–308. Practical Solution to the Salt Lake Valley Smoke Nuisance: Ind. and Eng. Chem., vol. 27, 1935, pp. 1278–1283.

[67] Tupholme, C. H. S., Gasoline from Coal. Formal Opening of the Billingham Hydrogenation Plant, Ind. and Eng. Chem., News Ed., vol. 13, 1935, pp. 414–415, Coal-Hydrogenation Petrol Plant at Billingham, Engineering, vol. 140, 1935, pp. 440–442; Coal Carbonization, vol. 1, 1935, pp. 117–122.

[68] Petroleum Times, vol. 34, 1935, p. 506.

[69] Gordon, Kenneth, The Development of Coal Hydrogenation by Imperial Chemical Industries, Ltd.: Jour. Inst. of Fuel, vol. 9, 1935, pp. 69–89; Petrol, Times, vol. 34, 1935, pp. 547–558; Gas Jour., vol. 212, 1935, pp. 722–726.

No data are given yet as to the relation of actual production costs to the[70] original estimates of 7d. per imperial gallon[71] (12 cents per U. S. gallon).

In Germany, plans are reported to be under way to make possible the production of about 500,000 tons per year of gasoline by the hydrogenation of brown coal and bituminous coal at a cost of about 20 pfennigs per kilogram.[72] The capacity of the I. G. Farbenindustrie plant at Leuna at the beginning of 1935 was 220,000 tons of gasoline per year. Pier[73] has described recent work on the hydrogenation of bituminous coal.

In Russia, the monthly review of the Moscow Narodny bank reports that satisfactory progress is being made in the development of a coal hydrogenation industry in the Kutznetsk Basin in Western Siberia. A coal-liquefaction plant is already in operation, and the construction of another plant is to be finished this year.[74]

In France, development work on coal hydrogenation is being done by the Compagnie de Bethune, and the erection of a plant for the hydrogenation of lignite in the Bouches du Rhone district is being considered.[75]

In Japan, an experimental plant of 5 tons of coal per day capacity has been completed at the Imperial Fuel Research Institute,[76] and a survey of the suitability of Japanese coals for hydrogenation has been started.[77]

Hydrogenation research.—The research program of the Fuel Research Station of Great Britain on the hydrogenation of coal was begun in 1923 and has been pursued continuously since that date.[78] Elaborate experimental equipment is now available for continuous hydrogenation of either coal or tar at various scales of working from less than 1 ounce per hour to 2 pounds of coal or 10 gallons of tar per hour.[79] Research on high- and more especially on low-temperature tars from various sources indicated that (*a*) of those tested the most active catalysts are molybdenum, tungsten, and tin sulphides and compounds containing chlorine or iodine; (*b*) that a partial pressure of 1 atmosphere of hydrogen sulphide is essential for the maintenance of the activity of the molybdenum sulphide catalyst that is formed when alumina gel-supported molybdenum oxide catalyst is used in the charge; (*c*) that low-temperature tars are more easily hydrogentated than high-temperature tars; and (*d*) that a satisfactory motor fuel can be refined from the light oil but the lubricating oil made from the heavier fractions is not satisfactory because of loss of viscosity

[70] Cadman, Sir John, Coal—and a Great Experiment—an Examination of the Production of Motor Spirit and Fuel Oil from Coal by the Hydrogenation Process: Iron and Coal Trade Rev., vol. 132, 1936, pp. 97–98.
[71] Laupichler, F. G., Economics of Tar and Coal Hydrogenation: Gas Jour., vol. 212, 1935, pp. 727–730.
[72] Iron and Coal Trades Review (London), vol. 131, 1935, p. 362, Petroleum Press Service, Nov. 15, 1935.
[73] Pier, M., The Hydrogenation of Bituminous Coal: Petrol. Times, vol. 33, pp. 423–425, 435–437, 476–477, 535–537; Gas World, vol. 103, 1935, pp. 92–95; Fuel, vol. 14, 1935, pp. 136–146. Pier, M., and Gordon, K., The Hydrogenation of Bituminous Coal: Jour. Soc. Chem. Ind., vol. 54, 1935, pp. 284–288.
[74] Gas Times, Spetember 21, 1935.
[75] Iron and Coal Trades Review, vol. 131, 1935, p. 831; Coll. Guard. vol. 151. 1935, p. 835.
[76] Journal of the Fuel Society of Japan, Hydrogenation: Vol. 15, 1936, p. 5.
[77] Journal of the Fuel Society of Japan, vol. 14, 1935, p. 38.
[78] Horton, L., Williams, F. A., and King, J. G., The Action of Hydrogen upon Coal, part II. Early Experiments with the Bergius Process: Dept. of Sci. and Ind. Res., Fuel Research Tech. Paper 42, 1935, 58 pp.
[79] Fuel Research Board, Report: H. M. S. Office, London, Mar. 31, 1935, pp. 91–134. Sinnatt, F. S., and King, J. G., Hydrogenation of Coal: Coll. Guard, vol. 150, 1935, pp. 982–985; Gas World, vol. 102, 1935, Coking Sec., pp. 61–67; Yearbook, Coke Oven Managers' Assoc., 1936, pp. 211–231.

on becoming heated.[80] Perhydrochrysene, a thick oil obtained by the catalytic hydrogenation of chrysene, likewise failed to qualify as a lubricant because of a similar unsatisfactory temperature coefficient of viscosity.[81] A recent patent claims that pretreatment with silent electric discharges before catalytic hydrogenation results in good lubricating oils.[82] Other investigators find that MoS_2–ZnO catalysts are easily poisoned by oxygen and water vapor [83] and that the presence of hydrogen and sulphur [84] is required to maintain the activity of Mo–S catalysts. According to the reaction-mechanism studies of Galle and Michelnitsch,[85] molybdenum disulphide is the most active form of these catalysts.

Japanese investigations of the catalytic hydrogenation of the phenolic [86] and neutral [87] oils of low-temperature tars [88] indicated that salts of molybdenum, tin, iron, nickel, zinc, cobalt, and chromium all increased the yield of the gasoline fraction, but ammonium molybdate, tin chloride, zinc chloride, and nickel oxide gave the best results in the order named. The catalytic materials for coal and tar hydrogenation most frequently mentioned in patent disclosures are: Oxides and sulphides of molybdenum, tungsten, chromium, tin, and uranium, with promoters such as oxides and carbonates of magnesium, zinc, aluminum, and calcium.[89]

The thiomolybdates of cobalt, chromium, tin, and bismuth are listed as effective in the hydrogenation of phenols and cresols,[90] and the addition of small amounts of organic halogen compounds or metal halides to many of the previously mentioned catalysts apparently is of considerable importance.[91] Other patents cover neutralization with acids of alkaline materials in the coal prior to hydrogenation; [92] corrosion-resistant reactor vessels or linings and neutralization of

[80] Department of Scientific and Industrial Research, The Hydrogenation-Cracking of Tars.—I. Preliminary Experiments: Fuel Research Tech. Paper 40, 1935, 107 pp. King, J. G., and Cawley, C. M.; II. The Preparation of a Catalyst: Dept. Sci. and Ind. Res., Fuel Research Tech. Paper 41, 1935, 17 pp.; Rept. of Fuel Research Board, Mar. 31, 1935, pp. 94–123.

[81] Spilker, A., on Perhydrochrysene (Octodecahydrochrysene, $C_{18}H_{30}$) and the Constitution of Lubricating Oils: Ztschr. angew. Chem., vol. 48, 1935, pp. 368–369.

[82] I. G. Farbenindustrie A. G., Improvements in or Relating to the Production of Hydrocarbon Lubricating Oils: British Patent 433061, Aug. 8, 1935.

[83] Maslyanskii, G. N., and Nemcov, M. S., The Poisoning of Molybdenum-Zinc Catalyst: Compt. Rend. Acad. Sci. (U. S. S. R.), vol. 2, 1935, pp. 404–407 (in English, pp. 408–409).

[84] Prokopetz, E. I., and Eru, I., Some Properties of Molybdenum-Sulphur Catalysts: Khim. Tverdogo Topliva, vol. 6, 1935, pp. 67–73.

[85] Galle, E., and Michelnitsch, W., Hydrogenation Catalysts: Petrol. Ztschr. vol. 31, no. 8, February 1935, pp. 1–8; Montan. Rundschau, vol. 27, no. 5, Mar. 1, 1935, pp. 1–8.

[86] Ando, Shingo, Catalytic Hydrogenation of Phenolic Oil in Low-Temperature Tar. III. Effect of Catalysts: Jour. Soc. Chem. Ind. Japan, vol. 38, 1935, suppl. binding, pp. 567–569.

[87] Ando, Shingo, Catalytic Hydrogenation of Neutral Oil from Low-Temperature Tar. I. Effect of Some Catalysts: Jour. Soc. Chem. Ind. Japan, vol. 38, 1935, suppl. binding, pp. 267–269.

[88] Ando, Shingo, High-Pressure Hydrogenation of Low-Temperature Tar. II. Comparison between Neutral Oil and Phenolic Oil from Low-Temperature Tar: Jour. Soc. Chem. In. Japan, vol. 38, 1935, suppl. binding, pp. 145–148. III. Effects of Catalysts and Hydrogenating Conditions: Vol. 38, 1935, pp. 196–199.

[89] Krauch, C., and Pier, M., Destructive Hydrogenation of Carbonaceous Materials such as Oil, Coal, etc.: To Standard Oil Co., U. S. Patent 2005192, June 18, 1935; to I. G. Farbenindustrie, U. S. Patent 1996009, Mar. 26, 1935; to I. G. Farbenindustrie, U. S. Patent 2006996, July 2, 1935; to I. G. Farbenindustrie, German Patent 614916, June 25, 1935; to I. G. Farbenindustrie, British Patent 439366, 1935. Rittmeister, Wm. (to Deutsche Hydrierwerke, A. G.), Hydrogenating Coal, etc.: German Patent 611922, Apr. 9, 1935. Waterman, H. I. (to Shell Development Co.), U. S. Patent 1998212, Apr. 16, 1935.

[90] Yorkshire Tar Distillers and Maxted, E. B., British Patent 435192, Sept. 13, 1935.

[91] Holroyd, R., Cockram, C., and Imperial Chemical Industries, Ltd., British Patent 427883, Apr. 19, 1935. International Hydrogenation Patents Co., Ltd. (to I. G. Farbenindustrie, A. G.), Treatment with Hydrogenating Gases of Distillable Carbonaecous Materials: British Patent 438084, Nov. 11, 1935. A Process for Hydrogenation of Coal or Tars: British Patent 439265, 1935. International Hydrogenation Patents Co., Ltd., Hydrogenating Carbonaceous Materials: French Patent 786937, Sept. 14, 1935. Destructive Hydrogenation: French Patent 787520, Sept. 24, 1935.

[92] International Hydrogenation Patents Co., Ltd., British Patent 422892, Jan. 21, 1935. British Patent 428749, May 17, 1935. Destructive Hydrogenation: French Patent 780050, Apr. 17, 1935; French Patent 780077, Apr. 18, 1935. I. G. Farbenindustrie, A. G., British Patent 432489, July 22, 1935. French Patent 782201, May 31, 1935. Matthews, M. A., Parsons, L. G. B., and Imperial Chemical Industries, Ltd., British Patent 440456, Dec. 21, 1935.

corrosive compounds;[93] application of the catalyst in aqueous solution or in some organic solvent to obtain maximum impregnation of the coal substance;[94] regeneration of spent catalyst material;[95] use of two or three stages of hydrogenation with a selective catalyst for each stage;[96] production of lubricating oil[97] and direct production of hydrogen under high pressure from zinc[98] or other finely divided metal;[99] apparatus and procedures for preheating or recycling a portion of the charge;[1] and removal of hydrocarbons and other foreign gases from the circulating hydrogen.[2] Although some fundamental studies[3] have been made on the mechanism and kinetics of the reactions involved in hydrogenation reactions, most of the investigations published in the last year deal with empirical studies (previously cited) and others, such as mechanical features of hydrogenation equipment,[4] the action of selective catalysts, and the best conditions for the

93 Cockram, C., Holroyd, R., and Imperial Chemical Industries, Ltd., Improvements in the Treatment with Hydrogenating Gases of Distillable Carbonaceous Materials: British Patent 433020, Aug. 6, 1935; Imperial Chemical Industries, Ltd.: French Patent 783625, July 17, 1935. Holroyd, R., Cockram, C., and Imperial Chemical Industries, Ltd., Improvements in the Thermal Treatment with Hydrogenating Gases of Distillable Carbonaceous Materials to Obtain Hydrocarbons, and Apparatus Therefor: British Patent 432958, Aug. 6, 1935. I. G. Farbenindustrie, A. G., Improvements in the Thermal Treatment of Carbonaceous Substances: British Patent 431519, Aug. 7, 1935; British Patent 427435, Apr. 24, 1935. Russell, R. P. (to Standard I. G. Co.), U. S. Patent 1949631, Mar. 6, 1934. I. G. Farbenindustrie, A. G., Destructive Hydrogenation: French Patent 780826, May 4, 1935.

94 International Hydrogenation Patents Co, British Patent 427275, Apr. 18, 1935; British Patent 431435, July 8, 1935; French Patent 777119, Feb. 12, 1935; French Patent 777147, Feb. 12, 1935; French Patent 778674, Mar. 22, 1935. Compagnie des Mines de Vicoigne, Noeux, and Drocourt, French Patent 787211, Sept. 19, 1935.

95 I. G. Farbenindustrie, German Patent 617236, Aug. 15, 1935. International Hydrogenation Patents Co., Ltd., French Patent 781846, May 22, 1935.

96 I. G. Farbenindustrie, British Patent 431683, July 9, 1935. International Hydrogenation Patents Co., Ltd., British Patent 431795, July 16, 1935.

97 Petrick, W. A., British Patent 435194, Sept. 16, 1935. I. G. Farbenindustrie A. G., British Patent 435597, Sept. 20, 1935. International Hydrogenation Patents Co., Ltd., British Patent 425814, Mar. 21, 1935; British Patent 427042, Apr. 15, 1935.

98 Pfirrmann, T. W., Hydrogenating Hydrocarbons Such as Coal or Coal Tar: U. S. Patent 2012318, Aug. 27, 1935.

99 Uhde, F., Process of and Apparatus for the Hydrogenation of Carbonaceous Materials: British Patent 435457, Sept. 20, 1935; *see also* Ipatieff, V. V., Jr., Schischkin, V. V., and Jurev, S. I., Electrolysis of Water under High Pressure: Ztschr. Electrochem, vol. 40, 1934, pp. 713–724; Schischkin, V. V., and Pubkov, I., II. Theoretical Basis of the Experimental Relation Between Both Voltage and Pressure in the Electrolysis of Water: Ztschr. Electrochem., vol. 40, 1934, pp. 724–728; Chem. Abs., vol. 29, 1935, p. 687. Jaubert, G. F., A New Process for Preparing Hydrogen under Very High Pressure: Paper presented at 15th Cong. Ind. Chem., Brussels, Sept. 23–25, 1935.

1 I. G. Farbenindustrie, A. G., British Patent 432638, July 25, 1935; British Patent 430655, June 17, 1935; French Patent 780385, Apr. 25, 1935; International Hydrogenation Patents Co., Ltd., British Patent 434307, Aug. 29, 1935. Chemical Reactions, Ltd., and Burns, J., British Patent 430364, 1935.

2 Gordon, K., and Imperial Chemical Industries, Ltd., British Patent 432574, July 30, 1935. International Hydrogenation Patents Co., Ltd., British Patent 431970, 1935.

3 Ipatieff, V. V., Jr., and Levin, M. I., The Solubility of Hydrogen in Aromatics and Naphthenes at High Temperatures and Pressures: Jour. Phys. Chem. (U. S. S. R.), vol. 6, 1935, p. 632; Chem. Abs., vol. 29, 1935, p. 7718. Pertierra, J. M., Contribution to the Study of the Colloidal Solution of Coal: Paper presented at 15th Cong. Ind. Chem., Brussels, Sept. 23–25, 1935; Chem. Abs., vol. 29, 1935, p. 7045; Hydrogenation of a Colloidal Solution of Coal: Jour. Inst. Fuel, vol. 9, 1935, pp. 16–23. Gillet, A., Pirlot, A., and Desirotte, L., A study of the Disintegration of Coal in a Solvent between 200° and 400° C.; The Stabilizing Effect of Fatty Acids: Paper presented at 15th Cong. Ind. Chem., Brussels, Sept. 23–25, 1935; Chem. Abs., vol. 29, 1935, p. 6394. Schmidt, O., Mechanism of Catalytic Hydrogenation: Ber. Deut. chem. Gesell., vol. 68, 1935, p. 1098. Galle, E., and Michelnitsch, W., Molybdenum and Molybdenum Compounds in Hydrogenation Reactions: Montan. Rundschau, vol. 27, no. 5, 1935, pp. 1–8; Petrol. Ztschr., vol. 31, no. 8, 1935, pp. 1–8. Maslyanskii, G. N., and Nemcov., M. S., The Poisoning of a Molybdenum-Zinc Catalyst: Compt. rend., Acad. Sci., U. S. S. R., vol. 2, 1935, pp. 404–407 (in English, pp. 408–409); Chem. Abs., vol. 29, 1935, p. 6827. Altman, L., and Nemcov, M., Research on Catalysts for Destructive Hydrogenation. II. Kinetics of Hydrogenation of Hydrocarbons on Molybdenum Disulphide: Acta Physicochimica (U. S. S. R.), vol. 1, 1935, pp. 429–448; Jour. Phys. Chem. (U. S. S. R.), vol. 6, 1935, pp. 221–233; Chem. Abs., vol. 29, 1935, p. 7767. Alchudzan, A. A., Vvedenskii, A. A., Gearkov, V. R., and Frost, A. V., Kinetics of Catalytic Hydrogenation of Aromatic Hydrocarbons with Palladium Catalysts at Pressures from 1 to 100 Atmospheres and 140 to 330° C.: Jour. Gen. Chem. (U. S. R. R.), vol. 4, 1935, p. 3220. Tanaka, Y., and Kobayashi, R., High-Pressure Hydrogenation of Aromatic Compounds. II. Production of Active Catalyst by Reduction of Nickel Oxide in a Benzene Medium. III. Mechanism of High-Pressure Hydrogenation of Benzene with Nickel Oxide: Jour. Soc. Chem. Ind. Japan, vol. 37, 1934, pp. 559–560B, 560–561B. Yende, Y., Mechanism of Production of Hydrocarbons from Fatty Acids by Hydrogenation at High Temperature and Pressure: Bull. Inst. Phys. Chem. Res. Japan, vol. 14, 1935, pp. 965–1080; British Chem. Abs., B 1936, p. 10.

4 Palfray, L., Special Apparatus for Catalytic Hydrogenation at High Pressure: Paper presented at 15th Cong. Ind. Chem., Brussels, Sept. 23–25, 1935.

reduction of phenols,[5] for the hydrogenation-cracking of anthracene,[6] naphthalene,[7] pitch,[8] coal,[9] and lignite,[10] and for the desulphurization of polynuclear aromatic hydrocarbons.[11] Experiments with Alberta coals, ranging in rank from lignite to anthracite, dispersed in liquid petrolatum or tetralin and using molybdic oxide as catalyst, showed nearly complete conversion of the lignites into liquid and gaseous products, and a somewhat lesser conversion for the sub-bituminous and bituminous coals.[11]

SYNTHETIC PRODUCTS FROM GASES

Two commercial-scale pilot plants for the production of motor fuel from water gas at atmospheric pressure by the Fischer process have been installed in Germany—one by the Ruhrchemie A. G. at Oberhausen-Holten, the other by the Klöckner combine at Castrop-Rauxel. The combined capacity is estimated at 25,000 tons of gasoline per year.[12] The capital cost of a Fischer plant is estimated at 5,400 reichsmark ($1,964 per short ton) per metric ton of gasoline produced per day compared to 4,000 reichsmark ($1,455 per short ton) for the I. G. coal-hydrogenation plant; however, the depreciation resulting from the lower temperature and pressure used in the Fischer process should be less; also the Fischer process will consume 7 tons of coke per ton of gasoline produced compared with 4 tons of coal for the coal-hydrogenation process.[13] Berthelot,[14] assuming 2,000 and 4,000 cubic meters of hydrogen is required, respectively, for the Bergius and Fischer processes and that hydrogen from water gas costs 30 centimes per cubic meter (50 cents per 1,000 cubic feet) estimates the cost of the hydrogen required for 1 metric ton of gasoline at 600 francs for the Bergius process and 1,200 francs for the Fischer process (approximately 10 and 20 cents per U. S. gallon, respectively). He suggests that much cheaper hydrogen

[5] T. Bahr, The Recovery of Pure Benzene Hydrocarbons from Phenols: Brennstoff Chem., vol. 16, 1935, pp. 47–50. Lozovoi, L. V., and Kharlampovich, B. B., Destructive Hydrogenation of Peat Producer Tar: Khim Tverdogo Topliva, vol. 5, 1935, p. 791; Chem. Abs., vol. 29, 1935, p. 7615. Rapoport, I. B., Minchenkov, M. P., and Konov, V. P., Destructive Hydrogenation of Phenols in a Continuous Apparatus: Khim Tverdogo Topliva, vol. 6, 1935, pp. 146–161; Chem. Abs., vol. 29, 1935, p. 7618. Hall, C. C., Hydrogenation Cracking of Some Condensed Nuclear Hydrocarbons: Jour. Soc. Chem. Ind., vol. 54, 1935, pp. 208T–217T. Pier, M., and Simon, W., U. S. Patent 1999735, Apr. 30, 1935.

[6] Khadzhinov, V. N., Destructive Hydrogenation of Crude Anthracene for the Purpose of Preparing Light Fuel or Aromatic Compounds. I and II: Jour. App. Chem. (U. S. S. R.), vol. 8, 1935, pp. 294–307, 889–902; Chem. Abs., vol. 29, 1935, p. 6727. Prokopetz, E. I., and Khadzhinov, V. N., Hydrogenation of Anthracene: Khim. Tverdogo Topliva, vol. 6, 1935, pp. 347–353.

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could be obtained from the carbonization of anthracite. At the Leuna works (Germany) of the I. G. Farbenindustrie, hydrogen for ammonia synthesis is obtained by the complete gasification of brown coal with a 1:1 oxygen-nitrogen mixture and highly superheated steam in an enormous producer having a shaft area of 20 square meters (215 square feet) and producing 75,000 cubic meters (2,648,000 cubic feet) of gas per hour.[15]

Research on Fischer process.—Continued foreign interest in the production of fuels and lubricants by the Fischer process is evident in the considerable number of reviews[16] and research reports[17] published within the past year.[18] Fischer and associates found that three-stage operation of the process gave a life of 5 months for the cobalt-copper-thorium-kieselguhr catalyst and a yield of 140 grams of gasoline plus oil per cubic meter of gas compared to a life of 3 months and a yield of 120 grams for single-stage treatment,[18] and that lubricating oils could be formed by condensation of alkyl chlorides prepared from synthetic Diesel oil.[19] Ruthenium plus 2 percent potassium carbonate heated to 180° to 300° C. catalyzes the reduction of carbon dioxide to methane and higher hydrocarbons; the life of the catalyst is short, but it may be regenerated by heating it in air at 300°–400° C.[20] Thermal decomposition of "Kogasin II"[21] yielded 56 percent of C_2H_4 and higher homologs. Japanese chemists have continued detailed experimentation on the influence of various factors on yields and quality of products.[22]

Pyrolysis of hydrocarbons.—The industrial development of two new processes for the manufacture of the high-antiknock gasoline from oil-refinery gases and the volatile condensate of natural gas is an outstanding event of the year in the production of motor fuel.[23]

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This gasoline, known as polymer gasoline or "polygasoline" has an octane number of 81 and therefore is likely to give strong competition to benzol and tetra-ethyl lead, which are now added as "antiknocks" to ordinary gasoline. Egloff states that there is enough raw material for polygasoline available in the United States to produce 9,000 millions of gallons annually, or 50 percent of the gasoline used in 1934.[24]

The catalytic olefine-polymerization process developed by the Universal Oil Products Co., employs phosphoric acid on an inert carrier, with the addition of a small amount of steam to the olefinic gas to maintain the active form of the phosphoric acid catalyst. The temperature is about 230° C. and the pressure 100 to 200 pounds per square inch. The operating data for a pilot plant using waste refinery gas containing 37.5 percent propylene and butylene indicate a yield of 6.5 gallons per 1,000 cubic feet of gas, the space velocity being about 2 cubic feet per hour per pound of catalyst.

In the thermal condensation process of the Phillips Petroleum Co. a stream of predominantly saturated hydrocarbons, such as butane, maintained at about 470° C. and 3,000 pounds per square inch is mixed with successive small quantities of predominantly olefinic hydrocarbons, such as ethylene or propylene. The olefines at no time constitute more than 5 to 10 percent of the total hydrocarbons present.

Experiments on the rate and mechanism of ethylene polymerization are reported by the United States Bureau of Mines and by Russian workers.[25]

The production of acetylene by incomplete combustion of natural gas and the utilization of acetylene to produce motor fuel, ethylene, pyridine bases, and acetals have been the subjects of several patents.[26]

There is widespread interest in the synthesis of octane by the polymerization of butylene, followed by hydrogenation or by the reaction of butane with butylene for the production of a high-antiknock motor fuel. The literature on the subject is, however, very meager.[27]

Additional experiments on the pyrolysis of propane, butane, and pentane have yielded data on composition of products and optimum conditions for a given product.[28]

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FUEL BRIQUETS

By L. N. Plein and J. B. Clark

SUMMARY OUTLINE

Production of fuel briquets increased encouragingly in 1935. The total output was 860,707 tons, a gain of 155,851 tons (22.1 percent) over 1934. The number of plants in operation increased from 27 to 29, the largest number in the history of the industry.

The outstanding development of the year was the installation at retail coal yards of machines for the manufacture of "packaged fuel"—cube-shaped briquets wrapped in paper in rectangular blocks of a size convenient for hand firing. Because of its special form, such fuel is not included in the statistics of the briquet industry proper, but data on this significant development are given in a separate section at the end of this report. The statistical tables relate to the production of unwrapped briquets only.

Trends in the industry since 1907, the date of the first statistical survey of fuel briquets, are summarized in the following table:

Salient statistical trends in the fuel-briquet industry in the United States, 1907–35

[The statistics in this and the following tables cover all types of briquets and boulets except the cube-shaped types wrapped in paper and sold under the name "Packaged Fuel." Data regarding the latter are given separately on pp. 658 to 661]

Year or yearly average	Production of briquets (Thousands of net tons)				Imports (Thousands of net tons)	Consumption[1] (Thousands of net tons)	Value of product, thousands of dollars	Number of plants in operation	Average output per plant, tons	Average value per ton f. o. b. plant	
	Eastern States	Central States	Pacific Coast States	Total						Pennsylvania	Central States
YEARLY AVERAGE											
1907–9	(2)	(2)	(2)	99	(3)	99	345	12	8,691	(2)	(2)
1912–15	76	90	53	219	(3)	219	1,037	17	13,179	$2.68	$4.62
1916–20	129	172	107	408	(3)	408	2,763	13	30,640	4.17	7.48
1921–25	188	299	140	627	12	639	5,418	14	43,672	6.04	9.07
1926–30	268	648	115	1,031	84	1,115	8,354	22	47,646	6.42	8.36
1931–35	220	374	59	653	40	693	4,374	27	23,879	5.06	7.18
YEAR											
1929	325	788	99	1,212	89	1,301	9,515	25	48,497	6.22	8.13
1930	301	641	87	1,029	73	1,102	8,029	25	41,155	6.22	8.13
1931	243	382	73	698	61	759	5,261	27	25,864	5.90	8.11
1932	128	296	47	471	80	551	3,459	26	18,100	5.21	7.60
1933	155	318	57	530	42	572	3,498	27	19,646	4.89	6.71
1934	264	388	53	705	-------	705	4,276	27	26,106	4.69	6.54
1935	310	485	66	861	17	878	5,376	29	29,680	4.60	6.96

[1] Production plus imports; the quantity exported has been negligible.
[2] Not available before 1912.
[3] No record of imports is available before 1919, but the quantity imported prior to that time was negligible.

Production of fuel briquets.—The Central States continued to lead in tonnage of briquets produced, followed by the Eastern and Pacific States, in the order named. All three regions increased their production in 1935, the greatest gains having been made in the Pacific Coast and Central States.

Production cannot be shown by States without revealing the operations of individual plants, except for Pennsylvania and Wisconsin. Six plants in Wisconsin produced 410,715 tons, valued at $2,986,847 and four plants in Pennsylvania produced 154,380 tons worth $710,544. The product of these two States therefore represents over 64 percent of the national output and over 68 percent of the value of the briquets made. Other important producing States are West Virginia, Massachusetts, and Oregon. In all, briquets are manufactured in 16 States.

Fuel briquets produced in the United States, 1934–35

	Production			Value		
	1934	1935	Increase or decrease	1934	1935	Increase or decrease
	Net tons	*Net tons*	*Percent*			*Percent*
Eastern States	263,734	309,416	+17.3	$1,245,973	$1,386,137	+11.2
Central States	388,557	485,010	+24.8	2,540,221	3,374,542	+32.8
Pacific Coast States	52,565	66,281	+26.1	490,272	615,449	+25.5
	704,856	860,707	+22.1	4,276,466	5,376,128	+25.7

Monthly production.—The use of briquets for house heating makes their manufacture highly seasonal. Many plants shut down in the spring and early summer and those that continue to operate report only a small output at that time. In 1935 January was the busiest month, 133,332 tons having been reported, or more than five times the output in July when business was poorest.

Monthly production of fuel briquets in the United States, 1933–35, in net tons

Month	1933	1934	1935	Month	1933	1934	1935
January	42,548	83,607	133,332	August	52,008	38,265	41,674
February	42,682	71,757	85,578	September	49,844	64,420	74,794
March	20,381	55,550	46,165	October	76,061	77,896	112,152
April	26,252	29,104	45,432	November	64,421	83,467	97,393
May	37,214	39,692	47,328	December	74,797	111,836	118,185
June	24,079	22,581	34,334				
July	20,143	26,681	24,340		530,430	704,856	860,707

Value.—The total sales value, f. o. b. plants, of the briquets manufactured in 1935 was $5,376,128, a gain of 25.7 percent over 1934. The average value per ton produced was $6.25. The average for the entire industry is of doubtful significance, because of the difference in cost of raw materials and in prices of competing fuels in various parts of the country. The average prices received in the three major sections of the country are shown in the table following. In the Eastern States the average realization declined slightly in 1935, due more to shifts in the relative proportions of the output derived from northern and southern plants than to changes in prices at particular plants, however. In the Central States, on the other hand, the average price obtained increased, reflecting the increased costs and price levels in the bituminous-coal industry, which supplies most of the solid fuel used in the Mississippi Valley. For the Central States as a whole the average realization, f. o. b. plant, increased from $6.54 in 1934 to $6.96 in 1935.

Average value per net ton of fuel briquets produced in the United States, 1933–35

	1933	1934	1935
Eastern States	$4.76	$4.72	$4.48
Central States	6.71	6.54	6.96
Pacific Coast States	10.94	9.33	9.29
	6.60	6.07	6.25

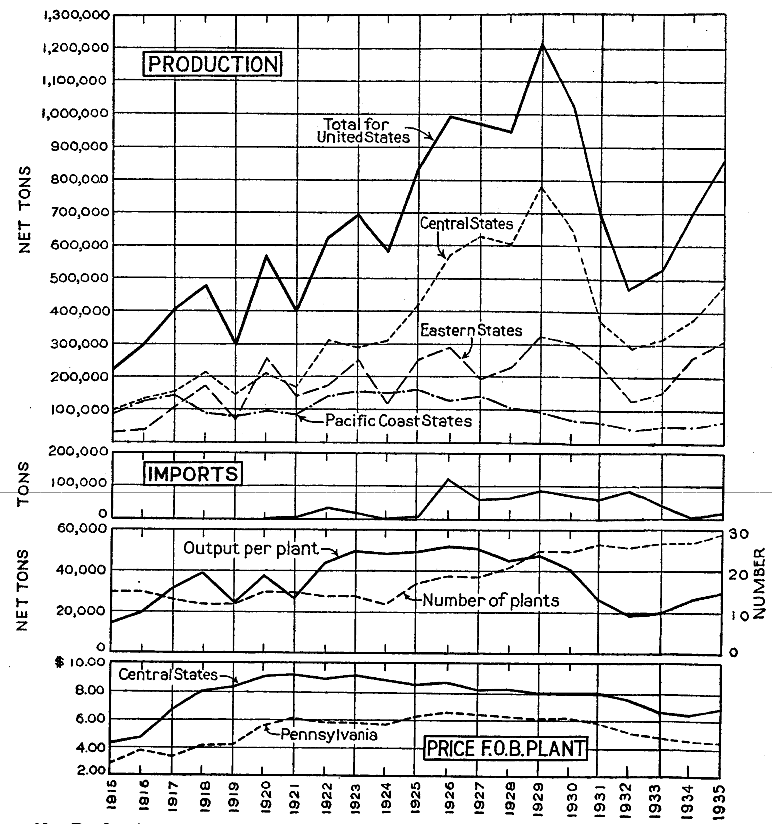

FIGURE 98.—Production and imports of fuel briquets, number of plants in operation, and average price received, f. o. b. plants, 1915–35.

Number and location of plants.—Twenty-nine plants reported production of briquets on a commercial scale during the year. Four plants active in 1934 produced no briquets in 1935, but six additional plants—the Allegheny River Mining Co., Cadogan, Pa.; Coal Processing Co., Superior, Wis.; Great Lakes Coal Co., St. Paul, Minn.; Great Lakes Coal Co., Casper, Wyo.; Paris Purity Coal Co., Paris, Ark.; and Dixie Modern Coal Co., Fort Smith, Ark.—were in active operation during the year. The Standard Briquet Fuel Co. leased its plant in Kansas City, Mo., to the Binkley Coal Co.

The construction of new plants indicates an active interest in the utilization of fine material suitable for briquetting, and the number of plants now operating is greater than at any time since the first statistical survey was made in 1907. Since 1907 a number of large plants have established themselves firmly and built up a permanent business, and briquetting apparently is now a stable commercial industry assured of a profitable future. However, during the development of the industry a great many small plants were erected that have later been dismantled or abandoned. The files of the Bureau disclose that 66 plants in all went out of business in the last 28 years. For every plant now in operation, therefore, more than two plants have been abandoned or dismantled. Promoters of new ventures should realize that the existence of a local accumulation of cheap slack alone will not assure a profit and they should give thought to the factors of location, freight rates, accessibility to markets, and prices of competing fuels as well as to cost of raw material.

Most of the briquets have been produced in the northwest dock cities on Lake Superior and the west bank of Lake Michigan, the low-volatile coal fields of southern West Virginia, the Pennsylvania anthracite region, the metropolitan district of Boston, and certain cities of the Pacific coast where carbon residue from oil gas is used as raw fuel. However, the record shows a number of plants in other locations that have continued in business for years. A significant new development in this business is the utilization of local accumulations of petroleum coke.

Briquetting plants operated in the United States in 1935

[Does not include makers of paper-wrapped briquets sold under the name Packaged Fuel]

State	Name and address of operator	Location of plant	Date put in operation	Raw fuel used, as reported by producer
Eastern States:				
Massachusetts	American Briquet Co., 1505 Philadelphia Bank Bldg., Philadelphia, Pa.	Charlestown	1929	Anthracite.
Do	Staples Coal Co., 80 Federal St., Boston, Mass.	Fall River	1932	Anthracite and bituminous slack.
Pennsylvania	American Briquet Co., 1505 Philadelphia Bank Bldg., Philadelphia, Pa.	Lykens	1920	Anthracite.
Do	Atlantic Refining Co., 260 South Broad St., Philadelphia, Pa.	Philadelphia	1933	Petroleum coke.
Do	Henriette Coal Mining Co., 15 Moore St., New York, N. Y.	Dunlo	1929	Bituminous, low volatile.
Do	Allegheny River Mining Co., North McKean St., Kittanning, Pa.	Cadogan	1935	Bituminous, high volatile.
West Virginia	Berwind Fuel Co. of West Virginia, 122 South Michigan Ave., Chicago, Ill.	Berwind	1929	Bituminous, low volatile.
Do	Raleigh-Wyoming Mining Co., 230 South Clark St., Chicago, Ill.	Glen Rogers	1932	Do.
Central States:				
Arkansas	Paris Purity Coal Co., American Bank Bldg., Paris, Ark.	Paris	1935	Do.
Do	Dixie Modern Coal Co., 422 Commerce Bldg., Pittsburg, Kans.	Fort Smith	1935	Semianthracite.
Colorado	Acme Smokeless Fuel Co., 212 Davidson Bldg., Bay City, Mich.	Salida	1931	Anthracite and bituminous slack.
Minnesota	Great Lakes Coal & Coke Co., 910 South Michigan Ave., Chicago, Ill.	St. Paul	1935	Petroleum coke.

Briquetting plants operated in the United States in 1935—Continued

[Does not include makers of paper-wrapped briquets sold under the name Packaged Fuel]

State	Name and address of operator	Location of plant	Date put in operation	Raw fuel used, as reported by producer
Central States—Con.				
Missouri	Binkley Coal Co., 230 North Michigan Ave., Chicago, Ill.	Kansas City	1909	Anthracite and semianthracite.
Nebraska	Christopherson-Renstrom Co., 30th and Boyd St., Omaha, Nebr.	Omaha	1932	Petroleum coke.
North Dakota	Lehigh Briquetting Co., Universal Bldg., Fargo, N. Dak.	Lehigh	1929	Lignite char.
Oklahoma	Superior Smokeless Coal & Mining Co., 20 North Wacker Drive, Chicago, Ill.	Tahona	1933	Semianthracite.
Texas	Magnolia Petroleum Co., P. O. Box 3311, Beaumont, Tex.	Chaison	1930	Petroleum coke.
Wisconsin	Berwind Fuel Co., 122 South Michigan Ave., Chicago, Ill.	Superior	1912	Bituminous, low volatile.
Do	C. Reiss Coal Co., Reiss Bldg., Sheboygan, Wis.	Sheboygan	1933	Do.
Do	Panda Briquet Co., 1011 Foshay Tower, Minneapolis, Minn.	Ashland	1931	Do.
Do	Stott Briquet Co., Inc., 1204 East First National Bank Bldg., St. Paul, Minn.	Superior	1909	Anthracite and bituminous, low volatile.
Do	United Coal & Dock Co., 102 West Wells St., Milwaukee, Wis.	Milwaukee	1928	Bituminous, low volatile and high temperature coke.
Do	Coal Processing Corporation, 230 South Clark St., Chicago, Ill.	Superior	1935	Bituminous, low vol atile.
Wyoming	Great Lakes Coal & Coke Co., 910 South Michigan Ave., Chicago, Ill.	Casper	1935	Petroleum coke.
Pacific Coast States:				
California	California Fuel & Utilities, Inc., P. O. Box 390, Compton, Calif.	Compton	1931	Do.
Do	Los Angeles Briquet & By-Product Co., 6623 McKinley Ave., Los Angeles, Calif.	Los Angeles	1933	Do.
Oregon	Portland Gas & Coke Co., Public Service Bldg., Portland, Oreg.	Portland	1913	Carbon residue from oil gas.
Washington	Pacific Coast Coal Co., 608 Smith Tower, Seattle, Wash.	Renton	1914	Bituminous, high and low volatile.
Do	Calkins Pressed Fuel Co. of Renton, Renton, Wash.	do	1934	Do.

Size of plants.—That most briquetting plants are still small is shown in the following table, which classifies existing plants according to their annual output. In 1935 more than half of the plants produced less than 10,000 tons and eight plants produced less than 2,000. On the other hand, four plants produced over 100,000 tons each during the year.

Classification of briquetting plants by size of output, 1933–35

Output, net tons	Number of plants 1933	1934	1935	Output, net tons	Number of plants 1933	1934	1935
Less than 2,000	6	8	8	25,000 and less than 100,000	8	8	5
2,000 and less than 5,000	4	3	2	100,000 and over	------	1	4
5,000 and less than 10,000	6	3	6		27	27	29
10,000 and less than 25,000	3	4	4				

Raw fuels.—The briquetting process is now applied to a wide variety of raw fuels ranging from North Dakota lignite (after carbonization at low temperature) to Pennsylvania anthracite, and including low- and high-temperature coke, oil-gas residue, and petroleum coke. The number of plants that used each type of fuel in 1935 is shown below. The largest single number of plants employed low-volatile bituminous coal; followed by petroleum coke and anthracite or semianthracite in the order named.

Classification of briquetting plants, by kinds of raw fuel used in 1935

Kind of raw fuel used:	Number of plants
Anthracite or semianthracite fines	5
Mixture of anthracite or semianthracite and bituminous	3
Bituminous:	
Low volatile	[1] 9
High volatile	[2] 3
Semicoke (low-temperature coke or char)	1
Carbon residue from the manufacture of oil gas	1
Petroleum coke	7
	29

[1] 1 plant using low-volatile coal also reported using breeze of high-temperature coke.
[2] 2 plants using high-volatile bituminous also reported using some low-volatile as well.

The total quantity of raw fuel briquetted in 1935 was 823,719 tons; 31.5 percent of this was anthracite or semianthracite, 54.6 percent bituminous coal of various grades, and 13.9 percent was coke of different kinds or oil-gas residue. Over the last 10 years the proportion of anthracite fuel has declined and the proportion of bituminous fuel has increased. A significant increase, also, has occurred in the proportion of coke and oil-gas residue, which rose from 7.9 percent in 1925 to 13.9 in 1935. Most of this increase represented petroleum coke, which was first reported as a raw fuel for briquets in 1930.

Raw fuels used in making briquets in the United States, 1925, 1929, 1934, and 1935, in net tons

	Net tons				Percent of total			
	1925	1929	1934	1935	1925	1929	1934	1935
Anthracite and semianthracite culm and fine sizes	383,189	408,967	240,273	259,553	45.4	34.4	35.7	31.5
Semibituminous, bituminous, and subbituminous slack	394,486	711,459	347,446	449,570	46.7	59.9	51.7	54.6
Semicoke, coke, oil-gas residue, and petroleum coke	66,915	67,513	84,506	114,596	7.9	5.7	12.6	13.9
	844,590	1,187,939	672,225	823,719	100.0	100.0	100.0	100.0

Binders and recarbonization.—Asphaltic pitch is the binder used most often in the manufacture of fuel briquets. Of the 29 plants active in 1935, 19 used asphaltic pitch exclusively. Of the other plants that used binders, one used asphaltic pitch and white corn flour, two petroleum asphalt, two starch, asphalt, and water, one mixed pitches, one cement, one aspholeum, one briquetting asphalt. One plant that briquetted the carbon residue from the manufacture of oil gas required no binder.

The percentage of binder to raw fuel, by weight, ranged from less than 5 to more than 9. The proportion used most often was 5 to 8 percent, as in 1934.

One producer who used a binder reported recarbonizing the briquets coming from the presses to drive off smoke from the binder. Two other producers reported partly recarbonizing the briquets.

Classification of briquetting plants, by percentage of binder used in 1935

Binder used:	Number of plants
Using no binder (carbon residue)	1
Using—	
Less than 5 percent binder	2
5 and less than 7 percent	16
7 and less than 9 percent	9
9 percent and over	1
	29

Weight and shape.—American manufacturers favor a briquet size equivalent to the more popular sizes of anthracite rather than the massive blocks (up to 8 pounds in weight) which predominate in Europe, where "patent fuel" and large briquets are used for industrial and locomotive consumption. In 1935 the greatest number of plants were making a briquet weighing 2 to 3 ounces, the output constituting 71.59 percent of the total briquet product. About 22.27 percent of the output was made in sizes weighing 3 to 5 ounces. Nevertheless, a wide variety of sizes, from less than 2 ounces to a maximum of 5 pounds, has been offered to the American public. A small production of briquets of the last-named weight in blocks measuring 9½ by 4⅜ by 2⅝ inches was reported in 1935.

Prevailing weight of briquets manufactured in 1935

Weight of briquet (ounces)	Number of plants making briquets of specified size [1]	Production of briquets	
		Net tons	Percent
Less than 2	6	38,932	4.52
2 and under 3	14	616,184	71.59
3 and under 4	2	191,672	22.27
4 and under 5	4		
5 and under 6	1	5,274	.61
6 and under 10	2		
10 and under 16	1	8,645	1.01
16 and under 21	2		
42 and over	2		
	29	860,707	100.00

[1] Several plants made briquets of more than 1 size; hence the sum of the items in this column exceeds the total number of briquet plants.

The most frequent type of briquet reported is pillow-shaped. Of the 29 plants active in 1935, 16 made pillow-shaped briquets, 4 cubes, 3 cylindrical briquets, and 3 ovoid or egg-shaped briquets. One plant reported making three different shapes—pillow, cylindrical, and egg. Another plant made pillow and cylindrical shapes, and still another made oval and rectangular shapes.

Principal expenses and value added by manufacture.—The following table has been prepared to throw light on the cost of production. It analyzes the data of the Biennial Census of Manufactures, which gives information as to value of product and principal expenses in all industries. The census classification of the fuel-briquets industry includes only those establishments with an output valued at $5,000 or more, in which briquets are the chief product made. The Census, therefore, excludes a considerable tonnage of briquets produced at petroleum refineries or at city gas works utilizing the oil-gas process. The Census returns may be accepted as representative, however, of the independent briquetting plant.

In 1933 the cost of salaries per ton of briquets manufactured averaged 22 cents and the cost of wages 55 cents. The average cost of materials, including the raw fuel, purchased electric power, and fuel used for power at the plant averaged $3.96 per ton. The total of the expenses reported was $4.73 per ton, and the margin between this and the value of the product, f. o. b. plant, averaged $1.45 a ton. The margin, however, does not represent a profit, as numerous other charges not reported would have to be deducted also.

Analysis of Census of Manufactures data on production of fuel briquets, 1931 and 1933

Item	1931		1933	
	Total	Per ton	Total	Per ton
Number of establishments	23		24	
Production (net tons)	611,179		[1] 476,471	
Principal expenses:				
Salaries	[2] $134,000	[2] $0.22	$106,000	$0.22
Wages	356,633	.58	262,000	.55
Materials, power, and fuel used for power at plant	3,034,691	4.97	1,886,000	3.96
Total	3,525,324	5.77	2,254,000	4.73
Value of product, f. o. b. plant	4,567,853	7.47	2,944,000	6.18
Margin between value of product and expenses itemized above [3]	1,042,529	1.70	690,000	1.45

[1] Estimated in part by Bureau of the Census.
[2] Data on salaries paid were not collected in the census of 1931. The figures used have been estimated from the corresponding returns in 1929 and 1933.
[3] Not to be confused with profit. Charges for interest, depreciation, taxes, insurance, workmen's compensation, and all other expenses not itemized above would have to be deducted also.

Distribution.—The distribution of briquets, as indicated by reports of the manufacturers, is penetrating new markets. In 1935 briquets were shipped into 44 States, Alaska, and the District of Columbia and were exported to Canada. Shipments into many of the States were small, but a widening of the market is indicated by comparison with 1928, when briquets were shipped to only 25 States, with some exports to Canada. Minnesota is the largest consumer of fuel briquets.

Fuel briquets of domestic manufacture consumed in the United States and exported to Canada, 1934–35, in net tons

Shipped into—	1934	1935	Shipped into—	1934	1935
Alaska	218	467	Nevada	64	51
Arizona	18	80	New Hampshire	3,046	1,979
Arkansas	----------	38	New Jersey	4,369	2,777
California	4,398	8,094	New Mexico	88	70
Colorado	908	775	New York	42,897	58,021
Connecticut	1,545	2,240	North Carolina	3,618	5,090
Delaware	377	285	North Dakota	50,525	60,419
District of Columbia	312	464	Ohio	10,074	9,459
Florida	302	387	Oklahoma	241	92
Georgia	----------	29	Oregon	33,974	41,130
Idaho	285	402	Pennsylvania	13,427	24,329
Illinois	12,606	18,831	Rhode Island	6,861	6,165
Indiana	5,794	6,382	South Carolina	415	515
Iowa	22,713	23,068	South Dakota	34,401	43,596
Kansas	5,278	4,841	Texas	3,657	4,350
Kentucky	264	187	Vermont	295	354
Louisiana	799	782	Virginia	13,646	14,753
Maine	1,578	677	Washington	12,658	16,917
Maryland	3,799	3,323	West Virginia	1,144	1,730
Massachusetts	76,875	56,809	Wisconsin	104,885	154,857
Michigan	22,185	35,472	Wyoming	----------	3,125
Minnesota	168,067	195,384	Canada	12,889	27,049
Missouri	5,904	7,564			
Montana	22	23		703,592	858,646
Nebraska	16,171	15,214			

Foreign trade.[1]—No fuel briquets were imported in 1934 and but negligible amounts were received in 1935.

Briquets and other composition coals [1] *for fuels imported for consumption in the United States, 1930–35*

Year	Net tons	Value	Year	Net tons	Value
1930	73,418	$399,146	1933 [1]	42,395	$126,157
1931	60,950	325,189	1934	(2)	(2)
1932 [1]	80,288	335,358	1935	16,778	73,992

[1] Beginning July 1, 1932, coal and coke briquets only.
[2] None reported for 1934.

Fuel briquets imported into the United States, 1933–35, by months, in net tons [1]

Month	1933	1935	Month	1933	1935
January	14,783	1,511	August	----------	783
February	11,293	1,457	September	----------	----------
March	10,797	5,715	October	----------	3,280
April	----------	----------	November	----------	1,064
May	----------	----------	December	----------	2,128
June	5,522	840			
July	----------	----------		42,395	16,778

[1] None reported for 1934.

[1] 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.—The annual world production of briquetted fuel is now about 50,000,000 tons. Germany is by far the greatest producer and accounts for over 70 percent of the total supply. France and Belgium are the second and third largest producers. At present the United States contributes approximately 1.3 percent of the total amount. The briquetting industry has attained its greatest development in countries where a large part of the available fuel is of low grade and where market conditions warrant its conversion from the raw state to briquets.

World production of fuel briquets, 1931–35, in metric tons

[Compiled by M. T. Latus]

Country [1]	1931	1932	1933	1934	1935
Algeria	73,828	71,240	19,689	12,913	(2)
Australia: Victoria	296,000	325,000	315,754	(2)	(2)
Belgium	1,850,360	1,316,990	1,363,790	1,353,530	1,362,300
Bulgaria	------------	------------	6,234	19,534	(2)
Czechoslovakia:					
Coal	285,782	406,574	396,840	386,463	408,586
Lignite	209,435	202,003	194,497	194,893	188,466
France	7,185,830	7,537,000	7,534,000	7,947,000	7,830,000
Germany: [3]					
Coal	5,186,566	4,375,512	4,863,940	5,193,279	5,476,000
Lignite	32,422,214	29,752,172	30,064,899	31,384,338	32,903,456
Saar	1,178	6,939	7,706	6,105	(2)
Hungary:					
Coal					
Lignite	184,544	414,421	371,550	310,107	(2)
Indochina	134,000	97,406	73,219	62,231	(2)
Italy	2,450	2,414	4,926	18,290	(2)
Netherlands:					
Coal	1,212,621	1,170,930	1,102,551	1,087,145	(2)
Lignite	40,892	44,025	35,641	33,996	(2)
Netherland India	17,418	6,967	32,948	34,673	(2)
Poland	300,999	222,246	221,911	215,008	(2)
Portugal	(2)	(2)	[4] 727	[4] 511	(2)
Rumania	30,400	43,019	127,274	122,204	(2)
Spain	914,117	785,703	801,953	837,292	(2)
Tunisia	71,000	65,750	56,652	62,941	(2)
United Kingdom	883,498	923,048	955,822	891,303	(2)
United States	633,498	426,923	481,195	639,431	780,816
Venezuela	(2)	555	(2)	(2)	(2)
Yugoslavia	41,083	29,851	24,015	23,533	(2)
	51,977,713	48,226,688	49,057,733	50,836,720	(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] Exclusive of the Saar.
[4] From domestic coal only.

PACKAGED FUEL

A significant development in the merchandising of coal for domestic use is the introduction of cube-shaped briquets wrapped in paper, which are sold as "packaged fuel." The briquetting and wrapping machines are manufactured by C. M. Eberling at Cleveland, Ohio. Sales of packaged fuel began in the fall of 1932, but statistics of production were collected by the Bureau of Mines for the first time in 1935.

All of the machines that produce wrapped briquets of which the Bureau has obtained a record are operated by retail coal merchants. The raw material used is slack or screenings resulting from the degradation of prepared sizes in course of shipment from the mines or in subsequent handling at the dealer's yard. Ordinarily, yard screenings are salable only for steam raising at a price much below that of prepared coal. To dispose of the screenings profitably has always been a problem, and the idea of converting them into briquets, so as to command the higher prices of lump coal, is not new. For example, it has been done on a large scale at the upper Lake docks. Until now, however, the installation of an efficient briquetting plant has involved an investment out of proportion to the volume of screenings accumulated by a single retailer. The new development offers a smaller machine, available at a moderate cost, driven by purchased electric power, adapted to intermittent use, operable by laborers of the coal yard, and yielding a product with distinctive sales appeal.

Although packaged fuel is probably too friable to stand shipment by rail over long distances, it can easily be delivered locally by truck. A large briquet plant at a mine or a Lake dock must often absorb freight charges on much of its tonnage. A packaged-fuel plant, within its limited field, is relieved of the burden of freight, which helps to offset the disadvantage and presumably higher cost of small-scale operation.

Nearly all packaged-fuel installations, therefore, use yard screenings. At least one dealer, however, brings carloads of slack direct from the mines in the Pocahontas field. The Blue Ribbon Package Fuel Co. of Cleveland operates primarily as a manufacturer and retail distributor of packaged fuel, all of the slack it purchases going into cubes for wrapping and local sale. An article describing the operations of this company was published in the April 1936 issue of Coal Heat.

The process apparently is applicable to a wide variety of coals. At present both high-volatile and low-volatile bituminous coals are being used. Most of the product, however, is made from the low-volatile coals of southern West Virginia.

The binder customarily used is a starch product to which secret ingredients have been added and which is substantially smokeless. It is similar to a binder that is mixed with molding sand to make cores for foundry work. Some dealers, however, are using cement as a binder in preference to starch. The amount of starch binder used ranges from 15 to 20 pounds per ton of coal; that of cement, from 45 to 55 pounds. The slack coal, the binder, and a small amount of water are mixed together and pressed into cubes measuring 3½ or 4 inches. As the cubes come from the press they are wrapped in heavy kraft paper and bound together with gummed-paper tape, six cubes in a package. The 3½-inch cubes make a package 3½ inches high, 7 inches wide, and about 10½ inches long, weighing 10 pounds. The 4-inch cubes make packages 4 by 8 by 12 inches in size, weighing 15 pounds. The packages are cured for about 4 hours by drying in a hot room and are then ready for delivery.

No analyses of the quality of the cubes, based upon carefully prepared samples, are available. It is claimed that the starch binder does not add any ash or volatile matter to the finished product; the cement binder adds no volatile matter but tends to increase the ash content in proportion to the percentage used. The quality of the finished product will therefore closely resemble the quality of the raw coal used. Specimens of packaged fuel, collected by the senior author at two different plants, both using Pocahontas screenings, show the following range in composition: moisture, 1.1 to 1.4 percent; volatile matter, 17.7 to 19.3; ash, 5.4 to 9.5; and sulphur, 0.5 percent. The heating values, in British thermal units, were 14,060 and 14,520

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per pound on an "as-received" basis. One of these plants used a starch binder, and its product was lower in ash but higher in moisture and volatile matter than the plant using cement as a binder. However, the differences observed could easily have been caused by the differences in the quality of the raw coal rather than by the type of binder used.

Official data on the cost of manufacturing packaged fuel are not available, but certain items of cost have been published in the trade journals.[2] In Cleveland, Ohio, costs per ton of product are said to be as follows: Kraft paper, 40 cents; gummed tape, 12 cents; binder, 60 cents; labor, 60 cents; power for machinery, 5 cents; and maintenance, 5 cents. Other items of expense are involved of course, such as salaries, insurance, workmen's compensation, depreciation, interest on investment, and taxes, but no estimates of these overhead charges are available.

The cost of Pocahontas lump delivered in carload lots in Cleveland during the 1935–36 heating season was reported by one dealer as averaging about $5.70 per ton, and slack about $4.10 per ton. The retail price of "shoveled" coal (that is, as loaded out of the car) was $8.95 per ton delivered; "forked" Pocahontas (that is, coarser sizes only) was $9.95 per ton; and packaged fuel was $9.25 per ton.

The following is the packaged-fuel price list offered by a Cleveland dealer in the winter of 1935-36:

Packaged fuel:	*Delivered to consumer*	*Called for at dealer's yard*
1 ton	$9.25	$8.15
½ ton	4.80	4.25
32 packages (approximately ¼ ton)	2.75	2.25
13 packages (approximately ⅒ ton)	[1]	1.00

[1] Not delivered.

When delivered to a consumer, the packages are stacked neatly in the cellar close to the furnace. A considerable part of the business is in less-than-ton lots. An unexpected feature of the trade has been that customers drive into the dealer's yard in their own automobiles and purchase as little as a dollar's worth (13 packages) to take home. Such "called-for" purchases are especially common in the spring and fall, when consumers need only small amounts to tide them over a few days of cool weather. In addition to the domestic trade, packaged fuel is finding a commercial outlet in heating gasoline stations, attendants' quarters in city parking lots, and small stores.

For such small-scale heating and for the domestic trade, packaged fuel evidently has a distinct appeal. It has the advantage of cleanliness in delivery, requires no specially constructed storage bin, and is clean and convenient to fire. When made of low-volatile coal, the product is substantially free from smoke. Some of the dealers interviewed are making it as a convenience to their customers, others are primarily concerned with obtaining a better price for their slack. In general, those engaged in the business are optimistic as to its future. At the same time, certain factors are recognized as tending to limit the application of this product. Handling of wet coal is difficult. It is not always feasible to carry over large stocks from summer into the heating season. The over-all cost must be kept inside the spread between the price of screenings and the price of lump

[2] Newton, William C., Builds Business with Packaged Fuel: Coal Heat, April 1936, pp. 18, 20. R. F. Mitten, Packaged Fuel Proves Profitable: Pp. 52, 53.

coal. Some dealers who have investigated the matter are convinced that the best outlet for their screenings is still to be found in the steam trade. It is evident that each installation presents a problem of its own and that all controlling factors should be weighed carefully before an investment in equipment is made.

A factor that may tend to limit the sale of packaged fuel, particularly where the cost is relatively high, is the growing demand for automatic heat by gas, oil, or small coal stokers. Nevertheless, the hand-fired coal furnace is still the means of heating millions of homes and the convenience and cleanliness of packaged fuel, when available at no extra cost, have a decided appeal.

The success of the business depends upon the use of a slack coal comparable in quality with the best grades of domestic coal sold in the area in which the packages are being marketed. Attempts to use coal of poor quality undoubtedly would react unfavorably upon the trade.

The installation of a central plant to utilize the screenings of a number of dealers in a metropolitan area for the manufacture of a stock of packaged fuel, upon which these dealers could draw, offers possibilities. This plan has been tried in a small way by one operator.

The data below are summarized from reports furnished by operators of packaged-fuel plants, supplemented by information from the manufacturer of equipment.

Up to the end of 1935, packaged-fuel machinery had been installed in 32 retail yards operated by 30 dealers in 10 States. Five of these did not operate in 1935 but are expected to be in production sometime in 1936. Two others had supplied the Bureau with no definite information up to the completion of this report. Twenty-five plants are known to have been active in 1935 and to have produced 25,244 tons. Several of the 25 plants began producing late in the year so that the total output is not a fair indication of their capacity.

Statistics of paper-wrapped cube-shaped briquets sold as packaged fuel in 1935

[The plants and production reported in this table are not included in the preceding tables, which apply to unwrapped briquets only]

	Number of plants		Net tons produced
	Installed to end of 1935	Producing in 1935	
Ohio	14	14	13,890
9 other States [1]	18	11	11,354
	32	25	25,244

[1] Alabama, Connecticut, Indiana, Maine, Michigan, Minnesota, Nebraska, Pennsylvania, and Virginia.

More than half of the production reported came from 14 plants in Ohio, and most of this, in turn, came from Cleveland. Active production also was reported from one plant in Indiana, five in Michigan, one in Minnesota, one in Nebraska, one in Pennsylvania, and two in Virginia.

The average price received for packaged fuel by individual dealers ranged from $5.22 to $10.40 per ton. The average for all dealers reporting values in 1935 was $7.68.

PEAT

By F. M. Shore

SUMMARY OUTLINE

Reports received by the Bureau of Mines indicate that the production of peat in the United States in 1935 totaled 37,060 short tons valued at $199,377. These figures represent declines of 8.6 percent in quantity and 6.9 percent in value compared with 1934. Imports of peat moss were 54,547 short tons valued at $677,513 in 1935; both tonnage and value increased substantially over the preceding year.

The peat produced in this country at present is used chiefly for soil improvement. Although peat is used extensively as a fuel in various European countries, apparently it is unable to compete in the domestic fuel markets under present conditions, and no commercial production for such use was reported for 1934 or 1935.

Although the consumption of peat in the United States is small compared to the vastness of domestic deposits, probably a wider dissemination of information as to the availability and economic uses of peat will lead to its greater utilization. The existing situation in the domestic peat industry is indicated by the data herein, which were obtained chiefly from reports supplied by producers covering their operations in 1935.

The progress of the domestic peat-producing industry since it attained commercial importance in 1908 is outlined in figure 99. The record of this progress was compiled by the United States Geological Survey for the period 1908–26, and the results were published in the annual volumes of Mineral Resources of the United States. No data were gathered by the Federal Government for 1927–33. In the belief that developments affecting the utilization of the vast peat deposits of the Nation should be recorded for the benefit of both the industry and the public, the Bureau of Mines made an annual canvass of the peat industry for a record of its operations in 1934. The results of this survey are published in Minerals Yearbook, 1935.

It will be noted from the chart that the outstanding development in the history of the domestic peat industry occurred during the World War. The notable increase in the output of peat in 1917 and 1918 was attributed largely to the shortage and high prices of coal and nitrates and to the wide demand for soil improvement to increase the production of food. The production of peat for fuel in New England was a notable development in 1918.

Resumption of the canvass of the peat industry after a lapse of 7 years involved a widespread search for existing peat operations, which proved difficult owing to the widely scattered locations of the plants and the fact that many of them are relatively small. All known sources of information regarding the location of peat-producing operations have been canvassed, and it is believed that the results substantially cover the field. However, it is desired to improve this coverage if possible, therefore, the Bureau of Mines will appreciate any information regarding the inauguration of new producing operations in recent years or the resumption of operations at plants that have been idle.

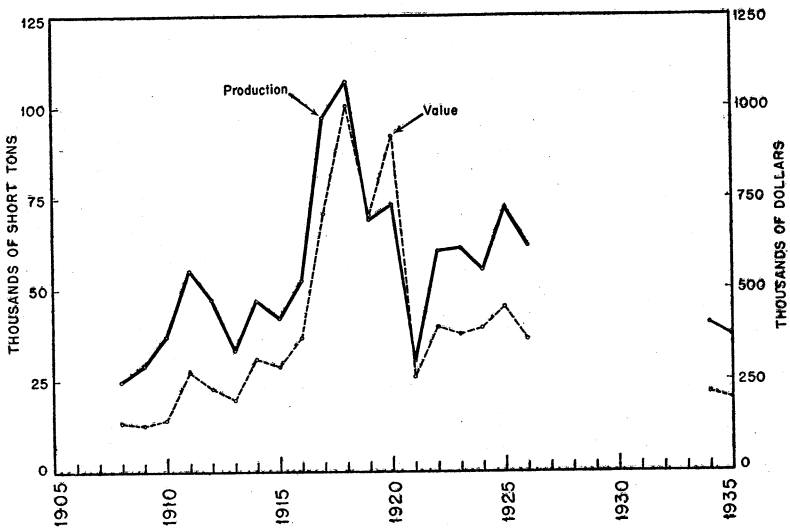

FIGURE 99.—Quantity and value of peat production, 1908–26 and 1934–35. No data are available for the period 1927–33.

Reserves.—The peat reserves of the United States (exclusive of Alaska) calculated as air-dried peat have been estimated at 13,827,000,000 tons.[1] Minnesota, Wisconsin, and Michigan account for about 75 percent of these reserves; and the entire northern region, embracing the New England States those bordering on the Great Lakes, and Iowa, contains about 80 percent of the total. The remaining reserves are found in the Atlantic coastal region and in the Pacific and Gulf Coast States.

Production.—The production of peat in the United States, since the industry attained commercial importance, has been shown in figure 99. Details of the quantity and value of production in recent years are shown in the following table. The output of 37,060 tons in 1935 had a total value or selling price at producing plants of $199,377, or an average value per ton of $5.38, compared with an average value of $5.28 per ton for the output in 1934.

[1] Soper, E. K., and Osbon, C. C., The Occurrence and Uses of Peat in the United States: U. S. Geol. Survey Bull. 728, 1922, p. 92.

Quantity and value of peat produced in the United States, 1917–26 and 1935 [1]

Year	Short tons	Value	Year	Short tons	Value
1917	97,363	$709,900	1923	61,355	$376,834
1918	107,261	1,047,243	1924	55,469	395,470
1919	69,197	705,532	1925	72,436	452,898
1920	73,204	921,732	1926	61,936	364,413
1921	30,406	260,119	1934 [1]	40,544	214,185
1922	60,680	397,729	1935	37,060	199,377

[1] Data not available for 1927–33. No canvass for those years.

New York and New Jersey were the largest producers of peat in 1935. Other producing States were Maine, Massachusetts, New Hampshire, Pennsylvania, Ohio, Michigan, Minnesota, Indiana, Illinois, Iowa, Florida, California, and Washington.

Of the tonnage of peat produced in 1935, approximately 79 percent was reported as peat humus and 19 percent as peat moss.

Uses.—Peat is used for soil improvement on lawns, golf courses, and gardens, and at nurseries and greenhouses; as fuel, in raw or manufactured form; as litter for live stock and poultry; as packing material for plants, shrubs, eggs, fruits, vegetables, and fragile articles; and for insulating material. Although peat may be put to many uses, at present it is used principally in agriculture and horticulture, as a soil conditioner and as an ingredient of fertilizer. Approximately 98 percent of the peat sold in 1935 was reported used for soil improvement. Poultry litter accounted for most of the remainder.

Imports.—Imports of peat moss in 1935 gained 23.6 percent in quantity and 23.8 percent in value over 1934. The United States continues to obtain most of its imports from Europe, principally from Germany and Sweden. Receipts from Canada, although small, increased substantially in 1935. The average value per ton of the peat moss imported was $12.42 in 1935 compared with $12.40 in 1934.

Imports of peat moss, by countries, 1934–35, in short tons

[Compiled from records of the Bureau of Foreign and Domestic Commerce]

Country	1934	1935	Country	1934	1935
Belgium	14	18	Netherlands	76	497
Canada	1,121	1,796	Norway	1,716	1,453
Czechoslovakia	24		Sweden	13,328	18,860
Denmark	1,167		U. S. S. R. (Russia in Europe).	444	542
Estonia	49	156	United Kingdom	29	218
Finland	2	1		44,132	54,547
Germany	26,149	30,977			
Japan	13	27			
Latvia		2			

Peat moss imported for consumption, 1918–35

Year	Short tons	Value	Year	Short tons	Value	Year	Short tons	Value
1918			1924	5,541	$47,208	1930	70,466	$869,381
1919	464	$16,345	1925	10,233	121,719	1931	63,928	682,553
1920	2,762	36,201	1926	16,669	174,241	1932	64,701	601,372
1921	3,450	22,754	1927	31,595	326,549	1933	41,217	442,766
1922	4,805	33,034	1928	40,087	422,275	1934	44,132	547,353
1923	5,973	43,184	1929	57,531	657,145	1935	54,547	677,513

CRUDE PETROLEUM AND PETROLEUM PRODUCTS [1]

By A. G. WHITE, G. R. HOPKINS, and H. A. BREAKEY

SUMMARY OUTLINE

The most noteworthy factor in reviewing the trends of the petroleum industry since 1929 is the relatively high volume of production and consumption maintained during the depression. This in itself is evidence of the indispensable position petroleum products have come to occupy in our national economy.

Many new records were set for the industry in 1935. The total demand for all oils reached a new peak of 1,110 million barrels—approximately 7 million barrels above the previous high point for 1929 and an increase of 75 million barrels over 1934.

The domestic demand of 982 million barrels was the largest so far recorded—42 million barrels above the 1929 figure and almost 62 million greater than in 1934. New records were established in 1935 for domestic consumption of motor fuel and kerosene.

Although the exports of all oils declined 35 million barrels compared with 1929, an increase of 14 million barrels over 1934 was indicated. The exports of crude petroleum were 10 million barrels greater than in 1934 and set a new record of 51 million barrels compared with 26 million in 1929. The exports of 77 million barrels of refined products indicated a gain of about 5 percent over 1934 yet were 60 million barrels below the peak of 1929. The growth in the export of crude petroleum and the decline in the export of refined products reflect the expansion of foreign refinery operations. Because of the relatively low volume of imports the net exports of all oils in 1935 set a new record of 76 million barrels compared with the previous high of 70 million in 1927.

The following table shows the trend of the demand for all oils since 1929:

[1] Figures for 1935 are preliminary; detailed data with final revisions will be released later.

Total demand for all oils

[Millions of barrels]

Year	Domestic demand	Exports	Total demand	Year	Domestic demand	Exports	Total demand
1929	940.1	163.1	1,103.2	1933	868.5	106.7	975.2
1930	926.4	156.5	1,082.9	1934	920.2	114.5	1,034.7
1931	903.2	124.4	1,027.6	1935	981.6	128.2	1,109.8
1932	835.5	103.3	938.8				

The longer-term trends for supply and demand from 1918 to 1935, inclusive, are shown graphically in figures 100 and 101.

The trend shown by the stocks of all oils has been generally downward—691 million barrels at the end of 1929 to 542 million at the end of 1935. In only one year, 1933, did total stocks show a small increase. This situation is particularly noteworthy during a period in which demand declined materially and new flush production of crude was developed; however, it has improved noticeably in 1934 and 1935 both due to further decreases in stocks and to increases in total consumption. A further reduction in stocks is desirable primarily because of large potential supplies of crude whose production has been postponed by various regulatory measures.

The balance between supply and demand generally is measured by changes in stocks of crude oil and gasoline. Crude stocks declined 17 million barrels in 1934 and 23 million barrels in 1935. Refined stocks decreased 21 million barrels in 1934 but increased about 1 million barrels in 1935, while gasoline stocks decreased 8 million barrels in 1934 and increased about 3 million barrels in 1935, reaching a total of 50.6 million barrels at the end of the year.

The domestic production of crude petroleum reached an all-time peak of 1,007 million barrels in 1929. The average for the following 6 years has been 890 million barrels, or over 88 percent of the 1929 peak. Production fell to 785 million barrels in 1932 and then rose to 908 million in 1934 and 994 million in 1935. A substantial decrease in crude oil in storage, an increase in the amount of gasoline produced by cracking, and a decline in total fuel-oil consumption—all controlling factors in the period since 1929—must be considered in evaluating the relation of crude production to consumption.

The total increase of 86 million barrels in crude production in 1935 was distributed widely among States. California made the largest increase (34 million barrels); this resulted in a sharp decline in crude prices within the State during October and November with partial recovery thereafter. Louisiana showed a notable increase of 17 million barrels with a record production of 50 million for the year. The development of the Rodessa field was particularly noteworthy. Daily production for December 1935 averaged 17,000 barrels. Continued expansion increased this average to 45,000 barrels for March 1936. Texas and Oklahoma recorded relatively small increases of 9 and 5 million barrels, respectively. Crude production in Kansas increased by 8 million barrels and in New Mexico and Michigan, 4 million barrels each.

Crude oil run to stills totaled 966 million barrels the greatest amount for any year except 1929, which exceeded 1935 by only 22 million barrels. The production of gasoline from crude reached a peak of 428 million barrels, which was 31 million more than the record of 1931. The maintenance of the domestic demand for motor fuels has

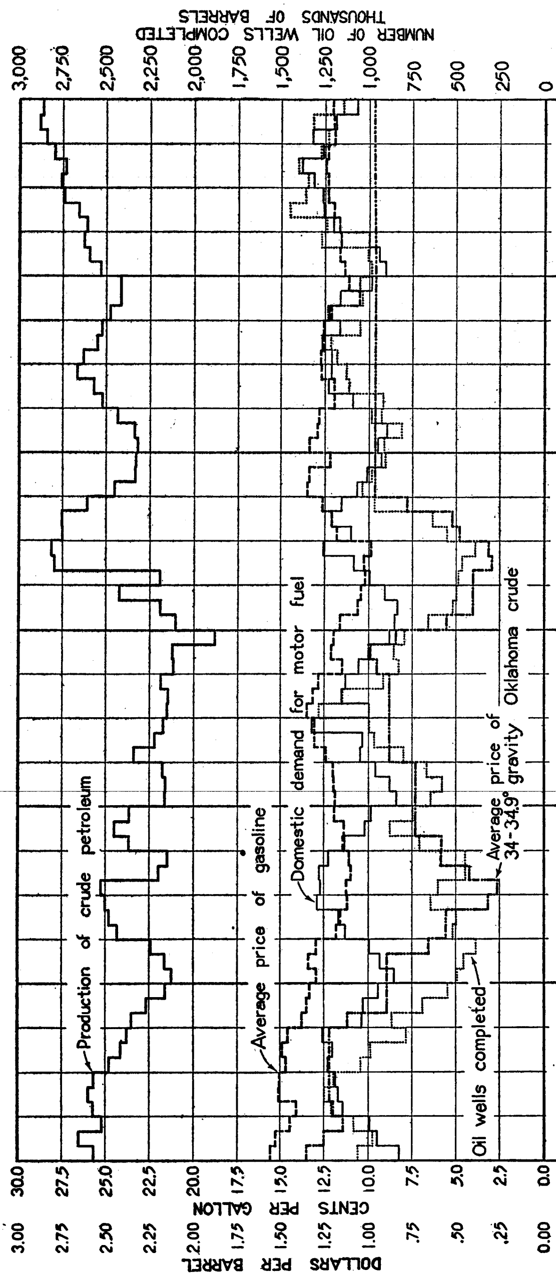

FIGURE 100.—Daily average production of crude petroleum, daily average domestic demand for motor fuel, total number of oil wells completed, average price per barrel of a selected grade of Oklahoma crude petroleum, and average tank-wagon price per gallon (excluding tax) of gasoline at 50 cities in the United States, 1930–35, by months.

been a most significant factor. The demand for 376 million barrels in 1929 was exceeded in 1930 and 1931. In 1932 it fell below the 1929 level by only 2 million barrels. Since then it has increased to new high levels of 407 million barrels in 1934 and 433 million in 1935. The amount produced by cracking has risen from 144 million barrels in 1929 to 208 million in 1935.

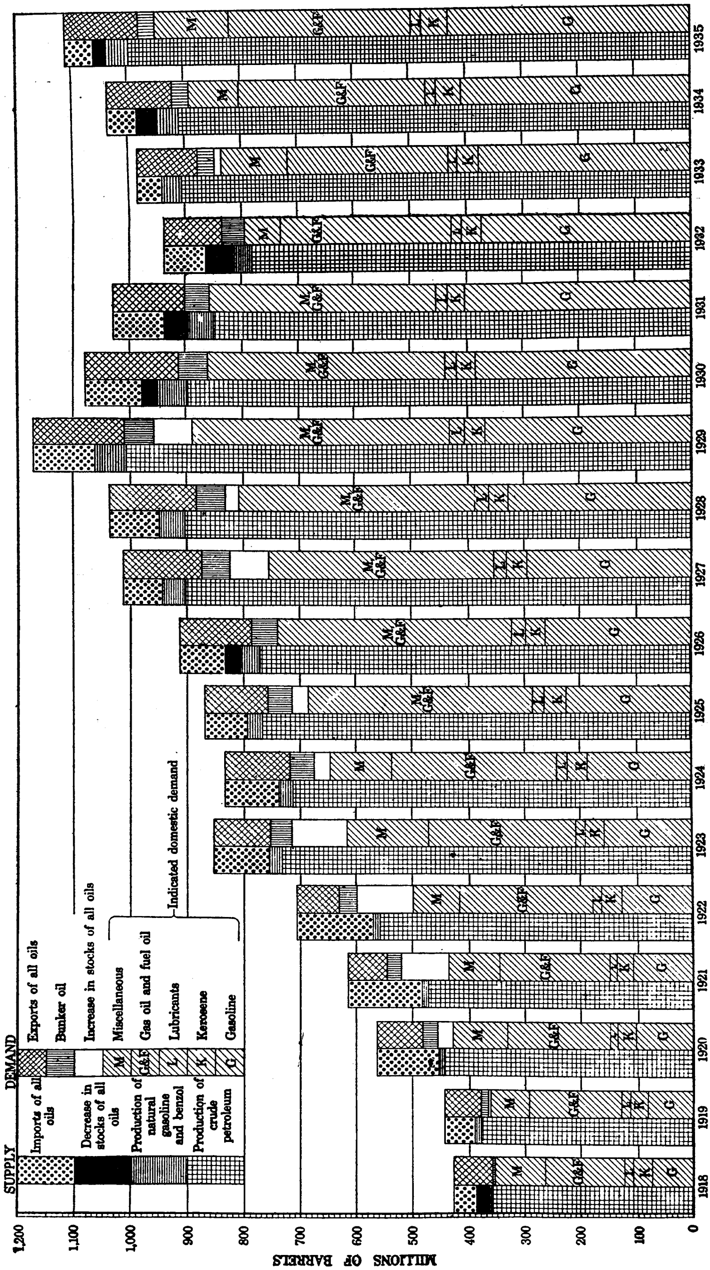

FIGURE 101.—Supply and demand of all oils, 1918–35.

The domestic demand for kerosene reached a new high level of approximately 48 million barrels. Although exports continued to decline, reaching a low point of less than 7 million barrels, refinery production was virtually the same as in 1929.

The demand for gas and fuel oils was affected to a greater extent by the depression than the demand for other major products. Indicated domestic consumption has increased steadily from the low of 1932 to 340 million barrels in 1934 and 367 million barrels in 1935. The largest increase in 1935 was for general industrial uses, as railroad consumption gained only about 3 million barrels, bunker demand about 1½ million barrels, and consumption by public-utility power plants 1 million barrels.

The production of lubricants increased about 1.4 million in 1935, which, with a slight decline in stocks, covered about a 1-million-barrel increase in domestic consumption and a small increase in exports.

With a total demand for all oils in 1934 almost equal to the 1929 figure and exceeding it in 1935 and with a substantial decrease in total stocks on hand, the industry showed an essentially healthy and fairly well balanced condition at the end of 1935. Temporary excess of refined stocks, control of flush production from new fields, and existence of large potential production in certain districts have created serious problems for regional adjustments and State control. However, these problems seem to represent the need for current stabilization and prevention of temporary demoralization and waste of resources rather than a restriction of long-term developments.

Salient statistics on the supply and demand of all oils, 1934–35

[Thousands of barrels of 42 gallons]

	1934		1935 [1]	
	Total	Daily average	Total	Daily average
New supply:				
Domestic production:				
Crude petroleum	908,065	2,488	993,942	2,723
Natural gasoline	36,556	100	38,858	107
Benzol	1,708	5	1,877	5
Total production	946,329	2,593	1,034,677	2,835
Imports:				
Crude petroleum [2]	35,558	97	32,239	88
Refined products	14,936	41	20,437	56
Total new supply, all oils	996,823	2,731	1,087,353	2,979
Change in stocks, all oils	−37,848	−104	−22,448	−62
Demand:				
Total demand, all oils	1,034,671	2,835	1,109,801	3,041
Exports:				
Crude petroleum	41,127	113	51,378	141
Refined products	73,380	201	76,774	211
Domestic demand:				
Motor fuel	407,106	1,115	432,556	1,185
Kerosene	44,234	121	47,652	130
Gas oil and fuel oil	331,989	910	352,712	966
Lubricants	18,484	51	19,598	54
Wax	857	2	930	2
Coke	7,540	21	6,724	18
Asphalt	13,924	38	16,384	45
Road oil	6,378	17	6,832	19
Still gas (production)	44,391	122	50,224	138
Miscellaneous	2,126	6	2,087	6
Losses and crude used as fuel	43,135	118	45,950	126
Total domestic demand	920,164	2,521	981,649	2,689
Stocks (end of year):				
Crude petroleum	337,254		314,631	
Natural gasoline	[3] 4,216		3,698	
Refined products	[3] 222,678		223,371	
Total stocks, all oils	[3] 564,148		541,700	
Day's supply	199		178	

[1] Subject to revision. [2] As reported to the Bureau of Mines. [3] For comparison with 1935.

Supply and demand of all oils in 1935, by months [1]

[Including wax, coke, and asphalt in thousands of barrels of 42 gallons]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
New supply:													
Domestic production:													
Crude Petroleum	78,715	72,763	81,488	78,427	82,454	82,338	85,485	84,816	84,109	88,160	86,476	88,711	993,942
Daily average	2,539	2,599	2,629	2,614	2,660	2,745	2,758	2,736	2,804	2,844	2,883	2,862	2,723
Natural gasoline	3,286	2,952	3,223	3,062	3,091	3,014	3,138	3,064	3,202	3,574	3,598	3,654	38,858
Benzol	147	148	153	138	145	137	144	159	162	174	178	192	1,877
Total production	82,148	75,863	84,864	81,627	85,690	85,489	88,767	88,039	87,473	91,908	90,252	92,557	1,034,677
Daily average	2,650	2,709	2,738	2,721	2,764	2,849	2,863	2,840	2,916	2,965	3,008	2,986	2,835
Imports:													
Crude petroleum [2]	2,011	1,903	2,608	2,599	3,433	2,848	2,520	3,354	2,908	2,477	2,242	3,336	32,239
Refined products	2,073	1,786	1,807	1,851	1,641	1,988	1,704	1,458	1,839	1,332	1,240	1,718	20,437
Total new supply, all oils	86,232	79,552	89,279	86,077	90,764	90,325	92,991	92,851	92,220	95,717	93,734	97,611	1,087,353
Daily average	2,782	2,841	2,880	2,869	2,928	3,011	3,000	2,995	3,074	3,088	3,124	3,149	2,979
Change in stocks, all oils	+1,231	+2,922	+2,528	−1,291	−1,198	−287	−2,041	−7,959	−4,466	−6,732	−1,669	−3,486	−22,448
Demand:													
Total demand	85,001	76,630	86,751	87,368	91,962	90,612	95,032	100,810	96,686	102,449	95,403	101,097	1,109,801
Daily average	2,742	2,737	2,798	2,912	2,966	3,020	3,065	3,252	3,223	3,305	3,180	3,261	3,041
Exports: [3]													
Crude petroleum	2,369	2,804	3,281	3,776	4,613	5,589	5,832	4,946	4,971	4,810	4,289	4,098	51,378
Refined products	6,411	3,830	6,564	4,305	5,133	7,362	7,093	6,631	7,867	5,950	8,116	7,512	76,774
Domestic demand:													
Motor fuel	28,062	26,432	31,997	36,082	39,095	37,890	41,209	42,836	37,862	41,401	35,956	33,734	432,556
Kerosene	4,299	4,597	3,959	3,751	3,545	2,768	2,885	3,631	3,892	4,520	4,724	5,081	47,652
Gas oil and fuel oil	33,751	29,643	30,249	28,685	27,010	24,417	23,454	27,389	28,160	30,988	30,615	38,351	352,712
Lubricants	1,557	1,297	1,617	1,802	1,919	1,558	1,655	1,667	1,697	1,820	1,576	1,433	19,598
Wax	69	64	75	88	93	71	70	75	73	97	80	75	930
Coke	702	593	465	406	531	534	552	517	548	638	614	624	6,724
Asphalt	592	612	709	1,244	1,531	1,733	2,034	2,223	1,889	1,949	1,037	831	16,384
Road oil	156	124	145	292	478	873	1,204	1,453	1,037	558	273	239	6,832
Still gas (production)	3,808	3,513	4,007	3,916	4,411	4,368	4,814	4,608	4,363	4,273	4,041	4,102	50,224
Miscellaneous	203	163	205	167	187	161	177	180	138	147	154	205	2,087
Losses and crude as fuel	3,022	2,958	3,478	2,854	3,416	3,288	4,053	4,654	4,189	5,298	3,928	4,812	45,950
Total domestic demand	76,221	69,996	76,906	79,287	82,216	77,661	82,107	89,233	83,848	91,689	82,998	89,487	981,649
Daily average	2,459	2,500	2,481	2,643	2,652	2,589	2,649	2,878	2,795	2,958	2,767	2,887	2,689
Stocks:													
Crude petroleum	338,174	337,319	339,139	339,793	338,559	334,757	329,351	324,966	320,705	317,155	315,558	314,631	314,631
Natural gasoline	4,530	4,781	5,252	5,586	5,977	5,851	5,816	5,578	5,133	4,384	3,917	3,698	3,698
Refined products	222,675	226,201	226,438	224,159	223,804	227,445	230,845	227,509	227,749	225,316	225,711	223,371	223,371
Total stocks, all oils	565,379	568,301	570,829	569,538	568,340	568,053	566,012	558,053	553,587	546,855	545,186	541,700	541,700

[1] Preliminary.
[2] As reported to Bureau of Mines.
[3] Exports include benzol and shipments to Alaska, Hawaii, and Puerto Rico.

REGULATION AND LEGISLATION

The problems connected with oil stabilization and control have originated largely in the periods of flush production of certain of the larger new fields or districts. Stocks of oil began to accumulate with the depression of 1921–22 and continued to increase with the expansion in new production from the Los Angeles Basin in California and the Smackover field in Arkansas. The year 1926 marked the only decrease in total oil stocks from 1919 to the end of 1929. In 1927 the expansion of crude production in west Texas and the Seminole field in Oklahoma resulted in a further upward movement in the total stocks of all oils to a peak of 691 million barrels at the end of 1929. Later developments in the Oklahoma City field, the Kettleman Hills field in California, and the east Texas field have stimulated the adoption of control measures to avoid overproduction and further accumulation of excess stocks. While the stocks of all oils have shown a decreasing trend since 1929, the constant threat of overproduction resulted in low prices for crude during 1931, 1932, and 1933. This situation was corrected by regulatory measures put into force in 1934 and 1935. It is a notable fact that approximately five-eighths of a total production of 13 billion barrels of crude petroleum during the period 1919 to 1935 has been produced in the seven districts mentioned.

Relative importance of crude petroleum produced in certain districts, 1919–35

[All quantities in millions of barrels]

Year	Los Angeles Basin (Calif.)	Smackover (Ark.)	West Texas	Seminole (Okla.)	Oklahoma City (Okla.)	Kettleman Hills (Calif.)	East Texas	Total seven districts	All other	Total United States	Change in stocks, all oils [1]	Value per barrel [2]
1919	30							30	348	378	+4	$2.01
1920	30							30	413	443	+27	3.07
1921	35							35	437	472	+85	1.73
1922	69	2						71	487	558	+102	1.61
1923	205	30						235	497	732	+99	1.34
1924	151	40	1					192	522	714	+28	1.43
1925	154	72	10					236	528	764	+29	1.68
1926	144	52	15	11				222	549	771	−26	1.88
1927	150	35	52	136				373	528	901	+70	1.30
1928	158	25	124	106				413	488	901	+23	1.17
1929	208	19	133	101	9	2		472	535	1,007	+68	1.27
1930	138	15	109	66	35	6		369	529	898	−24	1.19
1931	103	12	79	48	45	18	110	415	436	851	−45	.65
1932	95	10	63	43	33	22	121	387	398	785	−42	.87
1933	90	9	55	41	68	22	205	490	416	906	+11	.67
1934	86	8	50	38	63	21	182	448	460	908	−38	1.00
1935	96	7	55	48	54	28	176	464	530	994	−22	1.00
Total	1,942	336	746	638	307	119	794	4,882	8,101	12,983	+349	[3] 1.40

[1] Plus indicates an increase in stocks and minus a decrease. Total stocks of all oils were 183 million barrels at the end of 1919, reached a peak of 691 million by the end of 1929, and were reduced to 542 million by the end of 1935.
[2] Average value per barrel of crude at the well in dollars.
[3] Unweighted average.

The uncontrolled development of a single new major field reacts on all other fields. Thus, inadequate control in one State may compel other States to regulate what would otherwise be considered normal production. The past accumulation of excess stocks is a relatively small amount when compared to the total volume of production. Broadly, the problem is one of temporary adjustment and stabilization with relatively short-time postponement of flush production. Oil and natural gas differ from other minerals in the suddenness with which vast new supplies may be thrown on the market. The opening of new coal or metal mines on a large scale is a much longer term operation, and the resultant increase in production can be foreseen more adequately.

Conservation of natural gas has been an important consideration in the development of regulatory measures. A rough estimate indicates that 55 percent of the total natural gas produced and consumed comes to the surface with oil. In California the waste of gas has been reduced from 40 percent of the estimated total production in 1930 to only 6 percent in 1935.

The history of progress toward conservation and stabilization [2] in the oil industry during the past 10 years has shown that any effective national balance between production and consumption requires some form of Federal cooperation in the allocation of production between States as well as in the prevention of interstate movements of oil produced in violation of State laws. Furthermore, cooperative agreements between States are essential to the effective operation of any general program. Proration—the more or less mandatory control of production by setting up quotas as between fields, properties, and individual wells—seems to be primarily a function to be carried out by authorized agencies created by State law. Where effective State laws are lacking cooperation by individual producers or producers' organizations is an essential factor.

The first forecasts of demand and recommendations of required crude-petroleum production on a national basis were undertaken by the Oil Conservation Board in 1930, 1931, and 1932. The work was carried out through a voluntary committee, and its effectiveness depended on the cooperation of the industry. With the adoption of the Petroleum Industry Code in August 1933 national allocation of production by States was inaugurated in September of that year and continued until invalidation of the National Industrial Recovery Act in May 1935. Under an amendment to the code similar estimates of gasoline-production requirements were begun in June 1934; allocations were administered through the Planning and Coordination Committee representing the industry. After the nullification of the code the United States Bureau of Mines undertook to issue monthly forecasts of motor-fuel demand and recommendations of required crude-oil production by States. The States are not required to accept the Bureau recommendations but, through the action of the Interstate Oil Compact Commission, have expressed confidence in the figures as reliable evidence of market demand.

The strengthening of the enforcement of State laws through Federal regulation of interstate commerce is another essential factor in the present program. Section 9 (*c*) of the National Industrial Recovery Act prohibited the transportation in interstate commerce of petroleum produced in violation of State laws. The first Federal Tender Board was established in October 1934 to carry out this pro-

[2] A much more complete review of this subject is contained in a paper on "Conservation of Petroleum and Natural Gas" prepared for the Third World Power Conference by the Petroleum and Natural Gas Division and the Petroleum Economics Division of the Bureau of Mines.

vision with particular reference to the shipments from the east Texas field. Following the invalidation of this section of the National Industrial Recovery Act by the Supreme Court on January 7, 1935, Congress passed the Connally Act, which became effective February 22, 1935. This act applies to both crude petroleum and petroleum products and requires certificates of clearance to indicate compliance with State regulations. The provisions of the act are now administered by the Secretary of the Interior through the Petroleum Conservation Division recently created within the Department.

After an exhaustive investigation the Committee on Interstate and Foreign Commerce recommended to Congress, in a report submitted January 2, 1935, that the oil-producing States be granted permission to adopt compacts to deal jointly with problems of conservation and production control with which individual States were powerless to cope. An interstate compact has since been ratified by the legislatures of several major oil-producing States. Texas, Oklahoma, Kansas, New Mexico, Illinois, and Colorado are compact members, and unofficial representatives from other States have attended meetings.

Proration and control of oil and gas production within a State were generally developed prior to the interstate and national relations just reviewed. The alarming expansion of production from the Seminole field in Oklahoma late in 1926 is believed to be responsible for proration control. Now most of the larger producing States exercise some control through conservation or regulatory laws. Texas has the most far-reaching regulations; these are administered by the Texas Railroad Commission. The Oklahoma conservation law is comprehensive in its terms. In California regulation of waste in natural gas has been very effective, although there is no law authorizing the control of crude production; that problem has had to be worked out through voluntary cooperation of the producers. The New Mexico Oil Conservation Commission is functioning effectively. Kansas has enacted recent legislation pertaining to conservation, vesting the enforcement of the law in the State Corporation Commission. Louisiana is also in the group of States that have conservation laws of wide scope.

The concept of conservation has thus been broadened to include economic as well as physical waste. The extension of State laws, the development of cooperation between State and Federal agencies, and the voluntary cooperation of industry are all working toward a more effective balance of production and demand.

CRUDE PETROLEUM

Supply and demand.—The total supply of crude petroleum in 1935 was approximately 1,049 million barrels—less than 2 million barrels below the record set in 1929. The domestic production of 994 million barrels increased 86 million barrels over 1934 and was only 13 million below the figure for 1929. Imports of crude slightly exceeded 32 million barrels and represented only 41 percent of the imports for 1929. Stocks declined about 23 million barrels in 1935 compared with a decrease of 17 million in 1934 and an increase of 15 million in 1933.

Factors that have contributed to substantial recovery in the demand for crude petroleum have been the general downward trends in imports and stocks since 1929, an increasing trend in the export demand, and expansion in domestic consumption of motor fuel to an all-time record.

The total demand for crude petroleum in 1935 was almost 1,049 million barrels—over 966 million barrels run to stills, more than 51 million barrels exported, and 31 million barrels used as fuel or lost in handling. The amount run to stills was the largest for any year

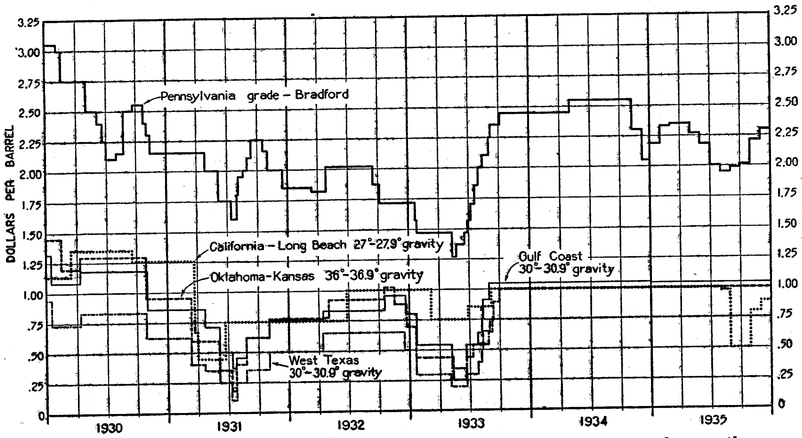

FIGURE 102.—Posted prices of selected grades of crude petroleum, 1930–35, by months.

except 1929. Exports reached a record figure and have shown a consistent increase to almost twice the amount exported in 1929.

Supply and demand for crude petroleum, 1934–35

[Thousands of barrels of 42 gallons]

	1934	1935
Production	908,065	993,942
Imports	35,558	32,239
Decrease in stocks	16,969	22,623
Total new supply plus decrease in stocks	960,592	1,048,804
Runs to stills:		
Domestic	860,776	934,112
Foreign	34,860	32,131
Total runs to stills	895,636	966,243
Exports	41,127	51,378
Losses and crude used as fuel	23,829	31,183
Total demand	960,592	1,048,804

PRICES AND VALUES

For most districts the general stability of crude-oil prices that characterized 1934 continued during 1935. The estimated average price for all crude at the well approximated closely the $1-per-barrel level for 1934. Exceptions to the general situation, however, were the greater fluctuation and downward trend compared to 1934 in the prices of Pennsylvania-grade crudes and a decided break in the prices of California grades during September and October, with a partial restoration of prices thereafter.

The posted price of 36°–36.9° gravity crude in Oklahoma, the grade generally accepted as the standard, remained at $1 throughout 1935.

The price of Bradford crude, a premium eastern grade, was $2.05 on January 1, reached a maximum of $2.35 for the year on February 4, fell to a low of $1.95 on July 16, and finally rose to $2.30 on November 20, where it remained for the balance of the year. Prices changed more frequently than in 1934 and were generally lower, the average for the year being $2.18 compared with $2.46 for 1934.

The price trends of representative grades of crude petroleum over a period of years are shown graphically in figure 102.

Average monthly prices per barrel for selected grades of crude petroleum at wells in 1935

Month	Pennsylvania grade		Lima, Ohio	Illinois	Oklahoma-Kansas 36°–36.9°	Panhandle, Tex. (Carson and Hutchinson Counties) 35°–35.9°	West Texas	Gulf-coast grade B, 30°–30.9°	California (Long Beach) 27°–27.9°
	Bradford	Southwest Pennsylvania							
January	$2.19	$1.86	$1.30	$1.13	$1.00	$0.71	$0.75	$1.04	$1.00
February	2.33	2.00	1.15	1.13	1.00	.71	.75	1.04	1.00
March	2.35	2.02	1.15	1.13	1.00	.71	.75	1.04	1.00
April	2.35	2.02	1.15	1.13	1.00	.71	.75	1.04	1.00
May	2.27	1.97	1.15	1.13	1.00	.71	.75	1.04	1.00
June	2.18	1.90	1.15	1.13	1.00	.71	.75	1.04	1.00
July	2.00	1.72	1.15	1.13	1.00	.71	.75	1.04	1.00
August	1.95	1.67	1.15	1.13	1.00	.71	.75	1.04	.98
September	1.99	1.71	1.15	1.13	1.00	.71	.75	1.04	.50
October	2.01	1.73	1.15	1.13	1.00	.71	.75	1.04	.50
November	2.21	1.93	1.15	1.13	1.00	.71	.75	1.04	.80
December	2.30	2.02	1.15	1.13	1.00	.71	.75	1.04	.88
Average for year	2.18	1.88	1.16	1.13	1.00	.71	.75	1.04	.89

Posted price per barrel of petroleum at wells in 1935, by grades, with dates of change

Date	Pennsylvania grade		Corning grade in Buckeye Pipe Line Co. lines [2]	Western Kentucky [3]	Lima, Ohio [3]	Illinois and Princeton, Ind.[3]	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	$2.05	$1.72	$1.32	$1.08	$1.30	$1.13	$1.02	$0.96	$1.00
Jan. 4	2.20	1.87							
Feb. 1					1.15				
Feb. 4	2.35	2.02							
May 16	2.20	1.92							
May 22				1.13					
June 26	2.05	1.77							
July 16	1.95	1.67							
Sept. 6	2.00	1.72							
Oct. 29	2.15	1.87							
Nov. 7							1.12		
Nov. 20	2.30	2.02							
Dec. 15							1.22		
	2.18	1.88	1.32	1.11	1.16	1.13	1.04	.96	1.00

Date	Panhandle, Tex. (Carson and Hutchinson Counties 35°–35.9°)[6]	West Texas [6]	Hobbs, N. Mex.[6]	Darst, Tex.[6]	Southwest Texas, Mirando [6]	Van, Tex., 34°–34.9° [4]	East Texas [7]	Gulf coast	
								Conroe, 38°–38.9° [6]	Grade B, 30°–30.9° [8]
Jan. 1	$0.71	$0.75	$0.75	$0.87	$0.80	$0.96	$1.00	$1.15	$1.04
July 22						[9] .90			
	.71	.75	.75	.87	.80	.93	1.00	1.15	1.04

See footnotes at end of table.

Posted price per barrel of petroleum at wells in 1935, by grades, with dates of change—Continued

Date	North Louisiana, 34°–34.9° [10]	Smackover, Ark.[10]	Salt Creek, Wyo., 36°–36.9° [11]	Sunburst, Mont.[3]	California [12] 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	$0.83	$0.70	$1.00	$1.35	$1.08	$1.00	$0.64	$0.90	$1.16
July 19				1.20					
Aug. 29					.57	.50	.57	.40	.46
Nov. 1					.88	.80	.65	.78	.82
Dec. 6					1.08	.90	.66	.84	.95
	.83	.70	1.00	1.25	.97	.89	.63	.80	.99

[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] Humble Oil & Refining Co.
[7] Magnolia Petroleum Co.
[8] Gulf Pipe Line Co.
[9] Gravity scale discontinued.
[10] Standard Oil Co. of Louisiana.
[11] Stanolind Oil & Gas Co.
[12] Standard Oil Co. of California.

CONSUMPTION AND DISTRIBUTION

Runs to stills.—Crude runs to stills totaled 966 million barrels in 1935, a gain of 70 million barrels over 1934 and only 22 million barrels less than in the record year of 1929. The runs of domestic crude gained 73 million barrels over 1934, while runs of foreign crude declined almost 3 million barrels. The amount of foreign crude run has declined every year since 1929, from 76 million barrels in that year to 32 million in 1935 or from 7.6 to 3.3 percent of the total.

The outstanding changes in crude runs by districts in 1935 compared with 1934 were increases in the Texas Gulf Coast of 20 to 21 percent of the total and in California of 17 to 18 percent of the total. Of the increase of 70 million barrels in total runs for the year, about 22 million barrels were credited to California; 21 million to the Texas Gulf Coast; 13 million to the Oklahoma, Kansas, and Missouri district; and 11 million to the Indiana, Illinois, and Kentucky district. The only districts to show actual decreases were the East Coast, Texas Inland, and Arkansas and Louisiana Inland.

Runs to stills by months showed greater refinery activity for every month in the year during 1935, compared with 1934, with the largest relative increases during the last 4 months of the year.

Crude runs to stills, 1933–35, by districts

District	1933 Thousands of barrels	1933 Percent of total	1934 Thousands of barrels	1934 Percent of total	1935 [1] Thousands of barrels	1935 [1] Percent of total
East Coast	166,932	19	171,733	19	170,277	18
Appalachian	33,567	4	35,809	4	33,454	4
Indiana, Illinois, Kentucky, etc	117,073	14	119,166	13	129,958	13
Oklahoma, Kansas, and Missouri	96,541	11	95,006	11	107,752	11
Texas Inland	57,454	7	61,941	7	61,694	6
Texas Gulf Coast	160,691	19	179,418	20	200,799	21
Louisiana Gulf Coast	39,034	4	41,341	5	43,015	5
Arkansas and Louisiana Inland	18,485	2	18,850	2	17,416	2
Rocky Mountain	14,209	2	16,037	2	19,029	2
California	157,268	18	156,335	17	177,849	18
	861,254	100	895,636	100	966,243	100

[1] Subject to revision.

Runs to stills of crude petroleum in 1935, by districts and months [1]

[Thousands of barrels of 42 gallons]

District	January	February	March	April	May	June	July	August	September	October	November	December	Total
East coast:													
Domestic	11,612	11,746	11,889	11,469	12,346	11,888	12,280	12,641	12,257	12,075	12,006	12,141	144,350
Foreign	1,935	1,505	1,857	2,086	2,383	2,307	2,444	2,579	2,350	2,484	1,948	2,049	25,927
Total, east coast	13,547	13,251	13,746	13,555	14,729	14,195	14,724	15,220	14,607	14,559	13,954	14,190	170,277
Appalachian	2,886	2,848	3,107	3,068	3,298	3,331	3,337	3,258	3,434	3,394	3,343	3,150	38,454
Indiana, Illinois, Kentucky, etc	9,714	9,086	10,330	10,475	11,224	11,687	11,792	11,536	10,978	11,687	10,642	10,807	129,958
Oklahoma, Kansas, and Missouri	8,403	7,404	S,621	8,760	9,109	9,486	9,807	10,010	9,286	9,255	9,056	8,555	107,752
Texas inland	4,552	4,740	4,979	4,526	4,958	5,100	5,420	5,677	5,805	5,464	5,450	5,023	61,694
Texas Gulf Coast:													
Domestic	16,148	14,888	16,168	14,573	14,825	16,387	17,384	16,467	16,537	16,926	17,348	18,538	196,189
Foreign	163	508	240	535	496	330	616	352	435	428	47	460	4,610
Total, Texas Gulf Coast	16,311	15,396	16,408	15,108	15,321	16,717	18,000	16,819	16,972	17,354	17,395	18,998	200,799
Louisiana Gulf Coast:													
Domestic	3,614	3,084	3,279	3,016	3,376	3,468	3,369	3,151	3,598	3,766	3,860	3,840	41,421
Foreign	14	57	63	212	76	126	220	203	102	254	131	136	1,594
Total, Louisiana Gulf Coast	3,628	3,141	3,342	3,228	3,452	3,594	3,589	3,354	3,700	4,020	3,991	3,976	43,015
Arkansas and Louisiana Inland	1,385	1,218	1,325	1,408	1,499	1,632	1,402	1,423	1,400	1,435	1,577	1,712	17,416
Rocky Mountain	1,292	1,247	1,449	1,535	1,692	1,704	1,754	1,912	1,719	1,646	1,650	1,429	19,029
California	13,738	12,486	13,323	13,403	15,130	14,278	15,078	15,375	15,446	16,318	16,122	17,152	177,849
Total domestic	73,344	68,747	74,470	72,233	77,457	78,961	81,623	81,450	80,460	81,966	81,054	82,347	934,112
Total foreign	2,112	2,070	2,160	2,833	2,955	2,763	3,280	3,134	2,887	3,166	2,126	2,645	32,131
Total United States: 1935	75,456	70,817	76,630	75,066	80,412	81,724	84,903	84,584	83,347	85,132	83,180	84,992	966,243
1934	71,512	66,470	71,807	73,563	76,258	76,054	80,065	79,928	73,611	75,991	73,784	76,593	895,636
Daily average, 1935	2,434	2,529	2,472	2,502	2,594	2,724	2,739	2,729	2,778	2,746	2,773	2,742	2,647

[1] Subject to revision.

Distribution.—The development of new statistical data for 1934 and 1935 has made available a much more adequate picture of the movements and final distribution of crude petroleum. On a monthly basis this information is an essential factor in the consideration of the amount and sources of crude required to insure a reasonable balance between current production and consumption. The annual summaries, as presented in the accompanying tables, serve as an index of the longer-term competitive shifts in the sources of supply, in the channels of distribution, and in the relation of refinery location to markets.

The movement of crude to refineries represents the major factor in total distribution, which includes the new production plus imports and withdrawals from field and pipe-line stocks. On this basis the amount available for distribution in 1934 was 960 million barrels, of which 94 percent was received at refineries, 4 percent was exported, and 2 percent represented use as fuel and losses. In 1935 the amount available was 1,044 million barrels, of which 93 percent went to refineries, 5 percent was exported, and 2 percent represented use as fuel and losses. Adequate information on crude exports has long been available; these have increased steadily in recent years. Information on crude used for fuel and losses is less exact, but the amount is relatively small.

Crude receipts at refineries totaled 898 million barrels in 1934 and 967 million in 1935, an increase of almost 69 million barrels. Intrastate sources representing crude refined within the State of origin showed a slight relative gain from 55 percent of the total receipts to 55.7 percent. This increase balanced a decline in foreign sources, since the interstate movements represented 41 percent of total receipts for both years. A relative increase in crude refined in California and a decrease in crude refined on the Atlantic coast accounted in part for this change. Refinery receipts, classified by methods of transportation, showed a slight gain for pipe-line movements, 71.5 percent in 1935 compared to 71.2 percent in 1934. A corresponding decline was shown for the comparatively small movement by tank cars and trucks, as the percentage for boat movement was 25.9 percent for both years.

Summary of crude-oil receipts and consumption at refineries, 1935

[Thousands of barrels]

	Receipts at refineries						Change in refinery stocks	Crude runs to stills	Fuel and losses
	Intrastate	Interstate				Foreign			
		Oklahoma	Texas	Other	Total				
Arkansas	5,959		1,643		1,643		+158	7,410	34
California	179,749						−636	177,849	2,536
Colorado	665			517	517		+38	1,139	5
Georgia [1]			1,514		1,514	2,193	−7	3,712	2
Illinois	3,536	23,054	3,077	5,695	31,826		−141	35,469	34
Indiana	9	31,196	7,784	19,209	58,189		−549	58,767	−20
Kansas	31,993	11,759	164		11,923		−356	44,304	−32
Kentucky [2]	5,141	1,851		148	1,999		−63	7,203	
Louisiana [3]	15,090	3,937	28,007	3,566	35,510	1,529	−1,443	53,021	551
Maryland			8,074	1,163	9,237	2,539	−20	11,744	52
Massachusetts [4]			9,366	146	9,512	3,904	−316	13,722	10
Michigan	5,556	3,275			3,275		+39	8,772	20
Missouri		3,548	659	1,797	6,004		−2	6,006	
Montana	1,676			1,540	1,540		−89	3,293	12
New Jersey		6,590	39,811	9,226	55,627	5,256	+522	60,133	228
New Mexico	1,277		132		132		+7	1,403	−1
New York	3,599	1,766	4,318	1,272	7,356	3,669	+259	14,374	−9
East			4,318		4,318	3,669	+14	7,973	
West	3,599	1,766		1,272	3,038		+245	6,401	−9
Ohio	2,671	17,021	909	8,596	26,526		−227	29,428	−4
East	1,740	7,043		860	7,903		−39	9,681	1
West	931	9,978	909	7,736	18,623		−188	19,747	−5
Oklahoma	53,203		1,384	1,777	3,161		−1,169	57,442	91
Pennsylvania	12,395	5,044	54,944	10,146	70,134	8,766	−300	91,433	162
East		3.454	52,753	7,990	64,197	8,766	−182	72,993	152
West	12,395	1,590	2,191	2,156	5,937		−118	18,440	10
Texas	203,661	24,476		30,581	55,057	4,383	+176	262,493	432
Utah			336	2,010	2,346		−88	2,427	7
West Virginia	1,241	2,389		298	2,687		−3	3,932	−1
Wyoming [5]	10,041			59	59		−741	10,767	74
Total United States	537,462	135,906	162,122	97,746	395,774	32,239	−4,951	966,243	4,183
Daily average	1,472	372	444	268	1,084	88	−14	2,647	11

[1] Includes Delaware, South Carolina, and Virginia.
[2] Includes Tennessee.
[3] Includes Alabama and Mississippi.
[4] Includes Rhode Island.
[5] Includes Nebraska and South Dakota.

Distribution of crude petroleum in 1935, by States

[Thousands of barrels of 42 gallons]

State	Production	Imports	Receipts from other States		Runs to stills	Exports	Deliveries from other States		Net changes in total crude stocks by location
			Quantity	State			Quantity	State	
Arkansas	10,973		1,643	Texas	7,410		4,767	Louisiana, New Jersey, and Texas	+390
California	207,832				177,849	16,918			+1,415
Colorado	1,549		517	New Mexico, and Wyoming	1,139		823	Utah, and Wyoming	+46
Georgia		576	1,514	Texas	[1] 3,712				[1] −7
Illinois	4,305		31,826	Indiana, Kansas, Kentucky, Louisiana, New Mexico, Oklahoma, and Texas.	35,469	587	100	Ohio	−89
Indiana	757		58,189	Kansas, Louisiana, Michigan, New Mexico, Oklahoma, and Texas.	58,767		794	Illinois and Kentucky	−468
Kansas	54,787		11,923	Oklahoma and Texas	44,304		21,956	Illinois, Indiana, Ohio, Oklahoma, and West Virginia.	−1,179
Kentucky and Tennessee	5,265		1,999	Indiana and Oklahoma	7,203	2	365	Illinois	−234
Louisiana	49,869	1,529	[2] 35,510	Arkansas, Oklahoma, and Texas	[2] 53,021		29,569	Illinois, Indiana, Maryland, Massachusets, Missouri, New Jersey, Pennsylvania, and Texas.	[2] −2,082
Maryland		2,539	9,237	Louisiana, New Mexico, and Texas	11,744				−20
Massachusetts		3,617	[3] 9,512	do	[3] 13,722				[3] −316
Michigan	15,256		3,275	Oklahoma	8,772	175	8,219	Indiana and Ohio	−66
Missouri	(4)		6,004	Kansas, Oklahoma, and Texas	6,006				[5] +103
Montana	4,594		1,540	Wyoming	3,293	2,797	13	Wyoming	+52
New Jersey		5,256	55,627	Arkansas, Louisiana, New Mexico, New York, Oklahoma, Pennsylvania, Texas, and West Virginia.	60,133				+375
New Mexico	20,586		132	Texas	1,403		19,267	Colorado, Illinois, Indiana, Maryland, Massachusetts, New Jersey, Pennsylvania, Texas, and Utah.	+173
New York	4,237	3,669	7,356	Oklahoma, Pennsylvania, and Texas	14,374		352	New Jersey and Pennsylvania	+197
Ohio	4,070		26,526	Illinois, Kansas, Michigan, Oklahoma, Texas, and West Virginia.	29,428		1,303	Pennsylvania and West Virginia	−704
Oklahoma	185,348		3,161	Kansas and Texas	57,442	7,264	135,906	Illinois, Indiana, Kansas, Kentucky, Louisiana, Michigan, Missouri, New Jersey, New York, Ohio, Pennsylvania, Texas, West Virginia.	−11,919
Pennsylvania	15,830	8,766	70,134	Louisiana, New Mexico, New York, Ohio, Oklahoma, Texas, and West Virginia.	91,433		4,939	New Jersey and New York	−475
Rhode Island		287	(3)	Texas	(3)				(3)
South Carolina		557			(1)				(1)

Texas	391,097	4,383	55,057	Arkansas, Louisiana, New Mexico, and Oklahoma.	262,493	23,495	162,122	Alabama, Arkansas, Georgia, Illinois, Indiana, Kansas, Louisiana, Maryland, Massachusetts, Missouri, New Jersey, New Mexico, New York, Ohio, Oklahoma, Pennsylvania, Rhode Island, and Utah.	−6,784
Utah	(4)		2,346	Colorado, New Mexico, Texas, and Wyoming.	2,427				−88
Virginia		1,060			(1)				(1)
West Virginia	3,903		2,687	Kansas, Ohio, and Oklahoma	3,932		2,082	New Jersey, Ohio, and Pennsylvania	−136
Wyoming	13,650		59	Colorado and Montana	[6] 10,767	140	3,197	Colorado, Montana, and Utah	−807
Other	[4] 34								
	993,942	32,239	395,774		966,243	51,378	395,774		−22,623

1 Georgia includes Delaware, South Carolina, and Virginia.
2 Includes Alabama and Mississippi.
3 Massachusetts includes Rhode Island.
4 Mississippi, Missouri, and Utah included in "Other."
5 Includes Iowa.
6 Includes Nebraska and South Dakota.

STOCKS

Since 1929 the stocks of all oils have declined every year except 1933. This decline, combined with increasing demand, has resulted in a steady improvement in the statistical position of the industry as a whole. The decrease of 38 million barrels in the stocks of all oils in 1934 represented a decline of 17 million barrels in crude stocks and of 21 million barrels in stocks of refined products. In 1935 the total decrease in stocks was 22 million barrels, resulting from a decrease of 23 million barrels in crude-oil stocks and an increase of about 1 million barrels in refined stocks. The stocks of all oils at the end of 1935 totaled 542 million barrels, or a little less than 6 months' supply on the basis of total demand for the year.

The general downward trend in crude stocks continued throughout 1934 and 1935. Total crude stocks were 354 million barrels at the end of 1933, 337 million barrels at the end of 1934, and somewhat less than 315 million barrels at the end of 1935. They declined in the last 5 months of 1934, showed little change during the first 5 months of 1935, and declined thereafter steadily to the end of the year. By the end of March 1936 there was a further decline of 2 million barrels.

Of the total decrease in crude stocks of 23 million barrels for 1935, refinery stocks accounted for 5 million barrels and pipe-line and tank-farm stocks 20 million barrels, while producers' stocks increased 2 million barrels.

The most important decreases in crude stocks in 1935 by States of location were 11.9 million barrels in Oklahoma, 6.8 million barrels in Texas, 2.1 million barrels in Louisiana, and 1.2 million barrels in Kansas. California showed the greatest increase in crude stocks (1.4 million barrels), followed by Arkansas and New Jersey with 0.4 million barrels each.

Stocks of crude petroleum, natural gasoline, and refined products at the end of the year, 1931–35

[Thousands of barrels of 42 gallons, except as otherwise indicated]

	1931	1932	1933	1934	1935 [1]
Crude petroleum:					
At refineries [2]	[3] 35,821	55,513 [4] 61,769	66,049	64,099	59,148
Pipe-line and tank-farm	[5] 328,171	276,189 [4] 270,093	281,132 [4] 280,043	264,625	245,178
Producers'	[5] 6,202	8,013	8,131	8,530	10,305
Total crude petroleum [6]	370,194	339,715 [4] 339,875	355,312 [4] 354,223	337,254	314,631
Natural gasoline	2,825	3,203	3,317 [4] 3,680	3,740 [4] 4,216	3,698
Refined products:					
Gasoline [7]	52,401	50,602 [4] 51,107	52,616 [4] 56,255	48,205 [4] 47,531	50,647
Kerosene	5,332	4,974 [4] 5,033	6,558	6,398	7,915
Gas oil and distillate fuel oils	18,526	14,110 [4] 14,277	17,025 [4] 16,315	21,957	19,930
Residual fuel oils	117,330	115,771 [4] 116,476	106,475 [4] 106,689	88,440	84,054
Total gas oil and fuel oil [6]	135,856	129,881 [4] 130,753	123,500 [4] 123,004	110,397	103,984
Lubricants	9,485	8,465 [4] 8,694	7,100	7,331	7,025
Wax ... thousands of pounds	171,220	163,628 [4] 163,935	69,117	136,136	114,675
Coke ... thousands of short tons	1,511.6	1,330.2	727.4	405.1	388.9
Asphalt ... do	301.8	276.1	254.5	339.2	405.4
Road oil	333	564	832	664	875
Other finished products	734	456	388 [4] 216	231	220
Crude gasoline	44,757	43,359 [4] 43,753	48,300	5,014	6,046
Other unfinished oils			[4] 45,046	40,738	42,074
Total refined products [8]	258,879	247,188 [4] 249,116	244,578 [4] 244,295	223,356 [4] 222,678	223,371
Grand total	631,898	590,106 [4] 592,194	603,207 [4] 602,198	564,350 [4] 564,148	541,700

[1] Preliminary.
[2] Includes foreign crude held by importers.
[3] Refinery stocks in California included in pipe-line and tank-farm stocks.
[4] For comparison with succeeding years.
[5] Producers' stocks in California included with pipe-line and tank-farm stocks.
[6] California heavy crude and fuel oil included under refined products as residual fuel oil.
[7] Includes pipe-line and bulk-terminal stocks.
[8] Includes equivalents for wax, coke, and asphalt in barrels.

Stocks of crude petroleum in 1935, by States and months

[Thousands of barrels of 42 gallons]

State	Location[1]													Origin[2]
	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	Dec. 31
Arkansas	3,924	3,674	3,974	4,225	4,184	4,203	4,187	4,305	4,222	4,121	3,945	4,094	4,314	5,916
California	37,529	37,823	37,447	36,872	35,377	33,233	33,282	32,662	33,494	34,981	35,591	37,646	38,944	38,944
Colorado	439	452	412	438	428	412	420	434	406	404	429	453	485	551
Georgia[3]	713	752	649	691	613	634	668	643	551	663	608	623	706	----------
Illinois	11,719	12,091	12,293	12,284	12,358	12,374	12,451	12,214	12,305	11,877	11,586	11,657	11,630	11,052
Indiana	3,122	3,169	3,254	3,547	3,619	3,593	3,228	3,126	3,184	3,329	2,774	2,545	2,654	44
Kansas	13,350	13,472	13,633	13,506	13,161	13,227	13,185	12,933	12,480	11,982	12,054	11,936	12,171	5,165
Kentucky[4]	1,035	1,021	941	924	958	987	884	904	858	815	803	858	801	764
Louisiana[5]	11,181	11,436	10,858	11,313	11,631	12,265	11,948	12,072	12,236	11,792	10,380	9,572	9,099	8,803
Maryland	1,144	1,171	1,075	1,184	838	1,247	1,236	1,280	1,133	1,022	1,164	1,056	1,124	----------
Massachusetts[6]	1,078	1,033	1,059	1,227	1,195	1,101	1,060	814	979	1,043	1,066	880	762	----------
Michigan	810	714	818	861	919	884	733	735	801	751	759	649	744	895
Missouri[7]	3,351	3,306	3,385	3,428	3,484	3,602	3,491	3,565	3,611	3,562	3,547	3,455	3,454	----------
Montana	1,075	1,167	1,237	1,392	1,541	1,528	1,471	1,393	1,337	1,245	1,182	1,121	1,127	1,108
New Jersey	5,676	5,992	5,538	6,582	6,791	6,408	6,373	6,458	6,397	6,170	5,478	5,443	6,051	----------
New Mexico	536	689	681	690	708	699	745	728	669	650	635	698	709	5,573
New York	1,206	1,358	1,456	1,341	1,594	1,502	1,480	1,516	1,576	1,574	1,520	1,480	1,403	438
Ohio	8,079	8,229	8,155	8,335	8,320	8,268	7,765	7,855	7,822	7,802	7,594	7,467	7,375	1,117
Oklahoma	82,614	81,195	80,314	79,857	79,157	78,789	77,841	77,161	74,797	73,852	73,260	72,073	70,695	94,330
Pennsylvania	6,533	6,483	6,659	6,669	7,323	7,308	7,487	7,271	7,352	6,606	5,941	6,050	6,058	2,303
Texas	113,001	113,852	114,274	114,670	116,635	117,460	116,204	112,561	110,282	107,998	108,592	107,789	106,217	106,079
Utah	282	266	245	236	225	217	214	210	201	207	198	198	194	----------
West Virginia	2,124	2,049	2,100	2,125	2,144	2,172	1,980	2,073	2,033	2,107	2,088	1,983	1,988	1,752
Wyoming[8]	26,733	26,780	26,862	26,742	26,590	26,446	26,424	26,438	26,240	26,152	25,961	25,832	25,926	26,052
Foreign	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	3,745
Total United States	337,254	338,174	337,319	339,139	339,793	338,559	334,757	329,351	324,966	320,705	317,155	315,558	314,631	314,631

[1] Segregated by States of location regardless of origin.
[2] Segregated by States of production (origin) regardless of location.
[3] Georgia includes Delaware, South Carolina, and Virginia.
[4] Includes Tennessee.
[5] Includes Alabama and Mississippi.
[6] Includes Rhode Island.
[7] Includes Iowa.
[8] Includes Nebraska and South Dakota.

Stocks of crude petroleum in 1935, by States of origin

[Thousands of barrels of 42 gallons]

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
Arkansas	6, 380	6, 360	6, 189	6, 409	6, 530	6, 665	6, 542	6, 864	7, 007	6, 589	6, 564	6, 461	5, 916
California	37, 529	37, 823	37, 447	36, 872	35, 377	33, 233	33, 282	32, 662	33, 494	34, 981	35, 591	37, 646	38, 944
Colorado	504	520	506	542	532	512	521	531	484	481	506	510	551
Illinois	11, 533	11, 489	11, 558	11, 607	11, 705	11, 671	11, 700	11, 535	11, 571	11, 344	11, 196	11, 199	11, 052
Indiana	49	46	45	45	41	35	31	31	31	38	37	44	44
Kansas	5, 108	5, 638	5, 978	6, 190	6, 046	6, 126	5, 692	5, 386	5, 237	5, 084	5, 083	4, 893	5, 165
Kentucky	1, 049	1, 059	1, 007	964	982	995	890	914	874	797	773	836	764
Louisiana	8, 833	8, 764	8, 452	8, 219	8, 701	9, 119	9, 611	9, 779	9, 618	9, 818	9, 435	8, 987	8, 803
Michigan	800	765	866	934	1, 010	1, 011	922	1, 024	1, 116	1, 126	1, 133	886	895
Montana	1, 074	1, 167	1, 236	1, 391	1, 533	1, 519	1, 470	1, 392	1, 338	1, 226	1, 183	1, 104	1, 108
New Mexico	4, 807	4, 846	4, 541	4, 646	4, 924	5, 293	5, 313	5, 851	5, 771	5, 505	5, 137	5, 235	5, 573
New York	446	490	490	418	458	491	496	515	521	491	487	453	438
Ohio	1, 047	1, 075	1, 051	1, 056	1, 064	1, 089	1, 012	1, 042	1, 007	1, 012	1, 038	1, 058	1, 117
Oklahoma	108, 037	106, 484	105, 835	105, 707	105, 332	104, 563	102, 952	101, 447	98, 980	97, 159	96, 462	95, 832	94, 330
Pennsylvania	2, 531	2, 390	2, 312	2, 439	2, 707	2, 664	2, 829	2, 861	2, 832	2, 700	2, 611	2, 447	2, 303
Texas	114, 918	116, 746	117, 398	118, 982	120, 553	120, 984	118, 908	115, 628	113, 206	110, 474	108, 970	107, 037	106, 079
West Virginia	1, 909	1, 894	1, 922	1, 924	1, 899	1, 921	1, 868	1, 937	1, 908	1, 963	1, 956	1, 911	1, 752
Wyoming	26, 909	26, 941	26, 986	26, 847	26, 696	26, 548	26, 526	26, 539	26, 350	26, 283	26, 065	25, 966	26, 052
Foreign	3, 791	3, 677	3, 500	3, 947	3, 703	4, 120	4, 192	3, 413	3, 621	3, 634	2, 928	3, 053	3, 745
Total United States	337, 254	338, 174	337, 319	339, 139	339, 793	338, 559	334, 757	329, 351	324, 966	320, 705	317, 155	315, 558	314, 631

Stocks of crude petroleum in 1935, by districts and months

[Thousands of barrels of 42 gallons]

	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 location of storage:													
East coast:													
Domestic	10,006	10,743	10,654	11,989	12,327	11,672	11,512	11,505	11,371	10,844	10,039	9,782	9,724
Foreign	2,683	2,452	2,249	2,083	2,147	2,565	2,683	2,427	2,568	2,502	2,053	2,203	2,976
Appalachian	1,249	1,426	1,426	1,544	1,639	1,705	1,594	1,638	1,744	1,720	1,618	1,458	1,334
Indiana, Illinois, Kentucky, etc	4,048	4,208	4,304	4,476	4,687	4,791	4,326	4,151	4,375	4,046	3,452	3,187	3,146
Oklahoma, Kansas, and Missouri	5,996	5,954	6,428	6,326	6,229	6,095	5,426	5,106	4,920	4,525	4,471	4,642	4,469
Texas inland	1,708	1,592	1,352	1,413	1,422	1,669	1,534	1,493	1,280	1,238	1,465	1,607	1,644
Texas Gulf coast:													
Domestic	10,677	10,659	10,944	10,302	11,148	11,395	10,673	10,144	10,139	9,783	10,493	10,727	11,145
Foreign	496	623	538	809	610	515	548	253	406	542	544	497	268
Louisiana Gulf coast:													
Domestic	3,424	3,560	3,507	3,503	3,979	4,388	4,334	4,427	4,590	4,029	3,539	2,477	2,045
Foreign	612	602	713	1,055	946	1,040	961	733	647	590	331	353	501
Arkansas and Louisiana inland	738	688	761	854	941	1,024	1,082	1,129	1,035	1,038	995	1,041	943
Rocky Mountain	13,382	13,385	13,440	13,297	13,268	13,050	12,911	13,075	12,980	12,853	12,751	12,521	12,509
California	9,080	8,414	8,514	7,703	6,729	5,976	6,939	7,007	7,245	7,822	7,437	8,506	8,444
Total at refineries	64,099	64,306	64,830	65,354	66,072	65,885	64,523	63,088	63,300	61,532	59,188	59,001	59,148
At refineries, by fields of origin:													
Appalachian:													
Pennsylvania grade	1,104	1,138	1,196	1,245	1,336	1,314	1,416	1,444	1,480	1,386	1,389	1,341	1,188
Other Appalachian (including Kentucky)	624	653	653	623	635	646	527	573	597	502	482	559	511
Lima-northeastern Indiana-Michigan	292	314	311	359	378	398	457	551	604	628	640	513	450
Illinois-southwestern Indiana	104	124	150	123	148	154	193	131	128	108	69	84	80
North Louisiana and Arkansas	1,982	2,051	2,049	2,116	2,208	2,578	2,669	2,869	2,855	2,471	2,708	2,237	1,986
West Texas and southeastern New Mexico	3,274	4,397	4,051	3,976	4,557	4,169	3,508	3,807	3,320	3,246	3,080	3,024	3,350
East Texas	6,238	6,279	6,659	6,735	7,531	6,966	7,009	6,208	6,491	6,110	5,720	5,757	4,960
Oklahoma, Kansas, north Texas, etc	16,610	16,379	16,628	17,720	17,740	18,082	16,080	15,090	15,390	14,073	13,317	13,241	13,493
Gulf coast	7,654	7,527	7,704	7,533	7,866	8,459	8,636	8,938	8,600	8,717	8,682	8,196	8,462
Rocky Mountain	13,346	13,353	13,415	13,274	13,241	13,023	12,897	13,057	12,969	12,835	12,736	12,490	12,479
California	9,080	8,414	8,514	7,703	6,729	5,976	6,939	7,007	7,245	7,822	7,437	8,506	8,444
Foreign	3,791	3,677	3,500	3,947	3,703	4,120	4,192	3,413	3,621	3,634	2,928	3,053	3,745
Total at refineries	64,099	64,306	64,830	65,354	66,072	65,885	64,523	63,088	63,300	61,532	59,188	59,001	59,148

Pipe-line and tank-farm stocks, by fields of origin:													
Appalachian:													
Pennsylvania grade	3,760	3,598	3,497	3,504	3,626	3,746	3,747	3,834	3,751	3,694	3,645	3,491	3,411
Other Appalachian (including Kentucky)	554	574	507	505	519	532	512	511	422	444	416	411	386
Lima-northeastern Indiana-Michigan	992	927	1,008	1,031	1,084	1,071	897	933	961	962	968	813	845
Illinois-southwestern Indiana	11,351	11,278	11,321	11,416	11,476	11,404	11,414	11,320	11,354	11,161	11,056	11,046	10,888
North Louisiana and Arkansas	7,999	7,751	7,764	7,959	8,119	7,983	7,904	7,938	8,165	8,374	8,093	8,162	7,690
West Texas and southeastern New Mexico	26,564	26,368	26,498	26,338	26,503	26,760	27,081	27,778	27,336	26,620	26,469	26,437	26,159
East Texas	24,928	25,305	25,100	25,487	25,285	24,819	24,082	22,650	20,915	19,814	18,588	17,133	16,629
Oklahoma, Kansas, north Texas, etc.	135,907	134,559	133,771	133,556	132,639	132,278	130,772	128,188	125,002	122,991	122,065	121,067	119,391
Gulf coast	11,034	12,136	12,122	12,843	13,675	14,604	15,136	15,492	15,726	16,157	16,949	17,213	17,906
Rocky Mountain	14,702	14,838	14,872	15,061	15,111	15,134	15,185	14,978	14,784	14,716	14,568	14,638	14,772
California	26,834	27,667	27,271	27,452	26,837	25,487	24,444	23,713	24,074	24,142	24,367	25,809	27,101
Total pipe-line and tank-farm	264,625	265,001	263,731	265,152	264,874	263,818	261,174	257,335	252,490	249,075	247,184	246,220	245,178
Producers' stocks	8,530	8,867	8,758	8,633	8,847	8,856	9,060	8,928	9,176	10,098	10,783	10,337	10,305
Total United States: 1935	337,254	338,174	337,319	339,139	339,793	338,559	334,757	329,351	324,966	320,705	317,155	315,558	314,631
1934	355,312	353,642	351,641	354,067	354,350	355,883	357,451	355,525	351,092	349,407	346,800	341,403	337,254

WELLS

In 1935, 15,108 oil wells were completed, an increase of 21 percent over 1934; the total number of wells completed—oil wells, gas wells, and dry holes—was 21,420 compared with 18,197 in 1934. It has been estimated that at the end of 1935 the total number of oil wells in the United States was approximately 340,000, an increase of nearly 7,000 over the number (333,070) producing at the end of the previous year.

The ratio of oil wells to total completions increased from 69 percent in 1934 to 70 percent in 1935; as the percentage of gas wells remained unchanged (7 percent) the percentage of dry holes declined from 24 to 23 percent. The percentage of failures in 1935 was the lowest in about 10 years, indicating that advances in the science of finding oil exerted

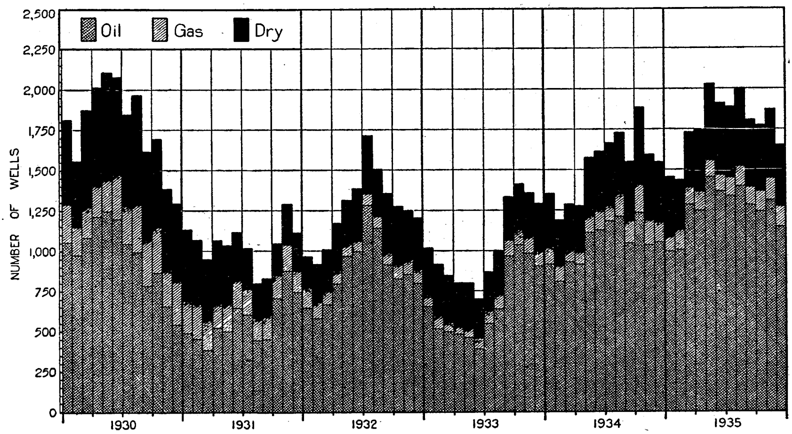

FIGURE 103.—Wells drilled, 1930–35, by months.

a greater effect than the increase in number of wildcatting operations in reducing the proportion of failures.

The east Texas and Bradford-Allegany fields, both of which reported more completions in 1935 than in 1934, continued to be the most active areas in the country, followed by Archer County, Tex., where development work declined. There were conspicuous increases in activity in 1935 in Lea County, N. Mex.; the Loma Novia and Samfordyce districts of Texas; Pontotoc County, Okla.; Reno, Rice, and Russell Counties, Kans.; and Montcalm County, Mich.

The total number of wells completed, divided as between oil wells, gas wells, and dry holes, is shown graphically in figure 103.

Wells drilled for oil and gas in the United States in 1935, by months

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total: Number	Total: Percent
Oil	996	1,003	1,288	1,248	1,465	1,369	1,340	1,403	1,286	1,243	1,318	1,149	15,108	70
Gas [1]	96	128	107	117	105	102	114	125	114	129	137	127	1,401	7
Dry	372	318	349	384	476	442	440	473	421	415	429	392	4,911	23
Total: 1935	1,464	1,449	1,744	1,749	2,046	1,913	1,894	2,001	1,821	1,787	1,884	1,668	21,420	100
1934	1,345	1,190	1,286	1,284	1,574	1,620	1,672	1,732	1,554	1,799	1,596	1,545	18,197	-----

[1] California dry gas wells not reported.

Drilling activity in leading districts, 1934–35 [1]

District	State	Completions		District	State	Completions	
		1934	1935			1934	1935
Archer County	Tex.	963	773	Montcalm County	Mich.	16	156
Bosco	La.	29	50	Ohio County	Ky.	256	187
Bradford-Allegany	Pa-N. Y.	1, 414	1, 650	Osage County	Okla.	320	302
				Pontotoc County	Okla.	115	277
Caddo Parish	La.	72	134	Pottawatomie County	Okla.	128	161
East Texas	Tex.	3, 517	4, 150	Reno County	Kans.	71	156
Glacier County	Mont.	116	113	Rice County	Kans.	121	203
Government Wells	Tex.	305	120	Russell County	Kans.	55	177
Gray County	Tex.	209	300	Samfordyce	Tex.	41	104
Lea County	N. Mex.	86	265	Seminole County	Okla.	106	211
Loma Novia	Tex.	1	201	Tomball	Tex.	111	108
Long Beach	Calif.	102	168	Ward County	Tex.	130	172

[1] Totals for oil wells, gas wells, and dry holes from Oil and Gas Jour. and Trans., Am. Inst. Min. and Met. Eng., vol. 114.

PRODUCTION BY STATES

Production in 1935 increased commensurately with seasonal requirements until about September, when overproduction in some States prevented the usual late-year decline. The daily average production for the year was 2,723,000 barrels compared with an average of 2,488,000 barrels in 1934. The highest average was 2,883,000 barrels in November and the lowest, 2,539,000 barrels in January.

Texas easily retained its rank as the leading producing State, although its percentage of the national total declined from 42.0 percent in 1934 to 39.4 percent in 1935. The most notable gains in relative importance of the producing States in 1935 were made by California, the ratio of which rose from 19.2 percent in 1934 to 20.9 percent in 1935, and Louisiana, which increased from 3.6 to 5.0 percent.

The relative production of crude by States for 1934 and 1935 is shown graphically in figure 104.

Petroleum produced in the United States, 1919–35, by States

[Thousands of barrels of 42 gallons]

Year	Arkansas	California	Colorado	Illinois	Indiana	Kansas	Kentucky	Louisiana	Michigan	Montana	New Mexico	New York
1919	-------	101, 183	121	11, 960	972	33, 048	9, 278	17, 188	(1)	90	(1)	851
1920	(1)	103, 377	111	10, 774	945	39, 005	8, 738	35, 714	-------	340	(1)	906
1921	10, 473	112, 600	108	10, 043	1, 158	36, 456	9, 013	27, 103	-------	1, 509	(1)	988
1922	12, 712	138, 468	97	9, 383	1, 087	31, 766	8, 973	35, 376	-------	2, 449	(1)	1, 000
1923	36, 610	262, 876	86	8, 707	1, 043	28, 250	8, 069	24, 919	-------	2, 782	(1)	1, 250
1924	46, 028	228, 933	445	8, 081	935	28, 836	7, 407	21, 124	-------	2, 815	98	1, 440
1925	77, 398	232, 492	1, 226	7, 863	829	38, 357	6, 759	20, 272	4	4, 091	1, 060	1, 695
1926	58, 332	224, 673	2, 768	7, 760	808	41, 498	6, 274	23, 201	94	7, 727	1, 666	1, 956
1927	40, 005	231, 196	2, 831	6, 994	852	41, 069	6, 719	22, 818	439	5, 058	1, 226	2, 242
1928	32, 096	231, 811	2, 774	6, 462	1, 052	38, 596	7, 359	21, 847	594	4, 015	943	2, 603
1929	24, 917	292, 534	2, 358	6, 319	981	42, 813	7, 775	20, 554	4, 528	3, 980	1, 830	3, 377
1930	19, 702	227, 329	1, 656	5, 736	994	41, 638	7, 389	23, 272	3, 911	3, 349	10, 189	3, 647
1931	14, 791	188, 830	1, 545	5, 039	840	37, 018	6, 456	21, 804	3, 789	2, 830	15, 227	3, 363
1932	12, 051	178, 128	1, 136	4, 673	806	34, 848	6, 287	21, 807	6, 910	2, 457	12, 455	3, 508
1933	11, 686	172, 010	919	4, 244	737	41, 976	4, 608	25. 168	7, 942	2, 273	14, 116	3, 181
1934	11, 182	174, 305	1, 139	4, 479	838	46, 482	4, 860	32, 869	10, 603	3, 603	16, 864	3, 804
1935 [2]	10, 973	207, 832	1, 549	4, 305	757	54, 787	5, 255	49, 869	15, 256	4, 594	20, 586	4, 237

[1] Included under "Other."
[2] Preliminary.

Petroleum produced in the United States, 1919–35, by States—Continued

[Thousands of barrels of 42 gallons]

Year	Ohio	Oklahoma	Pennsylvania	Tennessee	Texas	West Virginia	Wyoming	Other	Total		
									Quantity	Value at wells	
										Total (thousands of dollars)	Average per barrel
1919	7,736	86,911	8,137	15	79,366	8,327	13,172	12	378,367	760,266	$2.01
1920	7,400	106,206	7,438	14	96,868	8,249	16,831	13	442,929	1,360,745	3.07
1921	7,335	114,634	7,418	12	106,166	7,822	19,333	12	472,183	814,745	1.73
1922	6,781	149,571	7,425	10	118,684	7,021	26,715	13	557,531	895,111	1.61
1923	7,085	160,929	7,609	8	131,023	6,358	44,785	18	732,407	978,430	1.34
1924	6,811	173,538	7,486	10	134,522	5,920	39,498	13	713,940	1,022,683	1.43
1925	7,212	176,768	8,097	24	144,648	5,763	29,173	12	763,743	1,284,960	1.68
1926	7,272	179,195	8,961	43	166,916	5,946	25,776	8	770,874	1,447,760	1.88
1927	7,593	277,775	9,526	60	217,389	6,023	21,307	7	901,129	1,172,830	1.30
1928	7,015	249,857	9,956	46	257,320	5,661	21,461	6	901,474	1,054,880	1.17
1929	6,743	255,004	11,820	19	296,876	5,574	19,314	7	1,007,323	1,280,417	1.27
1930	6,486	216,486	12,803	21	290,457	5,071	17,868	7	898,011	1,070,200	1.19
1931	5,327	180,574	11,892	6	332,437	4,472	14,834	7	851,081	550,630	.65
1932	4,644	153,244	12,412	5	312,478	3,876	13,418	16	785,159	680,460	.87
1933	4,235	182,251	12,624	5	402,609	3,815	11,227	30	905,656	608,000	.67
1934	4,234	180,107	14,478	10	381,516	4,095	12,556	41	908,065	904,825	1.00
1935 [2]	4,070	185,348	15.830	10	391,097	3,903	13,650	34	993,942	994,000	1.00

[2] Preliminary.

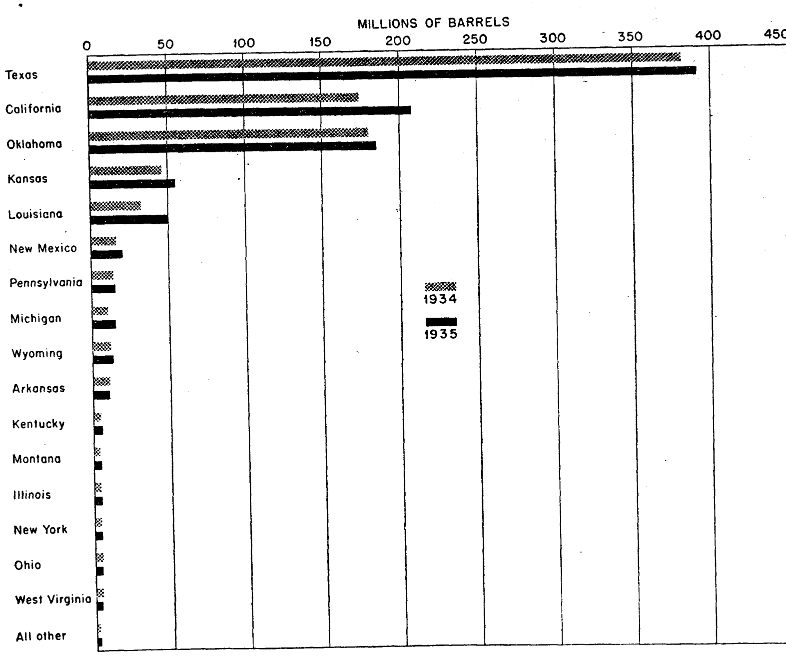

FIGURE 104.—Production of crude petroleum, 1934–35, by States.

Percentage of crude petroleum produced by principal States, 1929–35

	1929	1930	1931	1932	1933	1934	1935
Texas	29.5	32.4	39.1	39.8	44.5	42.0	39.4
California	29.0	25.3	22.2	22.7	19.0	19.2	20.9
Oklahoma	25.3	24.1	21.2	19.5	20.1	19.9	18.6
Total, 3 States	83.8	81.8	82.5	82.0	83.6	81.1	78.9
Kansas	4.3	4.7	4.4	4.4	4.6	5.1	5.5
Louisiana	2.0	2.6	2.6	2.8	2.8	3.6	5.0
New Mexico	.2	1.1	1.8	1.6	1.6	1.9	2.1
Michigan	.4	.4	.4	.9	.9	1.2	1.5
Pennsylvania	1.2	1.4	1.4	1.6	1.4	1.6	1.6
Arkansas	2.5	2.2	1.7	1.5	1.3	1.1	1.1
All other	5.6	5.8	5.2	5.2	3.8	4.4	4.3
Total United States	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Production of crude oil in leading fields, 1935, in barrels

Field	Production in 1935	Approximate increase or decrease compared with 1934
East Texas, Tex	175,918,000	−5,622,000
Oklahoma City, Okla	54,359,000	−8,470,000
Seminole, Okla	47,509,000	+9,326,000
Kettleman Hills, Calif	27,607,000	+6,217,000
Long Beach, Calif	26,563,000	+3,775,000
Midway-Sunset, Calif	19,713,000	−527,000
Bradford-Allegany, Pa.-N. Y	16,798,000	+1,874,000
Pecos County, Tex.[1]	16,472,000	+29,000
Santa Fe Springs, Calif	16,159,000	+1,437,000
Conroe, Tex.[1]	15,269,000	−1,874,000
Huntington Beach, Calif	15,133,000	+27,000
Van, Tex.[1]	14,265,000	−368,000
Hobbs, N. Mex.[1]	11,063,000	−1,375,000
Rice County, Kans.[1]	8,069,000	+4,164,000
Boscoe, La.[1]	6,356,000	+5,342,000
All other	522,689,000	+71,922,000
Total	993,942,000	+85,877,000

[1] From Oil and Gas Jour.

Production of crude petroleum in 1935,[1] *by States and months*

[Thousands of barrels of 42 gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	1935	1934
Arkansas	882	844	970	924	965	935	936	917	878	930	890	902	10, 973	11, 182
California:														
Huntington Beach	1, 212	1, 092	1, 230	1, 164	1, 189	1, 343	1, 322	1, 339	1, 283	1, 340	1, 300	1, 319	15, 133	15, 006
Kettleman Hills	2, 104	1, 898	2, 021	1, 588	1, 675	1, 850	1, 905	2, 229	2, 642	3, 104	3, 319	3, 272	27, 607	21, 390
Long Beach	1, 930	1, 843	2, 035	1, 956	2, 027	2, 232	2, 403	2, 443	2, 435	2, 407	2, 391	2, 461	26, 563	22, 788
Santa Fe Springs	1, 200	1, 057	1, 202	1, 108	1, 135	1, 176	1, 241	1, 384	1, 644	1, 698	1, 629	1, 685	16, 159	14, 663
Rest of State	9, 065	8, 069	8, 943	8, 358	9, 316	10, 108	10, 547	11, 209	11, 206	11, 603	11, 656	12, 290	122, 370	100, 458
Total California	15, 511	13, 959	15, 431	14, 174	15, 342	16, 709	17, 418	18, 604	19, 210	20, 152	20, 295	21, 027	207, 832	174, 305
Colorado	116	117	152	150	123	115	124	134	138	130	122	128	1, 549	1, 139
Illinois	332	295	370	338	382	358	377	379	370	391	369	344	4, 305	4, 479
Indiana	59	56	65	61	66	64	63	71	66	68	60	58	757	838
Kansas	4, 246	4, 177	4, 821	4, 550	4, 736	4, 607	4, 865	4, 613	4, 550	4, 785	4, 385	4, 452	54, 787	46, 482
Kentucky	445	405	438	445	464	427	467	454	433	462	424	391	5, 255	4, 860
Louisiana:														
Gulf Coast	2, 727	2, 540	2, 921	3, 096	3, 406	3, 435	3, 596	3, 617	3, 545	3, 807	3, 759	3, 868	40, 317	23, 794
Rest of State	708	640	684	708	734	686	716	758	826	948	962	1, 182	9, 552	9, 075
Total Louisiana	3, 435	3, 180	3, 605	3, 804	4, 140	4, 121	4, 312	4, 375	4, 371	4, 755	4, 721	5, 050	49, 869	32, 869
Michigan	1, 028	1, 019	1, 063	1, 179	1, 234	1, 235	1, 257	1, 337	1, 448	1, 649	1, 452	1, 355	15, 256	10, 603
Montana	374	301	325	332	384	380	416	426	408	409	412	427	4, 594	3, 603
New Mexico	1, 663	1, 402	1, 661	1, 639	1, 675	1, 680	1, 804	1, 822	1, 762	1, 822	1, 806	1, 850	20, 586	16, 864
New York	357	319	336	350	360	336	372	369	348	370	353	367	4, 237	3, 804
Ohio:														
Central and Eastern	264	248	266	274	278	256	264	234	281	286	252	260	3, 163	3, 258
Northwestern	76	64	79	82	85	80	85	77	74	81	66	58	907	976
Total Ohio	340	312	345	356	363	336	349	311	355	367	318	318	4, 070	4, 234
Oklahoma:														
Oklahoma City	4, 949	4, 201	4, 754	5, 013	5, 071	4, 805	4, 895	4, 365	4, 012	4, 348	4, 033	3, 913	54, 359	62, 829
Seminole	3, 708	3, 449	4, 035	3, 970	4, 182	4, 040	4, 306	3, 985	3, 951	4, 083	3, 920	3, 880	47, 509	38, 183
Rest of State	6, 559	6, 080	6, 859	6, 670	6, 962	6, 683	7, 234	7, 007	6, 971	7, 519	7, 366	7, 570	83, 480	79, 095
Total Oklahoma	15, 216	13, 730	15, 648	15, 653	16, 215	15, 528	16, 435	15, 357	14, 934	15, 950	15, 319	15, 363	185, 348	180, 107
Pennsylvania	1, 304	1, 214	1, 348	1, 380	1, 414	1, 285	1, 376	1, 305	1, 251	1, 356	1, 306	1, 291	15, 830	14, 478
Texas:														
Gulf coast	5, 263	4, 727	5, 296	5, 124	5, 213	5, 116	5, 287	5, 229	5, 300	5, 571	5, 876	6, 321	64, 323	60, 155
West Texas	4, 561	4, 260	4, 735	4, 523	4, 612	4, 502	4, 634	4, 600	4, 509	4, 727	4, 801	4, 825	55, 289	50, 272
East Texas	14, 257	13, 808	15, 319	14, 131	14, 954	15, 144	15, 279	15, 198	14, 524	14, 720	14, 140	14, 444	175, 918	181, 540
Panhandle	1, 827	1, 730	1, 885	1, 801	1, 894	1, 729	1, 774	1, 665	1, 673	1, 686	1, 797	1, 865	21, 326	20, 280
Rest of State	6, 063	5, 633	6, 316	6, 107	6, 410	6, 204	6, 323	6, 155	6, 058	6, 292	6, 219	6, 461	74, 241	69, 269
Total Texas	31, 971	30, 158	33, 551	31, 686	33, 083	32, 695	33, 297	32, 847	32, 064	32, 996	32, 833	33, 916	391, 097	381, 516
West Virginia	333	308	332	336	349	317	339	317	314	357	301	300	3, 903	4, 095
Wyoming:														
Salt Creek	539	499	536	530	539	499	522	515	510	527	516	520	6, 252	6, 520
Rest of State	564	464	487	536	616	707	752	659	694	680	591	648	7, 398	6, 036
Total Wyoming	1, 103	963	1, 023	1, 066	1, 155	1, 206	1, 274	1, 174	1, 204	1, 207	1, 107	1, 168	13, 650	12, 556
Other [2]	([3])	4	4	4	4	4	4	4	5	4	3	4	44	51
Total United States	78, 715	72, 763	81, 488	78, 427	82, 454	82, 338	85, 485	84, 816	84, 109	88, 160	86, 476	88, 711	993, 942	908, 065
Daily average	2, 539	2, 599	2, 629	2, 614	2, 657	2, 745	2, 758	2, 736	2, 804	2, 844	2, 883	2, 862	2, 723	2, 488

[1] Preliminary. [2] Mississippi, Missouri, Tennessee, Utah. [3] Not available.

Arkansas.—Field activity in Arkansas in 1935 continued at about the same rate as in 1934, but the average size of successful completions decreased and no new fields of importance were discovered; hence the total production for the State continued the decline begun in 1926. The total output in 1935 was 10,973,000 barrels compared with 11,182,000 barrels in 1934. The Smackover field showed the largest decline in production in 1935; in fact, production outside of Smackover, which contributed 71 percent of the State total in 1935, increased.

The discovery of the Rodessa field just over the line in Louisiana stimulated wildcatting in the adjacent counties of Arkansas, but the results were nil. Two notable deep tests were drilled in Arkansas, in 1935, one in the Smackover field and one at Champagnolle. The former was the deepest test ever drilled in Arkansas, reaching a depth of nearly 8,000 feet, when drilling was stopped in igneous rock.

California.—Production in California exceeded the 200,000,000-barrel mark in 1935 for the first time since 1930. The production in 1935 was 207,832,000 barrels compared with 174,305,000 barrels in 1934. Most of the increase over 1934 was registered in the last 4 months of the year, following a general break-down in proration after the invalidation of the code. Many fields flowed wide open during the last quarter of the year, producing considerably more than the market demand but much less than their rated potentials.

Drilling increased substantially in 1935, but few discoveries were made; in fact, outside of extensions in the older fields, only one new field—and that of questionable importance—was brought in. This is at El Segundo in the basin near the Lawndale field, of which it may be a part.

A review of production in California for 1935 by fields indicates that Kettleman Hills succeeded Long Beach as the leading producer because it flowed virtually wide open during the last quarter of the year after being curtailed much more than Long Beach. The northern or Valley fields showed the largest increases in production in California in 1935, the gains in the Kettleman Hills, Mountain View, and Mount Poso fields being outstanding. Most of the fields of the Los Angeles Basin increased their output over 1934 in 1935, a gain of 75 to 80 percent for Playa del Rey being noteworthy.

Colorado.—Production in Colorado in 1935 was 1,549,000 barrels, a substantial increase over 1934 due almost solely to increased production from the Iles field, as drilling declined and most of the older fields produced less.

A new field was discovered in Archuleta County, and a gas well on the Hiawatha Dome struck oil when deepened. These discoveries and a general increase in interest in Colorado bid fair to maintain the State production.

Illinois.—Although all restrictions on production were removed in Illinois in 1935 and the price remained stable, the output declined from 4,479,000 barrels in 1934 to 4,305,000 in 1935. This decrease reflected the natural decline of the fields, the comparative lack of field activity in proven areas, and the failure to find any new fields of importance, only partly offset by increased production from waterflooding and repressuring. Despite this apparent lack of interest Illinois was the scene of considerable geophysical work in 1935, and it was reported that several large areas were assembled for possible tests.

Indiana.—The 1935 production record for Indiana was similar to that of Illinois; that is, all restrictions on production were lifted, but the output for the year (757,000 barrels) was materially lower than in 1934 (838,000 barrels). Virtually all of the new developments were in gas, which finds a ready market at about the highest well price of any area in the United States.

Kansas.—Production in Kansas reached a new high level in 1935, when 54,787,000 barrels were produced, an increase of 18 percent over the record of 1934. Drilling also reached record levels, 890 oil wells being completed compared with 591 in 1934.

Wildcatters probably were more active in west central Kansas in 1935 than in any other area of comparable size. According to the Oil and Gas Journal about 50 discoveries were made in 1935; however, some of these represented extensions to older pools, and some can hardly be rated at more than "shows." These discoveries were distributed over 17 counties, with Russell County leading, followed by Rice, Butler, and Cowley. Some of the pools that had been completely shut in for the want of a market were given pipe-line connections in 1935; the resultant production was responsible for part of the increase in 1935. However, many of the discoveries of 1935 were shut in after initial tests, as the total potential for the State was several times the market demand.

The Ritz-Canton and Hollow pools, leaders in production in 1934, declined materially in 1935, the former losing the leadership to the Burrton pool of Reno County. Sumner County, featuring chiefly the prolific deep zone in the Oxford pool, in all probability will be a substantial producer in 1936.

Kentucky.—Although drilling declined in Kentucky in 1935, the production increased 8 percent—from 4,860,000 barrels in 1934 to 5,255,000 in 1935. Some of the increase can be attributed to the use of improved methods, although most of it resulted from a large output in the comparatively shallow areas of western Kentucky. Ohio County continued to lead in development, with most of the drilling concentrated in the Fordsville field, which produces from a sand only 400 feet deep.

Louisiana.—Production in Louisiana in 1935 was 49,869,000 barrels, an increase of 17,000,000 barrels over 1934 and more than 14,000,000 above the previous record established in 1920; 40,317,000 barrels (81 percent) came from the coastal district and 9,552,000 (19 percent) from the northern fields. These data indicate the increased importance of the coastal district, although 1935 was the first year since 1930 that the northern district has increased. The increase in production in Louisiana in 1935 (52 percent above 1934) was the highest for any State, allowing it to pass Kansas in November as the fourth most important producing State.

The increase in production in coastal Louisiana in 1935 resulted mainly from increases in allowables in the coastal fields, whereas the gain in northern Louisiana was due primarily to the completion of about 50 wells of large potential at Rodessa. These developments more than balanced a decline in number of oil wells completed as compared with 1934.

The discovery of the Rodessa oil field in Caddo Parish was the most important event of the year in Louisiana; in fact, it probably was the outstanding discovery in the United States since East Texas. Rodessa had been a gas field for some time, but in July 1935 deep flank oil production was found in oolitic lime in the lower Glen Rose formation at a depth of just over 6,000 feet. The daily production at Rodessa at the close of 1935 was about 18,000 barrels from about 30 wells, with a proven structure more than 5 miles long extending southwest into Cass County, Tex., and northeast nearly into Miller County, Ark.

The coastal district in 1935 yielded the usual number of new discoveries—six or seven new fields. Of these the Lafitte field, the first discovery of Jefferson Parish, and Garden City, Plaquemines Parish, the most easterly field of the State, were outstanding.

Michigan.—Production in Michigan again increased materially in 1935, 15,256,000 barrels compared with 10,603,000 in 1934. In August 1935 Michigan passed Pennsylvania as the most important producing State east of the Mississippi.

The outstanding development of the year was the discovery of the Crystal field in Montcalm County in March 1935. The discovery well at Crystal flowed at the rate of 4,000 to 5,000 barrels daily when first brought in and led to a feverish leasing and development campaign. About 90 oil wells were completed here before the end of the year; the average daily initial was more than 1,000 barrels. This discovery approximately represented the difference between drilling activity in 1934 and 1935; that is, the increase almost equaled the number of wells completed at Crystal. Crystal is a disappointment in that the wells are in a thin pay and are declining rapidly. Despite the interest in Crystal the Porter-Mount Pleasant district remained the mainstay of production, yielding about two-thirds of the output in 1935.

Mississippi.—Oil developments in Mississippi in 1935 were practically confined to exploratory work by a few major companies. No oil wells were completed, and production was limited to a few thousand barrels from the edge of the Jackson gas field.

Montana.—Production in Montana continued to increase, the 1935 output of 4,594,000 barrels being exceeded only by the totals of 1926 and 1927.

In 1935, as in 1934, the gain in production resulted from developments at Cut Bank, which yielded about 2,210,000 barrels in 1935, nearly double the production in 1934. Production increased in most of the other fields, except Kevin-Sunburst, which resigned first place to Cut Bank.

Drilling activity in Montana in 1935 continued at about the same rate as in 1934, with most of the completions in the Cut Bank field. Although a few more wells were completed in Montana in 1935 than in 1934, the total initial production declined slightly. One new oil field, Flat Coulee, was discovered in Montana in 1935.

New Mexico.—Production in New Mexico again reached a new peak in 1935, when 20,586,000 barrels were produced compared with 16,864,000 barrels in 1934. Although the Hobbs field continued to yield more than half of the State's total, it was about the only important field to decline in relative importance in 1935. However, this decrease was due to the division of the State's allowable, the potential of the field being slightly higher at the end of the year than at the beginning.

Several discoveries were made in New Mexico in 1935, the most important of which was the Monument field of Lea County; 25 to 30 producers were completed in this field in 1935, proving an area, which if connected with the Eunice field to the south will rival Hobbs in importance. Several other discoveries were made in the Eunice area, but little activity was displayed in the light-oil area of northwest New Mexico.

New York.—Production in New York in 1935 was 4,237,000 barrels, the highest since 1882. There has been a consistent upward trend in production in New York in recent years, not because of new discoveries but because of successful water-flooding in the Bradford-Allegany field.

Ohio.—The record of oil production in Ohio in 1935 was about the same as in 1934; drilling was confined to offsets and fulfilments of lease requirements. The number of completions in 1935, however, was considerably below that in 1934. Production declined from 4,234,000 barrels in 1934 to 4,070,000 in 1935. According to Lamborn[3] 1,022 tests were drilled in 53 counties of Ohio in 1935, 653 of which were commercial producers of oil or gas.

Oklahoma.—Production in Oklahoma rose from 180,107,000 barrels in 1934 to 185,348,000 in 1935. This gain was due primarily to increased demand for Oklahoma crude, causing a general increase in the allowables.

Drilling reached the highest point since 1930; 1,321 oil wells were completed in 1935 compared with 1,161 in 1934 and 2,061 in 1930. Wildcatting also increased, even surpassing the outstanding performance of 1934. According to the Oil and Gas Journal wildcat wells were drilled in 44 of the State's 77 counties in 1935, and oil and gas were discovered in 34 areas in 18 counties. Important new discoveries were the Britton, Stillwater, and Jesse fields in Oklahoma, Payne and Pontotoc Counties, respectively. Promising deep sand (8,088 feet) was found in the old Fox field of Carter County. The Fitts, Edmond, and Oklahoma City fields were extended.

The Seminole district, generally considered a "back number", continued to surprise; its output reached 47,509,000 barrels after a steady decline from the peak of about 130,000,000 in 1929 to 38,183,000 in 1934. The gain at Seminole in 1935 was due primarily to numerous extensions and recompletions throughout the district. The performance of the Oklahoma City field bore out the general predictions; the output declined from 62,829,000 barrels in 1934 to 54,359,000 in 1935. The development of the prolific Capitol extension in 1936, however, undoubtedly will check this decline.

Other fields contributing to the gain in production in Oklahoma in 1935 are Fitts, Pontotoc County, where the output increased from about 330,000 barrels in 1934 to about 6,900,000; Edmond, Oklahoma County, where production increased from approximately 90,000 to 1,480,000 barrels; Lucien, Noble County, which rose from 2,900,000 to 3,750,000 barrels; and South Burbank, which rose from 2,280,000 to 4,220,000 barrels.

[3] Lamborn, R. E., Oil and Gas Development in Ohio for 1935: Trans. Am. Inst. Min. and Met. Eng., 1936.

More and more attention was given to increasing the recovery in the stripper areas of the State in 1935; particularly favorable results were obtained from water-flooding in the old Nowata district.

Pennsylvania.—Production in Pennsylvania in 1935 was 15,830,000 barrels, an increase of 9 percent over 1934 and the highest annual total since 1897. The Bradford field accounted for most of the increase in production in 1935; its output (about 12,200,000 barrels) consequently represented a higher percentage of the State total than in 1934. This gain resulted primarily from increased drilling, although the major purchasers increased the "allowables" in their ratable-taking contracts.

In Pennsylvania, as in Oklahoma and other States, more and more attention was devoted to increasing the recovery of the stripper wells, with the result that a number of areas in western Pennsylvania outside of Bradford were cored and otherwise analyzed preparatory to installing water floods or other artificial recovery methods.

Tennessee.—The preliminary figure for production in Tennessee for 1935 is 10,000 barrels, the same as the final figure for 1934. The actual production in 1935 may have been as high as 20,000 barrels, but authentic data are lacking. Reports indicate that acidizing was used successfully in Tennessee in 1935 and that the potential possibilities in oil and gas production will warrant some geophysical work.

Texas.—Production in Texas in 1935 totaled 391,097,000 barrels, an increase of nearly 10,000,000 over the output in 1934. As in 1934, all the increase was outside the east Texas field, which yielded only 175,918,000 barrels in 1935 compared with 181,540,000 in 1934. The factor that controlled production in Texas in 1935 was the total State allowables as set by the Railroad Commission. Actual production was generally higher than the allowables, but without them it probably would have been much higher.

Development work in the Texas Panhandle continued to increase in 1935; 706 wells were completed compared with 436 in 1934. Of the completions in 1935, 80 were gas wells and only 41 dry holes, a relatively small percentage of failures. The total output in the Panhandle in 1935 was 21,326,000 barrels—1,000,000 more than in 1934. Gray County continued to lead in production and drilling although its output declined in 1935, whereas Hutchinson, Moore, and Wheeler Counties all made increases. No new fields of importance were discovered in the Panhandle in 1935.

Production in north Texas, including those parts of Texas commonly referred to as north Texas, north central, and west central Texas, amounted to about 32,500,000 barrels, or slightly more than in 1934. Production in Archer County, which led in both production and drilling, declined, but substantial increases were made in Baylor and Montague.

Considerably more wells were drilled in this district in 1935 than in 1934, although most of the increase in completions was accounted for by a gain in number of dry holes. Wildcatters were active in the district in 1935, giving considerable attention to locating deep production in Young, Shackelford, and Cooke Counties.

Although production in the East Texas field proper declined from 181,540,000 barrels in 1934 to 175,918,000 in 1935, no loss in prestige was sustained, as the decrease resulted primarily from a reduction in "hot-oil" production. In this field 4,083 oil wells were completed in 1935 compared with 3,441 in 1934. The completions in 1935 averaged 1,590 barrels in daily initial compared with an average of 1,884 barrels for 1934. About 10,000 acres were added to the proven limits of the field, mostly on the east side, so that at the close of 1935 there were about 19,500 producing oil wells on about 128,000 productive acres. As new wells were completed the allowable percentage of the potential was reduced, and the output of the field was close to 15,000,000 barrels per month for the entire year. This rate of production was found satisfactory from an engineering standpoint, and the bottom-hole pressure in the field declined only 35 pounds in 1935, considerably less than in the prior years.

Production in the east Texas district outside of the East Texas field proper probably declined in 1935, as production in the Van field, the only field of major importance in the area, showed a small decrease. A new field, Camp Hill, was discovered in Anderson County, and a well in the Cayuga field, Anderson County, struck oil in the Trinity when it was deepened. These two discoveries were important, as they enhanced the possibilities of deeper production in many other fields of the district.

The fault-line and Edwards Plateau fields in what is termed the "Central Texas" district had a quiet year in 1935, and production declined from natural causes. A small pool outside the Darst field was uncovered. Production in the Byersville pool of Williamson County increased materially in 1935, but Van Ormy, Bexar County, discovered in 1934, but not actively developed until 1935, proved inconsequential as a producer.

Interest in the west Texas district, which fell to a low ebb on discovery of the East Texas field, increased in 1935, when about 800 completions were reported compared with about 550 in 1934. Production rose from 50,272,000 barrels in 1934 to 55,289,000 in 1935, a gain of nearly 10 percent.

Production in the Yates field, by far the most important field in the district, declined slightly in 1935 owing to the trend in the allowables. The increased production from Ward County and the Cowden, Sayre, and Means fields in Ector, Winkler, and Andrews Counties, respectively, offset the declines in the older fields.

Several new fields were opened, the most promising of which was Goldsmith in Ector County. A test was drilled to 12,786 feet in the McElroy field of Upton County; it had several shows in the Ordovician formation but was finally plugged back to the regular Permian pay. This well was the deepest ever drilled in the world.

West Texas is predominantly a lime area; hence rejuvenation with acid became increasingly popular in 1935.

The Southwest Texas district, including principally the fields in Webb and Duval Counties, continued to be active, and production increased from 10,154,000 barrels in 1934 to 13,400,000 in 1935. Most of the increase was recorded in the Government Wells field, the most important field in the district, and the Samfordyce and Loma Novia fields. The latter, in Duval County near the Government Wells field, was discovered in 1935; about 200 wells were drilled there before the end of the year. Another important discovery in the district in 1935 was the Seven Sisters pool, also on the Government Wells trend. About 50 wells were drilled at Seven Sisters in 1935.

Production in the Texas Gulf Coast district increased from 60,155,000 barrels in 1934 to 64,323,000 in 1935, although the output at Conroe, the leading field, declined and fewer wells were drilled. The gain in output resulted from increased output in a number of fields, such as Greta, Manvel, Raccoon Bend, and Hastings, as well as from the new production at Anahuac, Plymouth, and other fields.

About 10 new fields were discovered in the Texas Gulf Coast district in 1935, Anahuac in Chambers County being regarded the most important. Another important discovery was the Plymouth field in San Patricio County, somewhat removed from the center of coastal production.

Utah.—The total output in Utah in 1935 was several thousand barrels, mostly from the Virgin field, Washington County. Work was continued on several wildcat tests, but the results in 1935 were generally discouraging.

West Virginia.—Production in West Virginia in 1935 continued the decline begun in 1928, which was interrupted only in 1934. The output for 1935 was 3,903,000 barrels compared with 4,095,000 barrels in 1934.

Drilling for oil declined in West Virginia in 1935; most of the work was routine in nature, with few wildcats drilled except for gas. Ritchie County countinued to be the favorite area for drilling.

Wyoming.—Although the decline at Salt Creek field was continued in 1935, most of the other fields of Wyoming increased their output, and the State total rose from 12,556,000 barrels in 1934 to 13,650,000 in 1935. This increase resulted primarily from a material increase in drilling; 58 oil wells were completed in the State in 1935 compared with 44 in 1934. The discovery of Sundance production at Lance Creek was capitalized, and the field output in 1935 was several times the 1934 total. The Frannie field, a producer of heavy oil, registered a material loss in output, but Oregon Basin, another heavy-oil field, made up part of the deficit.

The most important discovery of the year was the finding of flush production on the Medicine Bow structure of Carbon County, where a well in the second Sundance at about 5,350 feet yielded more than 6,000 barrels initially.

WORLD PRODUCTION

Total world petroleum production was 1,309,677,000 barrels in 1932, 1,442,112,000 in 1933, 1,522,230,000 in 1934, and continued the increasing trend to 1,642,605,000 barrels in 1935.

Iraq's outstanding increase from 7,689,000 barrels in 1934 to 26,500,000 in 1935 brings that country from thirteenth to eighth place among the producing nations of the world. Bahrein Island also jumped a place, producing 1,265,000 barrels in 1935 as against 285,000 barrels in 1934.

The seven leading producers of 1934—the United States, U. S. S. R. (Russia), Venezuela, Rumania, Iran, Netherland India, and Mexico—maintained their relative positions in 1935. With the exception of the United States, Venezuela, Iraq, and Bahrein Island, the 1935 production of the various producing countries approximated closely their production during the previous year.

World production of petroleum, 1930–35, by countries, in thousands of barrels

[Compiled by R. B. Miller]

Country	1930	1931	1932	1933	1934	1935
United States	898,011	851,081	785,159	905,656	908,065	993,942
U. S. S. R.	125,555	162,842	154,367	154,840	174,318	[1] 176,688
Sakhalin	1,805	2,734	2,631	2,338	2,881	(2)
Venezuela	136,669	116,613	116,541	117,720	136,103	149,113
Rumania	42,758	49,741	53,815	54,020	62,063	61,371
Iran	45,833	44,376	49,471	54,392	57,851	57,304
Netherland India	41,729	35,539	39,001	42,606	46,925	47,131
Mexico	39,530	33,039	32,805	34,001	38,172	40,235
Iraq	909	900	836	917	7,689	26,500
Colombia	20,346	18,237	16,414	13,158	17,341	17,595
Peru	12,449	10,089	9,899	13,257	16,314	17,067
Argentina	9,002	11,709	13,139	13,691	14,024	14,253
Trinidad	9,419	9,744	10,126	9,561	10,894	11,671
India, British	8,887	8,715	8,817	8,743	10,503	9,227
British Borneo (Sarawak and Brunei)	4,907	3,854	3,796	4,490	5,140	4,974
Poland	4,904	4,662	4,116	4,072	3,913	3,808
Germany	1,222	1,608	1,608	1,665	2,187	2,983
Japan (including Taiwan)	2,047	1,966	1,630	1,455	1,821	1,900
Ecuador	1,553	1,762	1,597	1,620	1,637	1,732
Canada	1,522	1,543	1,044	1,145	1,417	1,430
Egypt	1,996	2,038	1,895	1,663	1,546	1,295
Bahrein Island	------	------	------	31	285	1,265
France	523	527	530	562	557	535
Czechoslovakia	157	134	126	122	178	200
Bolivia	56	25	44	112	159	(2)
Italy	59	124	208	204	151	[1] 125
Other countries	56	54	62	71	96	261
Total	1,411,904	1,373,656	1,309,677	1,442,112	1,522,230	1,642,605

[1] Approximate production.
[2] Data not available.

World production of oil shale, 1931–35, in metric tons

[Compiled by M. T. Latus]

Country	1931	1932	1933	1934	1935
Australia:					
New South Wales	2,165	2,734	------	203	------
Tasmania	1,425	1,115	3,456	3,329	(1)
China (Manchuria)	1,245,097	1,412,558	(1)	(1)	(1)
Estonia	499,495	495,811	499,969	588,958	604,288
France [2]	78,350	87,971	84,576	(1)	(1)
Germany (Bavaria)	418	401	553	869	(1)
Italy	713	1,268	918	550	(1)
Spain	55,611	64,132	60,448	37,783	(1)
United Kingdom: Scotland	1,760,557	1,390,562	1,419,410	1,423,257	(1)

[1] Data not available.
[2] Includes some boghead coal.

IMPORTS AND EXPORTS

The general trend of imports of crude petroleum has been one of rapid decline since 1929. Venezuela supplied over three-quarters of the total in 1935. The imports for 1935 totaled 32.3 million barrels valued at 23.3 million dollars, according to figures compiled by the Bureau of Foreign and Domestic Commerce. Imports in bond represented 6.6 million barrels. Receipts by customs districts totaled 25.9 million barrels to Atlantic coast ports and 6.4 million to Gulf coast ports.

Exports of crude petroleum have increased steadily since 1929, reaching a peak of over 51 million barrels in 1935. Almost half of the total went to Canada in 1935, with Japan and France the other principal markets. A substantial increase in shipments to Italy and Germany accounted for much of the increase to other countries.

With a declining trend for crude imports and an expansion of exports the balance has shown an increasing net export in the last 3 years in contrast to a net import for many previous years.

Crude petroleum imported into and exported from the United States, 1929–35 [1]

[Millions of barrels]

	1929	1930	1931	1932	1933	1934	1935
Imports:							
By countries:							
Venezuela [2]	50.7	35.1	25.2	25.6	17.1	25.4	25.0
Colombia	12.6	14.2	12.3	10.6	7.7	4.2	3.8
Mexico	12.7	10.1	8.2	7.1	5.9	5.9	3.4
All other	2.9	2.7	1.6	1.4	1.2	0.1	0.1
Total	78.9	62.1	47.3	44.7	31.9	35.6	32.3
Exports:							
By countries:							
Canada	22.4	19.0	19.2	18.1	19.5	22.0	24.4
Japan	2.5	2.9	3.6	4.9	5.5	6.7	10.5
France			0.6	3.4	9.1	10.2	10.3
All other	1.5	1.8	2.1	1.0	2.5	2.2	6.2
Total	26.4	23.7	25.5	27.4	36.6	41.1	51.4
Net import	52.5	38.4	21.8	17.3			
Net export					4.7	5.5	19.1

[1] Data from the Bureau of Foreign and Domestic Commerce.
[2] Includes imports via Netherland West Indies.

REFINED PRODUCTS

In 1935 the output of refined petroleum products reached a high level exceeded only by the peak year of 1929.

The outstanding feature was the increase in motor-fuel demand. Both the production of 465.5 million barrels and the domestic demand of 432.6 million barrels were the highest so far recorded, the latter being approximately 30 million barrels greater than the previous maximum of 1931. Although exports of motor fuel gained 5.7 million barrels over 1934, the total was only 30.4 million barrels compared with the 65.6-million peak of 1930.

The domestic demand for kerosene also attained a new peak of 47.7 million barrels. Production was approximately the same as in 1929. Exports, however, declined to 6.6 million barrels, the lowest figure in many years, representing only one-third the export demand in 1929.

The domestic demand for refinery gas oil and fuel oil was about 353 million barrels and has continued to improve since a depression low of 308 million barrels in 1932. Exports remained virtually stationary, imports increased 7 million barrels, and domestic demand gained 21 million barrels over 1934. If transfers from crude in California, representing about 8 million barrels in 1934 and 14 million barrels in 1935, are added to the refinery figures just given, total domestic consumption of all gas oils and fuel oils would have been 340 million barrels in 1934 and 367 million in 1935. Consumption, however, was still substantially below the high level of 1929. The effects of the depression in reducing the industrial demand for fuels and of the substantial decrease in bunker demand for ships engaged in foreign trade were still apparent.

Although the production and export and domestic demands for lubricating oils all showed substantial gains over 1934, the figures indicate that the market was still about 20 percent below the 1929 level.

Comparative analyses of statistics for the major refined products, 1931–35

[Thousands of barrels of 42 gallons, except as otherwise indicated]

	1931	1932	1933	1934	1935 [1]
Motor fuel:					
Production	437,453	399,712	407,932	423,801	465,514
Imports	13,621	8,205	15	1	20
Exports	45,716	35,438	29,321	24,686	30,380
Stocks, end of period	55,226	53,805 [2] 54,310	55,933 [2] 59,935	51,945 [2] 51,747	54,345
Domestic demand	403,418	373,900	377,003	407,106	432,556
Kerosene:					
Production	42,446	43,836	48,977	53,855	55,813
Imports	11	71	----------	----------	----------
Exports	12,712	11,044	8,959	9,781	6,644
Stocks, end of period	5,332	4,974 [2] 5,033	6,558	6,398	7,915
Domestic demand	31,296	33,221	38,493	44,234	47,652
Gas oil and fuel oil:					
Production	336,967	[3] 301,353	[3] 316,439	[3] 335,353	[3] 355,125
Imports	24,998	21,286	13,215	12,634	19,663
Exports	29,231	19,994	20,563	28,605	28,489
Stocks, end of period [4]	135,856	129,881 [2] 130,753	123,500 [2] 123,004	110,397	103,984
Domestic demand	357,306	308,157	316,344	331,989	352,712
Lubricants:					
Production	26,704	22,433	23,775	26,373	27,771
Imports	32	12	1	2	1
Exports	8,128	6,851	8,218	7,660	8,480
Stocks, end of period	9,485	8,465 [2] 8,694	7,100	7,331	7,025
Domestic demand	20,068	16,614	17,152	18,484	19,598
Wax (thousands of pounds):					
Production	477,400	458,920	469,560	468,720	450,240
Imports	37,835	33,255	36,634	37,292	19,666
Exports	290,527	235,304	247,769	198,958	230,933
Stocks, end of period	171,220	163,628 [2] 163,935	69,117	136,136	114,675
Domestic demand	276,457	264,463	353,243	240,035	260,434

[1] Preliminary.
[2] For comparison with succeeding year.
[3] Does not include transfers.
[4] California heavy crude included.

Analysis of production and consumption of petroleum products in 1935 [1]

[Thousands of barrels of 42 gallons]

Product	Production	Imports	Exports	Changes in stocks	Domestic demand
Motor fuel:					
Gasoline	427,120	20	28,375	+3,116	432,556
Natural gasoline	36,517		1,655	−518	
Benzol	1,877	----------	350	----------	
Total motor fuel	465,514	20	30,380	+2,598	432,556
Kerosene	55,813	----------	6,644	+1,517	47,652
Gas oil and fuel oil	355,125	19,663	28,489	−6,413	352,712
Lubricants	27,771	1	8,480	−306	19,598
Wax	1,608	71	825	−76	930
Coke	7,290	----------	647	−81	6,724
Asphalt	17,857	132	1,233	+372	16,384
Road oil	7,039	----------	----------	+207	6,832
Still gas	50,224	----------	----------	----------	50,224
Other finished oils	2,065	87	76	−11	2,087
Unfinished gasoline (net)	1,032	----------	----------	+1,032	----------
Other unfinished oils (net)	873	463	----------	+1,336	----------
Refinery losses	12,453	----------	----------	----------	12,453
Natural-gasoline losses	2,341	----------	----------	----------	2,341
	1,007,005	20,437	76,774	+175	950,493

[1] Preliminary.

REFINERY OPERATIONS

The record demand for gasoline and kerosene combined with increases for other products resulted in the highest volume of refinery production ever made except for the peak year of 1929.

Approximately 966 million barrels of crude oil were run to stills in 1935—an increase of 70 million barrels over 1934 and only 22 million barrels less than in 1929. Foreign crude run to stills continued to decline and was almost 3 million barrels less than in 1934.

Natural gasoline blended, including that turned into pipe lines, approximated 31 million barrels in 1935 compared with 28 million in 1934 and 46 million in 1929.

The percentage of the various products derived from the crude run to stills is subject to considerable variation with changes in demand. The average yield of gasoline from crude has been a little above 44 percent for the past 5 years. In 1935 the yield was 44.2 percent compared with 43.4 percent for 1934, reflecting the greater demand for gasoline and a larger output from cracking. The total refinery output of gasoline was 458 million barrels in 1935, representing 31 million derived from natural gasoline and 427 million from crude refined; 219 million were produced by straight-run operation and 208 million by cracking. The amount derived by cracking has shown a consistent upward trend, increasing from 144 million barrels in 1929 to 183 million in 1934 and 208 million in 1935.

Runs to stills and production at refineries of the various refined products, 1931–35

[Thousands of barrels of 42 gallons, except as otherwise indicated]

	1931	1932	1933	1934	1935 [1]
Input:					
Crude petroleum:					
Domestic	847,671	777,696	825,786	860,776	934,112
Foreign	46,937	42,301	35,468	34,860	32,131
Total crude petroleum	894,608	819,997	861,254	895,636	966,243
Natural gasoline [2]	35,116	26,332	25,346	28,162	30,599
Total input	929,724	846,329	886,600	923,798	996,842
Output:					
Gasoline	431,510	392,623	401,591	416,932	457,692
Kerosene	42,446	43,836	48,977	53,855	55,813
Gas oil and distillate fuel oils	83,882	69,467	[3] 78,920	[3] 94,972	[3] 100,381
Residual fuel oils	253,085	225,283	[3] 237,519	[3] 240,381	[3] 254,744
Lubricants	26,704	22,433	23,775	26,373	27,771
Wax	1,705	1,639	1,677	1,674	1,608
Coke	10,363	9,123	7,900	6,500	7,290
Asphalt	16,371	13,612	12,757	15,623	17,857
Still gas	38,630	40,905	45,212	44,391	50,224
Wax ....thousands of pounds	477,400	458,920	469,560	468,720	450,240
Coke ....thousands of short tons	2,032.0	1,788.8	1,580.0	1,300.0	1,458.0
Asphalt ....do	2,976.5	2,474.9	2,319.5	2,840.5	3,246.8
Still gas ....millions of cubic feet	154,086	160,812	170,853	169,479	193,500
Road oil	5,177	6,879	5,534	6,210	7,039
Other finished products	4,150	1,738	1,435	1,872	2,065
Crude gasoline (net)	[4] 3,369	[4] 1,861	4,547	[4] 3,007	1,032
Other unfinished oils (net)				1,949	873
Shortage	19,070	20,652	16,756	16,073	12,453
Total output	929,724	846,329	886,600	923,798	996,842

[1] Preliminary.
[2] Includes natural gasoline run through pipe lines in California.
[3] Includes transfers in California. In 1932 such transfers constituted part of supply but were not included in refinery production.
[4] Negative quantity: represents net excess of unfinished oils rerun over unfinished oils produced.

The yield of kerosene from crude oil refined has averaged 5.5 percent for the last 5 years. The decline from 6.0 percent in 1934 to 5.8 percent in 1935 was due to the increase in crude refined and the diversion of a relatively larger percentage of distillates to cracking stock, inasmuch as the actual output of kerosene increased 2 million barrels.

Gas oil, distillate fuel oils, and residual fuel oils have represented a combined average of 36.9 percent for the past 5 years, the lighter oils comprising 9.6 percent and the residual fuel oils 27.3 percent. Some percentage decrease for both groups was indicated for 1935 owing to increased use of oils for cracking.

Summary of percentage yields of refined products, 1931–35

[Computed on total crude runs to stills]

	1931	1932	1933	1934	1935 [1]
Gasoline	44.3	44.7	43.7	43.4	44.2
Kerosene	4.7	5.3	5.7	6.0	5.8
Gas oil and distillate fuel oils	9.4	8.5	9.2	10.6	10.4
Residual fuel oils	28.3	27.5	27.6	26.8	26.4
Lubricants	3.0	2.7	2.8	2.9	2.9
Wax	.2	.2	.2	.2	.2
Coke	1.2	1.1	.9	.7	.8
Asphalt	1.8	1.7	1.5	1.7	1.8
Road oil	.6	.8	.6	.7	.7
Still gas	4.3	5.0	5.2	5.0	5.2
Other finished products	.5	.2	.2	.2	2
Shortage	2.1	2.5	1.9	1.8	1.3

[1] Preliminary.

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Runs to stills and production at refineries of the various refined products in 1935, by months [1]

[Thousands of barrels of 42 gallons, except as otherwise indicated]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Input:													
Crude petroleum	75,456	70,817	76,630	75,066	80,412	81,724	84,903	84,584	83,347	85,132	83,180	84,992	966,243
Natural gasoline [2]	2,332	2,051	1,995	1,964	1,948	2,090	2,219	2,567	2,937	3,717	3,470	3,309	30,599
Total input	77,788	72,868	78,625	77,030	82,360	83,814	87,122	87,151	86,284	88,849	86,650	88,301	996,842
Fresh cracking stocks charged to stills:													
Crude oil	5,434	4,627	5,053	4,459	5,133	5,120	5,909	5,258	5,820	6,161	4,910	5,620	63,504
Other oils	35,497	34,185	35,805	35,197	38,327	38,323	38,614	41,076	39,093	41,032	39,585	39,451	456,185
Output:													
Gasoline	35,330	32,702	35,314	34,728	37,583	38,180	40,667	40,488	39,817	41,956	40,260	40,667	457,692
Kerosene	5,011	4,791	5,215	4,325	4,474	4,417	4,212	4,390	4,498	4,978	4,878	4,624	55,813
Gas oil and distillate fuel oils	7,696	7,147	8,678	7,183	8,198	8,205	8,709	8,129	8,885	9,068	8,598	9,885	100,381
Residual fuel oils	20,335	19,178	20,453	19,328	21,311	20,267	20,210	21,232	21,495	22,652	23,278	25,005	254,744
Lubricants	2,175	2,028	2,251	2,309	2,392	2,247	2,213	2,399	2,357	2,463	2,453	2,484	27,771
Wax	132	126	133	154	147	112	116	125	130	140	149	144	1,608
Coke	580	550	594	602	660	676	699	655	614	593	539	528	7,290
Asphalt	810	727	1,000	1,380	1,692	1,925	1,936	2,090	1,886	1,931	1,365	1,115	17,857
Still gas	3,808	3,513	4,007	3,916	4,411	4,368	4,814	4,608	4,363	4,273	4,041	4,102	50.224
Wax, thousands of pounds	36,960	35,280	37,240	43,120	41,160	31,360	32,480	35,000	36,400	39,200	41,720	40,320	450,240
Coke, thousands of short tons	116.0	110.0	118.8	120.4	132.0	135.2	139.8	131.0	122.8	118.6	107.8	105.6	1,458.0
Asphalt, do	147.3	132.2	181.8	250.9	307.6	350.0	352.0	380.0	342.9	351.1	248.2	202.7	3,246.7
Still gas, millions of cubic feet	14,772	13,609	15,507	15,275	16,832	16,764	18,141	17,631	16,826	16,562	15,689	15,892	193,500
Road oil	175	197	197	460	677	982	1,184	1,367	941	354	259	246	7,039
Other finished products	186	181	221	174	181	188	173	170	128	152	143	168	2,065
Crude gasoline (net)	325	610	[3] 64	290	112	79	[3] 392	[3] 206	[3] 58	[3] 285	326	295	1,032
Other unfinished oils (net)	379	227	[3] 320	1,125	[3] 532	865	1,407	339	149	[3] 354	[3] 616	[3] 1,796	873
Shortage	846	891	946	1,056	1,054	1,303	1,174	1,365	1,079	928	977	834	12,453
Total output	77,788	72,868	78,625	77,030	82,360	83,814	87,122	87,151	86,284	88,849	86,650	88,301	996,842

[1] Preliminary.
[2] Includes 745,000 barrels run through pipe lines in California.
[3] Negative quantity; represents net excess rerun over production.

MOTOR FUEL [4]

Domestic motor-fuel demand established a new record of 432,556,000 barrels in 1935. This represents an increase of 25,450,000 barrels, or 6 percent more than the 1934 demand, and an increase of 58,656,000 barrels over the depression low of 1932. The petroleum industry suffered less during the depression than many of the other large industries, as can be seen from the following Federal Reserve Board indexes of industrial production.

Indexes of industrial production [1]

Industry	1929	1932	Percent of 1929	Industry	1929	1932	Percent of 1929
Automobile production	135	35	26	Lumber manufacture	91	25	27
Iron and steel	130	31	24	Petroleum refining	168	140	83
Textiles	115	83	72				

[1] Federal Reserve Board Indexes of Industrial Production. 1923-25=100.

Two principal elements contributed toward the maintenance of the petroleum index during the depression: (1) There was a strong upward trend in gasoline consumption per motor vehicle, which was due to factors little affected by the depression, and (2) the total number of automobiles in use did not change greatly, as the average life of an automobile is 7 years. Thus, although the index of automobile production dropped from 135 in 1929 to 35 in 1932, the decline in the number of automobiles in use from the peak of 24,710,000 in 1930 to the low of 22,650,000 in 1933 was only 8 percent.

Production, demand, and stocks of motor fuel, 1934-35 [1]

[Thousands of barrels of 42 gallons]

Month	Production		Demand				Stocks at end of month	
			Domestic		Exports			
	1934	1935	1934	1935	1934	1935	1934	1935
January	33, 915	36, 236	29, 489	28, 062	1, 940	2, 125	62, 422	57, 796
February	31, 202	33, 584	25, 310	26, 432	2, 025	1, 248	66, 289	63, 720
March	33, 606	36, 528	30, 577	31, 997	2, 538	2, 594	66, 780	65, 657
April	35, 056	35, 696	32, 736	36, 082	2, 713	1, 467	66, 387	63, 804
May	35, 642	38, 605	38, 071	39, 095	1, 907	2, 141	62, 051	61, 173
June	35, 356	38, 931	36, 430	37, 890	1, 994	3, 222	58, 983	58, 992
July	37, 535	41, 527	37, 466	41, 209	1, 718	3, 022	57, 354	56, 288
August	38, 164	40, 880	39, 105	42, 836	2, 165	2, 822	54, 228	51, 510
September	35, 042	40, 094	34, 669	37, 862	1, 876	2, 985	52, 725	50, 757
October	36, 381	41, 862	37, 674	41, 401	1, 965	2, 461	49, 467	48, 757
November	35, 413	40, 461	34, 998	35, 956	2, 210	3, 050	47, 672	50, 212
December	36, 489	41, 110	30, 581	33, 734	1, 635	3, 243	{ 51, 945 [2] 51, 747 }	54, 345
Total	423, 801	465, 514	407, 106	432, 556	24, 686	30, 380		

[1] Preliminary.—Imports: 1934, 1,000 barrels; 1935, 20,000 barrels.
[2] For comparison with 1935.

[4] By H. A. Breakey, Petroleum Economics Division, Bureau of Mines.

Motor vehicles in use in 1935 increased but slightly over 1934; the estimated number on July 1, based upon preliminary registration, was 23,591,000 compared with 23,355,000 for July 1, 1934. The demand per motor vehicle, according to these estimates, increased from 17.43 barrels in 1934 to 18.34 barrels in 1935. The following table shows the domestic demand, motor vehicles in use, actual trend, and deviations of motor-fuel demand per motor vehicle in use and the New York Federal Reserve Bank index of volume of trade.

Domestic demand per motor vehicle in use, 1924–35

Year	Domestic demand for motor fuel (barrels)	Motor vehicles in use July 1	Motor-fuel demand per motor vehicle in use (barrels)			Federal Reserve Bank index of total volume of trade
			Actual	1924–31 trend [1]	Deviation from trend	
1924	187,022,000	16,022,000	11.67	11.94	−0.27	0.00
1925	226,329,000	17,808,000	12.71	12.64	.07	.03
1926	264,391,000	19,784,000	13.36	13.36	.00	.05
1927	299,818,000	21,297,000	14.08	14.07	.01	.04
1928	332,033,000	22,025,000	15.08	14.77	.31	.05
1929	375,999,000	23,733,000	15.84	15.48	.36	.07
1930	394,800,000	24,710,000	15.98	16.19	−.21	−.08
1931	403,418,000	24,263,000	16.63	16.90	−.27	−.22
1932	373,900,000	23,208,000	16.11	17.61	−1.50	−.30
1933	377,003,000	22,650,000	16.64	18.32	−1.68	−.38
1934	407,106,000	23,355,000	17.43	19.02	−1.59	−.37
1935	432,556,000	23,591,000	18.34	19.73	−1.39	−.34

[1] Least squares straight-line trend based on 1924–31 data. Depression years have been omitted because they are not normal.

Motor fuel produced in 1935 totaled 465,514,000 barrels—219,583,000 barrels of straight-run gasoline, 207,537,000 barrels of cracked gasoline, 30,572,000 barrels of blended natural gasoline,

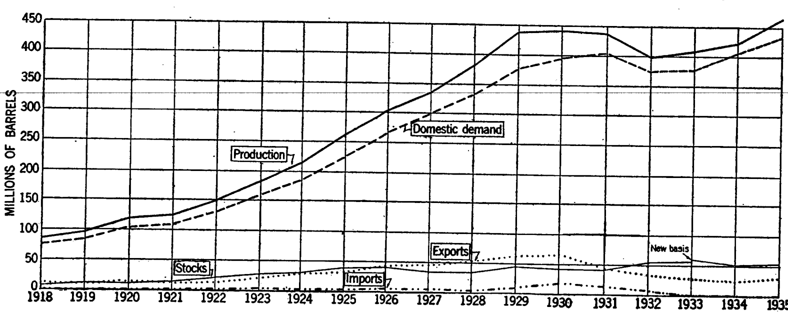

FIGURE 105.—Trends in production, domestic demand, exports, imports, and stocks of motor fuel, 1918–35.

5,945,000 barrels of unblended natural gasoline, and 1,877,000 barrels of benzol. The ratio of straight-run gasoline to total motor-fuel production declined from 48.8 percent in 1934 to 47.2 percent in 1935, while that of cracked gasoline increased from 43 percent in 1934 to 44.6 percent in 1935. The proportions of natural gasoline and benzol remained the same, 7.8 percent and 0.4 percent, respectively.

The average yield of gasoline increased from 43.4 percent in 1934 to 44.2 percent in 1935. The yield of cracked gasoline, continuing its upward trend which was broken in 1934, reached a new high of 21.5 percent in 1935, but the yield of straight-run gasoline declined from 23.1 percent in 1934 to 22.7 percent in 1935, the same as for 1933. The Arkansas-Inland Louisiana district was the only one that did not follow the general decline in yield in 1934 and was the only one to show a significant decline in 1935, the yield dropping from 45.2 percent in 1934 to 41.6 percent in 1935.

Refinery prices of gasoline, as shown in figure 107, continued to improve in 1935, averaging 4.49 cents per gallon, compared with 3.91 cents in 1934 for Oklahoma third-grade gasoline. Prices rose from the low in February of 3.25 cents to 4.75–4.875 cents per gallon, where they remained from the latter part of May until the first of December, during which month they receded to an average of 4.79 cents per gallon. It is worth noting that prices did not react to the fall decline in gasoline consumption as in 1934, when they reached a low of 2.75 cents in October. This was probably due to the better condition of gasoline stocks in the fall of 1935; there were 37.6 days' supply on September 31, 1935, compared with 44.9 days' supply on the same date in 1934.

Although it is quite clear that there is an intimate relationship between gasoline stocks and prices for gasoline, just what factors affect the price of gasoline and the extent to which they do so are still subjects of speculation, with but little real study of the problem. It is regrettable that one of the largest industries in the United States, whose ramifications in some way affect almost every phase of American life, whose taxes amount to over a billion dollars a year, and whose operations are the subject not only of State and National political policies but international policies as well has so little definite knowledge of the economic interrelations of stocks, prices, consumption, and taxes.

In comparing prices one should remember that the quality of gasoline has been considerably improved during the past few years and today's prices cover better quality of gasoline than for comparable prices in previous years. The following table shows the American Petroleum Institute service-station prices for 50 cities and refinery prices for Oklahoma third-grade gasoline. The latter, now known as 62 octane and below, was changed in 1934 from 59 octane and below and in 1933 from 57 octane and below.

Gasoline prices, in cents per gallon

Year	Refinery [1]	Service-station [2]		Year	Refinery [1]	Service-station [2]	
		Ex tax	Including State gasoline taxes			Ex tax	Including State gasoline taxes
1932	4.18	13.30	17.43	1934	3.91	13.64	17.84
1933	3.31	12.41	16.57	1935	4.49	13.55	17.84

[1] Third-grade gasoline f. o. b. cars at Oklahoma refineries. Source: Oil Price Handbook.
[2] American Petroleum Institute.

The average service-station price ex tax of 13.55 cents for 1935 was slightly lower than the 1934 average of 13.64 cents. The price pattern throughout the year was just the opposite from that of the preceding year. The prices in 1934 receded during the spring from the peak of the year of 14.33 cents in January, reached a second peak of

14.31 in June, and then declined severely in the fall to 11.72 cents. In 1935 the prices started with the low of 12.78 cents for January, rose gradually to a peak of 13.90 cents in July, then slipped back to 13.50 in October, and closed the year with 13.72 in December.

Helena, Mont., again demanded the highest price—25 cents on January 1 and 23.5 cents on December 31, both including 6 cents State tax. Minneapolis opened the year with the lowest price, 13.4 cents, including 4 cents State tax, but ended the year with 17.9 cents. The price in Detroit was 17 cents, including 4 cents State tax, on January 1 and 18.7 cents in May; in Peoria it was 14.8 cents on January 1 and 17.5 cents in June. Both closed the year at 15.5 cents, the lowest in the United States.

The average tank-wagon price of 12.02 cents for 1935 was a little lower than the average of 12.26 cents for 1934. There was little change throughout the year; the price was 11.39 cents in January, from which it rose to a peak of 12.45 cents in August, then dropped to 12.01 cents in November, and closed the year with an average of 12.16 cents for December.

State gasoline taxes ranged from 2 cents in Missouri, Rhode Island, and District of Columbia to 7 cents in Florida and Tennessee, in addition to a Federal tax of 1 cent per gallon plus various county and municipal taxes. Taxes were increased in Delaware from 3 to 4 cents on July 1, and in Nebraska from 4 to 5 cents on March 1; the latter tax was declared unconstitutional on September 20 and amended by a new law which again increased the tax to 5 cents on November 26. The tax in New York was increased from 3 to 4 cents on April 1, in Pennsylvania from 3 to 4 cents on July 1, and in Connecticut from 2 to 3 cents on October 1.

Motor-fuel stocks, including stocks of gasoline at refineries, at bulk terminals, and in pipe lines, and stocks of natural gasoline amounted to 54,345,000 barrels on December 31, 1935, compared with 51,747,000 on December 31, 1934. Owing to the increased demand in 1935, both of these figures represent approximately 56 days' supply. Reduction in stocks of motor fuel, well under way early in 1934, continued until the fall of 1935; November was the first month in 1935 to show more motor fuel on hand than for the same month in 1934, while December, due principally to the running of large quantities of crude oil to meet the fuel-oil needs of the unusually cold weather, showed a material increase. The principal increases were in the Indiana-Illinois and the Oklahoma-Kansas-Missouri districts, amounting to 1,153,000 and 1,019,000 barrels, respectively. The largest decrease was in the California district—273,000 barrels—and the Gulf Texas district was next with a decrease of 199,000 barrels.

The quantity of motor fuel that represents the economically desirable stocks for the industry to carry is difficult to determine. It changes from time to time with changes in business and transportation methods, in number of grades of gasoline sold, and in crude-oil potential. Many refiners claimed that their stocks had reached an uneconomical low level during the fall of 1935, and the fact that there was not the usual fluctuation in prices supports this contention. The quantity of stocks carried by the individual operator should be kept within his financial capacity so that he will not be forced to throw them on the market as distress gasoline. On the other hand, an operator should carry large enough stocks to have them distributed at points of use without having to purchase gasoline from some other operator in case of a sudden demand because of inability to transport his own stocks soon enough. Nor should he have to ship his gasoline by tank car when adequate stocks would permit shipment by water. Marine shipment of motor fuel requires the accumulation of larger stocks at the refinery in preparation for shipment and greater quantities stored at terminals than when shipments are in tank cars and more frequent. Marine terminals in the northern part of the country must accumulate enough stocks in the fall to last while the waterways are frozen.

The question as to what constitutes a desirable level of stocks is still undetermined but important, because of its bearing upon the whole economic structure of the petroleum industry through its relationship to gasoline prices.

Preliminary figures of gasoline consumption by States for 1935 indicate that New York still leads, with 38,346,000 barrels (9.1 percent of the total for the United States). California, with 35,238,000 barrels (7.6 percent); Pennsylvania, with 27,891,000 barrels (6.6 percent); Illinois, with 25,458,000 barrels (6.1 percent); and Ohio, with 24,165,000 barrels (5.8 percent) follow in order. They consume 35.5 percent of the total for the United States. All of the States and the District of Columbia enjoyed increases in consumption. The largest increases were in North Dakota, with 16.5 percent; Kansas, with 14.7 percent; and Wyoming, with 12.3 percent.

Motor-fuel imports totaled only 20,000 barrels in 1935, all of which was imported in bond. Exports, however, increased from 24,686,000 barrels in 1934 to 30,380,000 in 1935. This increase probably does not represent a reversal in the trend, which has been definitely downward during the past few years, but was caused by excessive buying in the European markets partly to supply Italy's war needs and partly to accumulate stocks in anticipation of an oil embargo by the League of Nations and by the United States.

Motor fuel transported by pipe line increased from 45,383,000 barrels in 1934 to 50,198,000 in 1935.

The table "Distribution of motor fuel by districts, 1935", shows for the first time an approximation of the interregional movements of motor fuel. Although complete data are not available, it is believed that this table portrays the major movements between the districts with fair accuracy.

Shipments of motor fuel by pipe lines in 1935, by months

[Thousands of barrels of 42 gallons]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Motor fuel turned into lines	3,992	3,286	4,023	4,126	4,101	3,992	4,521	5,072	4,107	4,618	4,677	4,469	50,984
Motor fuel delivered from lines	3,654	3,298	3,913	3,841	4,266	4,366	4,618	4,734	4,324	4,591	4,385	4,208	50,198
Shortage	52	12	8	30	16	16	23	22	20	38	25	30	292
Stocks in lines and working tanks, end of month	2,329	2,305	2,407	2,662	2,481	2,091	1,971	2,287	2,050	2,039	2,306	2,537	2,537

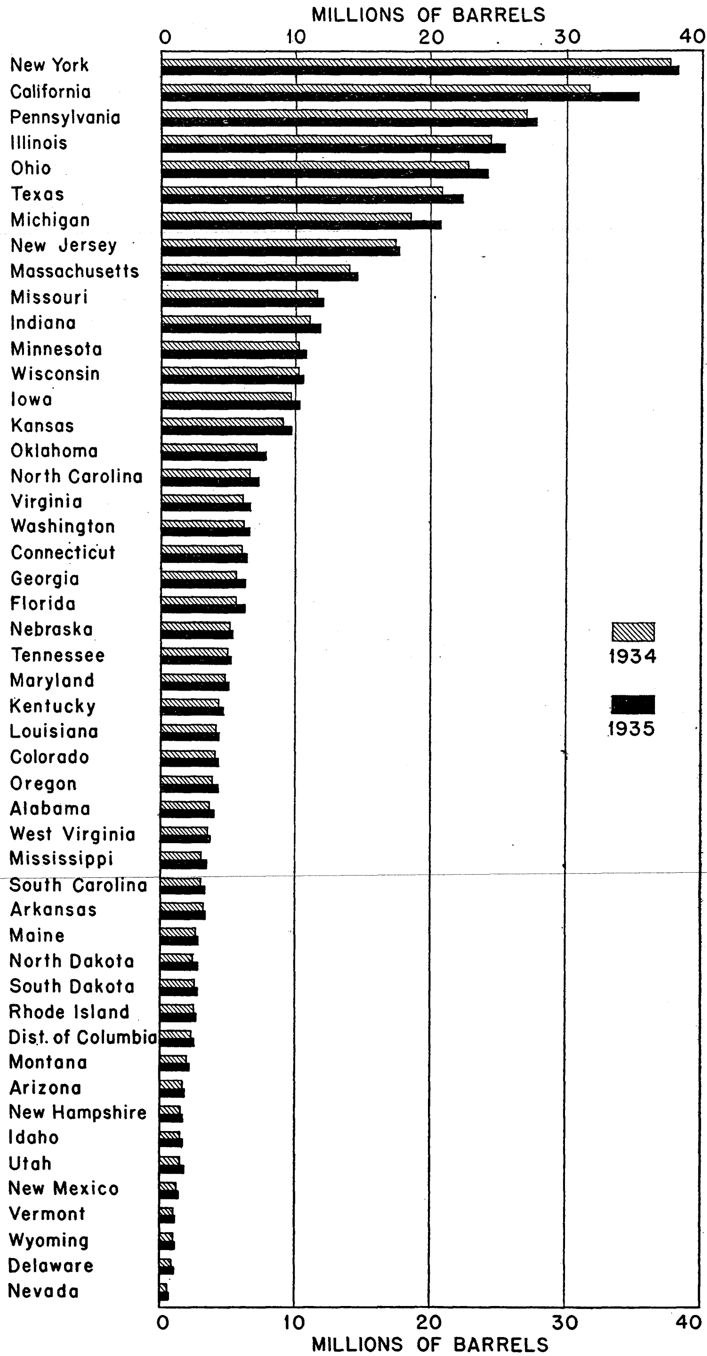

FIGURE 106.—Gasoline consumption, 1934–35, by States.

Distribution of motor fuel, in 1935, by districts

[Thousands of barrels]

District	Production	Receipts from other districts [1]								
		East Coast	Indiana-Illinois	Oklahoma	Kansas	Texas	Louisiana	Rocky Mountain	California	Total receipts
East Coast	74,150	------	------	10	------	68,650	7,150	-------	7,110	82,920
Appalachian	19,250	14,000	9,000	20	30	110	80	-------	------	23,240
Indiana-Illinois	76,480	------	------	14,360	6,770	7,380	4,790	-------	------	33,300
Oklahoma-Kansas-Missouri	63,950	------	1,450	------	------	6,820	20	600	------	8,890
Texas	125,250	------	------	160	------	------	1,610	150	120	2,040
Arkansas-Louisiana	24,300	------	------	410	80	7,130	------	-------	------	7,620
Rocky Mountain	10,900	------	------	800	1,000	------	------	-------	1,610	3,410
California	71,240	------	------	------	------	170	------	-------	------	170
Total	465,520	------	------	------	------	------	------	-------	------	-------
Shipments to other districts	-------	14,000	10,450	15,760	7,880	90,260	13,650	750	8,840	161,590

District	Supply and demand				
	Total net supply [2]	Imports	Change in stocks	Domestic demand	Exports
East Coast	143,070	20	+110	137,690	5,290
Appalachian	42,490	----------	+150	42,120	220
Indiana-Illinois	99,330	----------	+1,150	98,070	110
Oklahoma-Kansas-Missouri	49,200	----------	+1,020	48,140	40
Texas	37,030	----------	+170	24,520	12,340
Arkansas-Louisiana	18,270	----------	−10	16,760	1,520
Rocky Mountain	13,560	----------	+280	13,120	160
California	62,570	----------	−270	52,140	10,700
Total	465,520	20	+2,600	432,560	30,380

[1] Compiled from information collected by the Petroleum Administrative Board.
[2] Total net supply equals production plus receipts from other districts less shipments to other districts (bottom line).

Production of gasoline in 1935, by methods of manufacture, districts, and months [1]

[Thousands of barrels of 42 gallons]

Method and district	January	February	March	April	May	June	July	August	September	October	November	December	Total: Quantity	Total: Percent
Straight distillation:														
East Coast	2,534	2,338	2,759	2,580	2,798	2,536	2,666	2,573	2,622	2,547	2,451	2,613	31,017	42.8
Appalachian	800	723	760	829	834	860	840	793	832	809	801	790	9,671	50.9
Indiana, Illinois, Kentucky, etc.	2,326	2,095	2,355	2,606	2,650	2,680	2,819	2,680	2,599	2,975	2,614	2,676	31,075	40.6
Oklahoma, Kansas, and Missouri	2,282	2,016	2,310	2,285	2,429	2,642	2,774	2,861	2,674	2,688	2,707	2,487	30,155	48.3
Texas Inland	1,411	1,436	1,598	1,470	1,610	1,666	1,862	1,960	1,865	1,704	1,720	1,635	19,937	58.7
Texas Gulf Coast	3,379	3,075	3,083	3,038	3,156	3,316	3,802	3,124	3,179	3,517	3,219	3,676	39,564	44.2
Louisiana Gulf Coast	804	668	776	694	675	767	736	750	757	765	766	826	8,984	55.5
Arkansas and Louisiana Inland	340	299	347	349	330	321	316	329	318	307	365	366	3,987	51.9
Rocky Mountain	360	327	429	396	454	429	450	502	432	449	472	409	5,109	47.7
California	2,985	2,633	2,874	2,921	3,379	3,293	3,519	3,580	3,532	3,746	3,711	3,911	40,084	57.8
Total straight-run	17,221	15,610	17,291	17,168	18,315	18,510	19,784	19,152	18,810	19,507	18,826	19,389	219,583	48.0
Percent of total production	48.7	47.7	49.0	49.4	48.7	48.5	48.6	47.3	47.2	46.5	46.8	47.7	48.0	--------
Cracking:														
East Coast	3,154	2,896	2,942	2,957	3,305	3,309	3,343	3,675	3,562	3,647	3,620	3,596	40,006	55.2
Appalachian	675	648	728	686	802	772	791	827	834	830	741	699	9,033	47.5
Indiana, Illinois, Kentucky, etc.	3,144	2,932	3,298	3,319	3,617	3,901	4,008	3,852	3,520	3,906	3,337	3,422	42,256	55.3
Oklahoma, Kansas, and Missouri	2,051	1,882	2,093	2,230	2,233	2,209	2,336	2,248	2,317	2,168	2,131	2,088	25,986	41.6
Texas Inland	778	776	769	722	820	798	875	793	849	858	898	849	9,785	28.8
Texas Gulf Coast	3,518	3,320	3,677	3,334	3,954	3,860	4,366	4,323	4,189	4,318	4,243	4,353	47,455	53.1
Louisiana Gulf Coast	527	530	463	447	552	539	618	609	568	721	698	647	6,919	42.7
Arkansas and Louisiana Inland	270	273	265	277	243	271	264	273	278	270	283	288	3,255	42.4
Rocky Mountain	314	297	370	356	402	408	431	509	430	417	436	386	4,756	44.4
California	1,350	1,492	1,426	1,273	1,402	1,513	1,632	1,660	1,523	1,597	1,577	1,641	18,086	26.1
Total cracked	15,781	15,046	16,031	15,601	17,330	17,580	18,664	18,769	18,070	18,732	17,964	17,969	207,537	45.3
Percent of total production	44.7	46.0	45.4	44.9	46.1	46.0	45.9	46.4	45.4	44.6	44.6	44.2	45.3	--------
Natural gasoline blended at refineries [1]	2,328	2,046	1,992	1,959	1,938	2,090	2,219	2,567	2,937	3,717	3,470	3,309	30,572	6.7
Percent of total production	6.6	6.3	5.6	5.7	5.2	5.5	5.5	6.3	7.4	8.9	8.6	8.1	6.7	--------

[1] Preliminary.

Production of gasoline in 1935, by methods of manufacture, districts, and months—Continued

[Thousands of barrels of 42 gallons]

Method and district	January	February	March	April	May	June	July	August	September	October	November	December	Total: Quantity	Total: Percent
Total:														
East Coast	5,836	5,324	5,797	5,577	6,123	5,876	6,047	6,319	6,320	6,435	6,333	6,479	72,466	--------
Appalachian	1,510	1,405	1,519	1,534	1,651	1,646	1,649	1,646	1,688	1,671	1,576	1,521	19,016	--------
Indiana, Illinois, Kentucky, etc	5,689	5,231	5,905	6,165	6,501	6,731	7,043	6,723	6,377	7,284	6,326	6,467	76,442	--------
Oklahoma, Kansas, and Missouri	4,863	4,375	4,816	4,945	5,066	5,242	5,578	5,659	5,582	5,567	5,534	5,212	62,439	--------
Texas Inland	2,569	2,538	2,630	2,411	2,711	2,739	3,005	3,093	3,123	3,072	3,146	2,921	33,958	--------
Texas Gulf Coast	7,100	6,530	6,864	6,489	7,179	7,264	8,279	7,705	7,657	8,174	7,802	8,422	89,465	--------
Louisiana Gulf Coast	1,346	1,218	1,256	1,167	1,246	1,322	1,389	1,395	1,363	1,515	1,489	1,495	16,201	--------
Arkansas and Louisiana Inland	642	591	637	653	599	617	615	645	646	634	697	703	7,679	--------
Rocky Mountain	729	690	870	815	910	878	928	1,061	933	961	1,043	887	10,705	--------
California	5,046	4,800	5,020	4,972	5,597	5,865	6,134	6,242	6,128	6,643	6,314	6,560	69,321	--------
Total, 1935	35,330	32,702	35,314	34,728	37,583	38,180	40,667	40,488	39,817	41,956	40,260	40,667	457,692	100.0
Daily average	1,140	1,168	1,139	1,158	1,212	1,273	1,312	1,306	1,327	1,353	1,342	1,312	1,254	--------
Total, 1934	33,323	30,609	32,861	34,236	34,723	34,648	36,878	37,296	34,488	36,282	35,591	35,997	416,932	--------

KEROSENE

Domestic demand for kerosene increased for the fourth consecutive year in 1935, with a total demand of 47,652,000 barrels, or 3,418,000 barrels more than the 1934 consumption. Practically all of this increased demand can be accounted for in increased uses for domestic cooking and heating or as range-oil fuel. The following table shows the annual kerosene demand from 1931 to 1935.

Kerosene demand, thousands of barrels

Year	Total	Range oil	Other uses	Year	Total	Range oil	Other uses
1931	31,296	4,549	26,747	1934	44,234	15,756	28,478
1932	33,221	6,841	26,380	1935	47,652	[1] 20,000	27,652
1933	38,493	9,849	28,644				

[1] Estimated.

It will be seen that the use of kerosene as range oil shifted the depression low for kerosene consumption to 1931 instead of 1932, as was the case for other petroleum products. The principal market for range oil is in the New England States, but its use is increasing rapidly in the Lakes States.

Exports of kerosene fell to a new low of 6,644,000 barrels in 1935, a continuation of the downward trend in progress for a number of years. The percentage yield of kerosene was 5.8 percent, a slight break in the upward trend of the past few years. With an increase in production of 2 million barrels and a decrease in exports of 3 million barrels, kerosene stocks increased from 6,398,000 barrels in 1934 to 7,915,000 in 1935 in spite of the greater domestic demand.

The tank-wagon price for kerosene at Chicago, which remained at 8 cents per gallon from August 1934 to May 1935, rose in the latter month to 9.8 cents, where it remained throughout the balance of the year.

GAS OIL AND FUEL OIL [5]

A gain of 70 million barrels (8 percent) in crude run to stills in 1935 was reflected in a corresponding increase in the production of gas oil and residual fuel oil, which totaled 335,353,000 barrels in 1934 and 355,125,000 barrels in 1935. These figures include transfers from crude oil to residual fuel oil in California. The output of gas oil and distillate fuel oil increased from 94,972,000 barrels in 1934 to 100,381,000 in 1935, while the production of residual fuel oil rose from 240,381,000 barrels in 1934 to 254,744,000 in 1935. It is noteworthy that distillate grades of fuel oil made up the same percentage (28.3) of the total yield of fuel oils for both 1934 and 1935. The percentages of gas oil (10.4) and of residual fuel oil (26.4) from crude run to stills were fractionally under the corresponding percentages in 1934.

All principal consumers, such as class I railroads, steamships, public-utility power plants, manufacturing establishments, and the building-heating trade, required more fuel oil in 1935; consequently the indicated domestic demand increased from 340,371,000 [6] barrels in 1934

[5] By A. T. Coumbe, Petroleum Economics Division, Bureau of Mines.
[6] Includes 8,382,000 barrels of crude oil transferred to fuel oil in California.

to 366,586,000 [7] in 1935, a gain of 26,215,000 barrels (7.7 percent). The railroads are credited with 3,000,000 barrels of this gain, public-utility power plants used 1,000,000 barrels more fuel oil in 1935 than in 1934, and the consumption in ships' bunkers (foreign and coastwise) increased 1,400,000 barrels in 1935 over the previous year. The increasing demand for industrial grades of fuel oil and the sharp upward trend in heating-oil consumption account for about 21,000,000 barrels—70 percent of the gain of 1935 over 1934.

The gas-oil and fuel-oil supply of continental United States for 1935 was augmented by imports of 19,663,000 barrels in 1935 compared with 12,634,000 barrels in 1934. Increased shipments received from Netherland West Indies account for virtually the entire gain. Bunker oil received in bond for the supply of vessels totaled 12,105,000 barrels in 1935, a gain of 3,824,000 barrels over 1934, while duty-paid fuel oil amounted to 7,558,000 barrels in 1935, an increase of 3,205,000 barrels over the previous year. Gains in exports of fuel oil made in 1934 over 1933 were maintained in 1935, when a total of 28,489,000 barrels were shipped to foreign countries and noncontiguous territories of the United States compared with 28,605,000 barrels in 1934. Gas-oil exports increased from 14,131,000 barrels in 1934 to 15,858,000 in 1935, while heavy oils entering foreign trade declined from 14,474,000 barrels in 1934 to 12,631,000 in 1935. Japan continued to be the most important buyer of American fuel oil in 1935 taking 9,292,000 barrels compared with 7,917,000 in 1934. Exports of fuel oil to Canada increased slightly, while shipments to the United Kingdom, Panama, and the Netherland West Indies dropped noticeably.

The trend of fuel-oil stocks continued downward in 1935, although the net decrease was only 6,413,000 barrels in 1935 compared with 12,607,000 barrels in 1934. Stocks of heavy crude and fuel oil held in California, which declined 27,168,000 barrels during 1934, dropped only 634,000 barrels in 1935; an important factor bearing on this situation was the decline in the movement of these oils from California to the east coast of the United States from 14,000,000 barrels in 1934 to less than 1,000,000 in 1935. Gas-oil stocks in California gained 1,660,000 barrels in 1935, while in the other parts of the country the light grades of fuel oils dropped about 3,700,000 barrels. Residual fuel oil outside California declined approximately 3,750,000 barrels in 1935.

Generally higher prices for distillate fuel oil more than offset lower prices for residual fuel oil in some marketing areas, so that the average for all grades was higher in 1935 than in 1934. Data compiled by Joseph E. Pogue show a weighted average price of $0.893 per barrel for fuel oil in 1935 compared with $0.834 per barrel in 1934. Bunker C at New York declined from $1.15 to $1.05 per barrel on July 11 and on August 15 to $0.95 per barrel. The causes of the lower quotations are uncertain, although the shifting of foreign bunker-oil movements since the imposition of the 21 cents per barrel tax on imported crude and heavy fuel oil and the additional fuel oil originating at European refineries operating on Iraq crude appearing on the world market may be contributing factors. A favorable stock situation and a steady domestic and export demand for heavy fuel oil in the California

[7] Includes 13,874,000 barrels of crude oil transferred to fuel oil in California.

marketing area resulted in higher prices in 1935. Bunker C fuel oil at Los Angeles advanced from an average of $0.8375 per barrel in 1934 to an average of $0.8993 per barrel in 1935.

Fuel-oil statistics, 1933–35

[Thousands of barrels]

	1933			1934			1935		
	Gas oil and distillate fuel oil	Residual fuel oil	Total	Gas oil and distillate fuel oil	Residual fuel oil	Total	Gas oil and distillate fuel oil	Residual fuel oil	Total
Stocks at beginning of year	14,277	116,476	130,753	16,315	106,689	123,004	21,957	88,440	110,397
Production	78,920	237,519	[1] 316,439	94,972	240,381	[1] 335,353	100,381	254,744	[1] 355,125
Transfers from crude oil to residual fuel oil in California		7,361	7,361		8,382	8,382		13,874	13,874
Imports:									
Bonded		7,061	7,061		8,281	8,281		12,105	12,105
Duty paid		6,154	6,154	3	4,350	4,353	16	7,542	7,558
Exports	11,424	9,139	20,563	14,131	14,474	28,605	15,858	12,631	28,489
Stocks, end of year	17,025	106,475	123,500	21,957	88,440	110,397	19,930	84,054	103,984
Indicated domestic demand	64,748	258,957	323,705	75,202	265,169	340,371	86,566	280,020	366,586
Class I railroads [2]			40,370			44,130			47,097
Public-utility power plants [3]			9,940			10,379			11,393
Bunker oil, foreign trade			31,734			28,993			29,226
Bunker oil, coast-wise trade			26,711			24,910			26,119
All other demands			214,950			231,959			252,751

[1] Includes production by cracking: 1933, 152,498; 1934, 178,876; 1935, 194,734.
[2] Interstate Commerce Commission.
[3] U. S. Geological Survey.

LUBRICANTS

The total production of lubricants in 1935 was 27,771,000 barrels, or 5.3 percent more than the 26,373,000 barrels produced in 1934. The production was distributed among the various districts as follows:

Production and stocks of lubricants in 1935

[Thousands of barrels]

	Production	Stocks Dec. 31		Production	Stocks Dec. 31
East coast	7,709	2,227	Louisiana Gulf Coast	610	92
Appalachian	5,370	855	Arkansas-Inland Louisiana	215	34
Indiana-Illinois	2,686	514	Rocky Mountain	273	120
Oklahoma-Kansas-Missouri	3,389	562	California	1,821	975
Inland Texas	258	93			
Texas Gulf Coast	5,440	1,553	Total	27,771	7,025

The upward trend of the proportion of lubricants furnished by the Oklahoma-Kansas-Missouri district continued, the district producing 12.2 percent of the total in 1935 compared with 11.3 percent in 1934 and 7.6 percent in 1929. The upward trend of the Appalachian district, however, was broken, the 1935 percentage being 19.3 compared with 19.8 in 1934. The most notable change was in the Texas Gulf Coast district, which dropped from 21.2 percent in 1934 to 19.6 in 1935.

The total production of lubricants increased steadily throughout 1935. The daily average of 71,000 barrels for January was the lowest for the year, while the average of 80,000 barrels for December was exceeded only by November, when the daily average was 82,000 barrels.

The domestic demand for lubricants in 1935 was 19,598,000 barrels compared with 18,484,000 in 1934, an increase of 6 percent. It is estimated that 12,722,000 barrels of the domestic demand in 1935 were used by motor vehicles and 6,876,000 barrels for industrial purposes. One of the most striking features in connection with lubricating-oil demand is its failure to increase in proportion to the use of automobiles. This can be seen clearly in the accompanying table which compares the demand for this product over the past 12 years with that for motor fuel.

Domestic demand for lubricants and motor fuel, 1924–35

Year	Lubricants		Motor fuel		Percent lubricants of motor fuel	Year	Lubricants		Motor fuel		Percent lubricants of motor fuel
	Demand [1]	Index	Demand [1]	Index			Demand [1]	Index	Demand [1]	Index	
1924	18,124	100	187,022	100	9.69	1930	21,589	119	394,800	211	5.47
1925	20,581	114	226,329	121	9.09	1931	20,068	111	403,418	216	4.97
1926	22,568	125	264,391	141	8.54	1932	16,614	92	373,900	200	4.44
1927	21,669	120	299,818	160	7.23	1933	17,152	95	377,003	202	4.55
1928	23,168	128	332,033	177	6.98	1934	18,424	102	407,106	218	4.54
1929	23,609	130	375,999	201	6.28	1935	19,598	108	432,556	231	4.53

[1] In thousands of barrels.

The index for motor-fuel demand in 1935 is 231, using 1924 as the base year, but the index for lubricating-oil demand for the same year is only 108. While higher-quality lubricants and better automobiles have increased the efficiency of motor oil, the most important reasons for lubricating-oil consumption not increasing are probably the growing practice, especially among truck operators, of not changing the oil and the practice of reclaiming used oil.

Exports of lubricants amounted to 8,480,000 barrels in 1935, an increase of 10.7 percent over the 1934 figure of 7,660,000 barrels.

Stocks of lubricants totaled 7,025,000 barrels on December 31, a decrease of 4.2 percent from the stocks (7,331,000 barrels) at the end of 1934. The East Coast district, with 2,227,000 barrels, had a larger proportion of the stocks than any other district; Texas Gulf Coast district was next, with 1,553,000 barrels. The stocks in these two districts represent 54 percent of the total.

Prices of lubricating oil partly recovered in 1935 from their precipitous decline in the last half of 1934, when a typical midcontinent grade dropped from 24 cents per gallon in early June to 13 cents in December. The price for this same grade increased consistently throughout 1935 until it reached 16.5 cents per gallon late in October and remained there the rest of the year.

WAX

Although the production of wax declined from 468,720,000 pounds in 1934 to 450,240,000 in 1935, domestic demand increased from 240,035,000 pounds in 1934 to 260,434,000 in 1935. Exports also increased from 198,958,000 pounds in 1934 to 230,933,000 in 1935, while imports declined from 37,292,000 pounds in 1934 to 19,666,000 in 1935.

The average price in New York for yellow crude scale wax for domestic shipment declined from 3.49 cents per pound in 1934 to 2.20 cents in 1935.

COKE

The domestic demand for petroleum coke declined from 1,508,000 short tons in 1934 to 1,344,700 in 1935. Exports, on the other hand, increased from 114,300 short tons in 1934 to 129,500 in 1935. Stocks of petroleum coke totaled 388,900 short tons on December 31, 1935, 15,200 tons less than the stocks on the same day in 1934. This

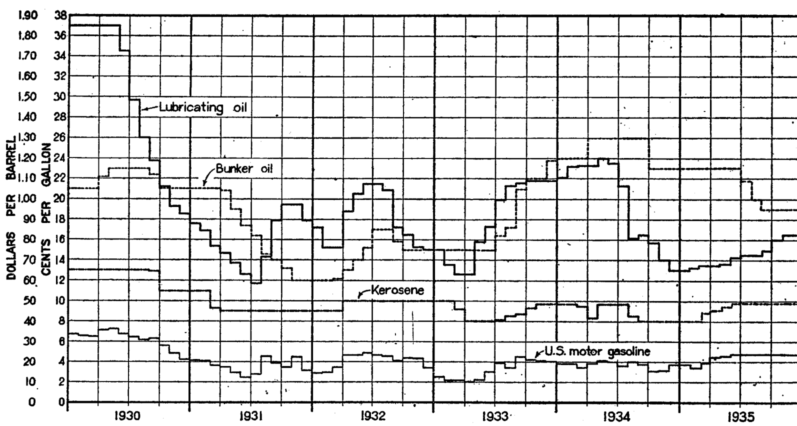

FIGURE 107.—Trends in prices of refined petroleum products, 1930–35, by months.

figure represents the smallest stocks of coke for a number of years and is only 26 percent of the quantity on hand December 31, 1931, when the stocks (1,511,600 short tons) represented 10 months' supply.

ASPHALT AND ROAD OIL

The production of and domestic demand for petroleum asphalt and road oil increased in 1934, and the upward trend was continued in 1935. Demand is affected primarily by activity in highway construction. Details for these two commodities may be found in the chapter on Asphalt and Related Bitumens.

STILL GAS

The production of still or refinery gas totaled 193,500 million cubic feet in 1935, an increase of 24,021 million cubic feet (14 percent) over the previous year and marks resumption of the upward trend broken for the first time in 1934.

IMPORTS, EXPORTS, AND SHIPMENTS THROUGH PANAMA CANAL [8]

Imports of refined petroleum products, chiefly fuel oil, into continental United States, both for domestic use and in bond, increased from 13,177,000 barrels in 1934 to 20,503,000 in 1935. The chief increase was in receipts of fuel oil in bond for the supply of vessels,

[8] By A. H. Redfield, Petroleum Economics Division, Bureau of Mines.

chiefly from the Netherland West Indies, from 8,404,000 barrels in 1934 to 12,218,000 in 1935. No fuel oil was imported in bond for refining and export of manufactured products in 1935, although 1,626,000 barrels were entered for this purpose in 1934. Direct imports of fuel oil for domestic consumption increased from 4,350,000 barrels in 1934 to 7,529,000 barrels in 1935. In addition, 301,000 barrels of fuel oil originally imported in bond were withdrawn for domestic consumption on payment of duty in 1935 compared with 380,000 barrels in 1934. Ninety-three percent of the fuel oil, dutiable and in bond, imported into continental United States went to Atlantic-coast ports, and 6 percent to Gulf-coast ports.

Imports of paraffin wax in the foregoing table included 3,543,000 pounds imported in bond for reexport in 1934 but only 409,000 pounds in 1935.

The excise taxes originating in the Revenue Act of 1932 were still effective in keeping imports of gasoline and lubricating oils down to insignificant proportions.

Exports and shipments of refined petroleum products to noncontiguous territories increased from 73,142,000 barrels in 1934 to 76,776,000 in 1935. The chief gain was in exports and territorial shipments of motor fuel, which increased 23 percent in quantity mainly because of larger purchases by countries of western Europe, Australia, and the Philippine Islands. Exports and shipments of lubricating oils, especially to Europe, Canada, Australia, Japan, and Brazil, increased 10 percent. Foreign and territorial shipments of gas oil and distillate fuel oil increased from 14,131,000 barrels in 1934 to 15,858,000 in 1935, mainly because of larger purchases by Japan, the Netherlands, Italy, and Sweden, in spite of reduced sales to the Netherland West Indies, the United Kingdom, Panama, and Canada. On the other hand, exports and shipments of kerosene, especially to the United Kingdom, China, and the Netherlands, declined 32 percent in 1935. Exports and shipments of residual fuel oil, world-wide in scope, decreased from 14,474,000 barrels in 1934 to 12,631,000 in 1935. Reduced sales to Japan, Mexico, New Zealand, Panama, the Philippine Islands, Cuba, and Spain were offset in part by increased shipments to Canada, Italy, and China in particular.

Imports and exports of petroleum products, 1934–35 [1]

	1934	1935
Imports:		
Gasoline thousands of barrels	1	20
Fuel oil do	12,634	19,565
Lubricants do	2	1
Wax thousands of pounds	37,292	19,669
Asphalt thousands of short tons	15.6	54.0
Unfinished oils thousands of barrels	4	463
Other petroleum distillates do	316	87
Exports: [2]		
Motor fuel do	24,686	30,380
Kerosene do	9,781	6,644
Gas oil and fuel oil do	28,605	28,489
Lubricants do	7,660	8,480
Wax thousands of pounds	198,958	230,933
Petroleum coke thousands of short tons	114.3	129.5
Petroleum asphalt do	239.9	224.3
Mineral spirits thousands of barrels	47	76

[1] Bureau of Foreign and Domestic Commerce.
[2] Includes shipments to Alaska, Hawaii, and Puerto Rico.

Exports [1] of major petroleum products in 1934 and 1935 [2] by countries of destination [3]

[Thousands of barrels of 42 gallons, except wax which is in thousands of pounds]

	Gasoline [4]		Kerosene		Gas oil and fuel oil		Lubricating oil		Wax	
	1934	1935	1934	1935	1934	1935	1934	1935	1934	1935
Argentina	205	18	41	1	498	------	92	60	1,995	4,691
Australia	2,141	2,233	346	278	------	5	288	416	426	454
Belgium	1,548	1 58	126	124	373	306	586	717	4,575	8,605
Brazil	972	1,144	541	524	77	44	197	229	1,752	2,388
British India	34	9	41	1	19	84	364	427	1,022	804
Canada	1,682	1,419	61	44	1,427	1,542	316	434	1,332	1,709
Chile	6	144	(5)	(5)	1,474	1,610	35	44	5,535	6,256
China, Hong Kong, and Kwantung	458	507	1,845	955	445	462	260	249	5,151	10,909
Colombia	53	10	3	(5)	2	1	15	12	11,559	4,640
Cuba	336	560	(5)	42	645	361	6	51	1,964	2,352
Denmark	10	16	1	(3)	------	138	117	196	1,733	2,255
Finland	80	58	(5)	------	------	34	5	5	602	733
France	1,616	2,413	88	1	335	66	802	532	354	662
Germany	275	744	121	6	883	843	946	591	18,922	17,093
Irish Free State	165	136	34	30	30	9	7	7	2,676	2,458
Italy	62	423	90	26	422	949	332	467	33,043	33,228
Japan	1,079	699	375	31	7,917	9,292	257	282	88	513
Mexico	113	209	16	21	1,014	1,088	50	62	931	3,370
Netherlands	959	928	942	526	857	1,010	254	158	10,946	9,344
Netherland West Indies	1,496	662	815	986	1,114	451	6	5	1	22
New Zealand	732	549	38	24	1,021	859	43	68	67	279
Norway	164	234	139	128	279	293	17	44	1,107	1,332
Panama	227	192	53	37	2,053	1,877	13	11	614	293
Philippine Islands	698	1,079	420	451	972	758	60	71	1,637	3,142
Spain	899	2,113	24	(5)	665	455	63	73	5,964	3,216
Sweden	805	1,048	361	298	272	536	82	96	4,487	6,467
Union of South Africa	714	747	157	150	1	26	96	97	1,728	1,164
United Kingdom	4,308	5,883	2,200	757	2,057	1,471	1,709	1,856	56,985	69,090
Other countries	1,223	2,764	729	1,021	1,125	1,470	536	1,140	22,047	32,395
	23,060	28,599	9,607	6,462	25,977	26,040	7,554	8,400	199,243	229,864

Shipments to noncontiguous territories

	Gasoline 1934	Gasoline 1935	Kerosene 1934	Kerosene 1935	Gas oil and fuel oil 1934	Gas oil and fuel oil 1935	Lubricating oil 1934	Lubricating oil 1935	Wax 1934	Wax 1935
Alaska	162	188	10	9	385	697	12	13	------	------
Puerto Rico	493	455	65	76	156	101	20	21	22	29
Virgin Islands [6]	9	10	3	3	1	2	1	1	2	------
Hawaii	780	1,045	106	107	2,081	2,138	42	67	8	15
	1,444	1,698	184	195	2,623	2,938	75	102	32	44

[1] Includes exports from noncontiguous territories.
[2] Statistics for 1935 are preliminary, but only a minimum of changes is anticipated.
[3] Compiled by N. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.
[4] Includes natural gasoline.
[5] Less than 500 barrels.
[6] In 1934 the Virgin Islands of the United States were classified as a foreign country for statistical purposes.

Shipments through Panama Canal.—Shipments of mineral oils from California to the Atlantic coast through the Panama Canal dropped from 24,719,000 barrels in 1934 to 9,769,000 in 1935. The principal decrease was in shipments of fuel oil, which formed 57 percent of the total in 1934. A 7-percent increase in the delivered price of California Bunker C oil at Atlantic ports, coincident with a decline of 12 percent in the delivered price of Gulf coast bunker oil, reduced intercoastal shipments of California fuel oil from 14,024,000 barrels in 1934 to 877,000 in 1935. Gasoline shipments from California to the Atlantic coast likewise declined from 8,694,000 barrels in 1934 to 7,108,000 in 1935 and intercoastal shipments of California kerosene from 1,800,000 barrels in 1934 to 1,189,000 in 1935.

NATURAL GAS [1]

By F. S. Lott and G. R. Hopkins

SUMMARY OUTLINE

Continued improvement in all branches characterized natural-gas activities in 1935. Recovery that began in 1933 when the industry "turned the corner" after the worst of the depression continued throughout 1935 with increasing momentum, as evidenced by a marked expansion in sales and profits of leading natural-gas companies in the last quarter. Figure 108 shows that the volume of marketed production recovered in 1934 and 1935 virtually all of the ground lost in 1931 and 1932.

It is estimated that the total quantity of natural gas produced and marketed in 1935 was 1,875,000,000,000 cubic feet, an increase of 6 percent over the 1,770,721,000,000 cubic feet produced in 1934. Allowing for the same imports as in 1934 (68,000,000 cubic feet) and for 6,000,000,000 cubic feet of exports to Canada and Mexico gives about 1,869,000,000,000 cubic feet as the estimated consumption of natural gas in the United States in 1935. The estimated value of this consumption in 1935 was $423,000,000, an increase of 7 percent over the preceding year's total of $394,257,000. The average value at points of consumption increased from 22.3 cents in 1934 to 22.6 cents in 1935. This increase of 0.3 cent probably reflected an increase in the relative importance of sales to miscellaneous industrial consumers at a slightly higher price. This contrasts with the experience of 1934, when an expansion of more than 13 percent in total sales over 1933 resulted in an increase of only about 7 percent in gross income.

[1] Figures for 1935 are preliminary; detailed data with final revisions will be released later.

Salient statistics of the natural-gas industry

	1934	1935 [1]	Percent of change in 1935
Production, millions of cubic feet:			
California	268,122	290,000	+8.2
Louisiana	225,713	253,000	+12.1
Oklahoma	254,457	260,000	+2.2
Texas	602,976	675,000	+11.9
West Virginia	109,161	115,000	+5.4
Other States	310,292	282,000	−9.1
	1,770,721	1,875,000	+5.9
Consumption, millions of cubic feet:			
Domestic	288,236	310,200	+7.6
Commercial	91,261	101,300	+11.0
Field	554,542	572,691	+3.3
Carbon-black manufacture	229,933	241,589	+5.1
Petroleum refineries	79,965	86,000	+7.5
Electric public-utility power plants	127,896	125,239	−2.1
Cement plants	27,331	26,981	−1.3
Other industrial	365,824	405,000	+10.7
	1,764,988	1,869,000	+5.9
Value, per thousand cubic feet:			
Average at wells .... cents	6.0	6.2	+3.3
Average at points of consumption .... do	22.3	22.6	+1.3
Average domestic .... do	74.6	74.2	−.5
Average commercial .... do	49.6	49.0	−1.2
Average industrial .... do	9.7	9.8	+1.0

[1] Largely estimated.

The foregoing indicates that success is attending the campaign of the industry during the past year or two directed toward the development of larger markets for gas in the general industrial field. This tends to accomplish two important objectives—first, the load factor of the pipe-line systems is increased and, second, a better average price is obtained for total industrial requirements when deliveries to miscellaneous industrials increase at a greater rate than those to low-priced markets, such as for field purposes and to carbon-black plants. In considering the possibilities of this development it is interesting to note that because the total volume of industrial sales is so large an increase of 1 cent per thousand cubic feet in the average price results in a material gain in gross revenue.

According to figures compiled by the Bureau of Mines,[2] carbon-black plants utilized 241,589,000,000 cubic feet of natural gas in 1935, an increase of 5 percent over 1934. Although this was somewhat short of the consumption in 1929 and 1930, the demand for carbon black reached a new high in 1935, indicating that when carbon-black stocks are reduced to minimum requirements the demand of the industry for natural gas will attain new peaks. Portland-cement plants consumed 26,981,000,000 cubic feet of natural gas in 1935, a small reduction in volume from the preceding year. Information furnished by the U. S. Geological Survey indicates that the demand of public-utility power plants also decreased, the total for 1935 of 125,239,000,000 cubic feet being about 2 percent below that in 1934. It is estimated that 572,691,000,000 cubic feet of natural gas was used in field operations during 1935 and that petroleum refineries consumed 86,000,000,000 cubic feet, increases of about 4 and 7 per-

[2] Hopkins, G. R., Summary of Carbon-Black Operations in 1935: Mineral Market Report 458, Bureau of Mines, 1936.

cent, respectively, over 1934. Other industrial consumers used about 405,000,000,000 cubic feet of gas in 1935, representing an increase of 11 percent over consumption in the preceding year. Estimated value at points of consumption of total industrial sales in 1935 was $142,963,000, an average of 9.8 cents per thousand cubic feet compared with an average of 9.7 cents in 1934.

The volume of natural gas used for domestic purposes in 1935 was about 310,200,000,000 cubic feet having an estimated total value of $230,168,000 and an average value of 74.2 cents per thousand cubic feet. Consumption for commercial purposes is estimated at 101,300,000,000 cubic feet with a market value of about $49,637,000, an average of 49 cents per thousand. Although total deliveries and sales value of natural gas to industrial consumers in 1935 were still materially below the peak figures for 1929 and 1930, the domestic and commercial markets have expanded steadily, with the result that the total value of all natural gas sold was probably greater in 1935 than in any other year in the history of the industry.

The total number of natural- and mixed-gas customers connected to pipe lines at the end of the year is estimated at 7,880,000, compared

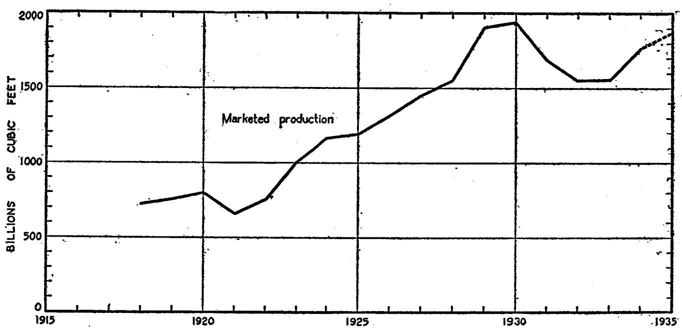

FIGURE 108.—Marketed production of natural gas, 1918–35.

with 7,597,000 at the end of 1934. The average value of the gas used per customer in 1935 ($53.68) was approximately 4 percent higher than in 1934.

REVIEW BY STATES

Arkansas.—No discoveries of natural gas were reported in Arkansas during 1935 although drilling continued to be very active in the southern part of the State according to information supplied by George C. Branner, State geologist. Two small gas wells were completed in Union County, from which the gas is used in field operations. Four gas wells were completed in the western Paleozoic area. Three of these, with a combined open-flow capacity of 8,150,000 cubic feet per day, were in the Vesta field of Franklin County, and the fourth, good for 200,000 cubic feet per day, was in the Roland-Dora field of Crawford County. Several deep tests in southern Arkansas added to knowledge of subsurface conditions, but their results were not encouraging.

Total natural-gas production in 1935 was 6,699,914,000 cubic feet, slightly less than in the preceding year. It was produced in the counties of Union, Johnson, Crawford, Ouachita, Sebastian, Franklin, and Nevada, named in the order of their importance.

California.—A decided increase in drilling and general field activity took place in California in 1935, as evidenced by the completion of 986 oil and gas wells compared with 643 in 1934. A report prepared by Claude C. Brown, chief engineer, Railroad Commission, State of California, is the principal source of the following information.

Total production, including losses, of natural gas in California in 1935 was 304,867,400,000 cubic feet, an increase of more than 8 percent over the 1934 production of 281,354,800,000 cubic feet. The increase in deliveries of gas in California in 1935 was partly the result of the lower-than-normal average temperatures experienced. The table below indicates the amounts of gas utilized for various purposes and comparisons with the preceding year. More than 90 percent of the natural gas produced in California is casinghead gas.

Salient statistics of the natural-gas industry in Californra, in 1934–35 [1]

Use	1934		1935	
	M cubic feet	Percent of total	M cubic feet	Percent of total
Repressuring and storage	3,852,800	1.4	3,892,700	1.3
Gasoline plant, fuel, and shrinkage	47,586,300	16.9	50,032,000	16.4
Field fuel	38,510,200	13.7	39,310,000	12.9
Other fuel (refineries)	7,041,200	2.5	8,804,700	2.9
Sales to utilities and others	167,644,300	59.6	183,453,400	60.2
Blown to the air	16,720,000	5.9	19,374,600	6.3
Total net production [2]	281,354,800	100.0	304,867,400	100.0

[1] Figures compiled by Claude C. Brown, chief engineer, Railroad Commission, State of California.
[2] "Net production" is the difference between total gross production and quantity of gas recirculated. Figures represent net quantity of gas taken from wells.

The total receipts of natural gas by distributing utilities amounted to 183,153,200,000 cubic feet, of which approximately 33 percent was sold to domestic consumers, 46 percent to commercial and industrial consumers, and 10 percent to electric generating stations. The remaining 11 percent is accounted for by losses and gas-utility company use At the end of 1935 there were about 1,480,000 consumers of natural gas in California.

New gas fields opened in 1935 include a discovery near Chowchilla, in Madera County, the Tracy gas field in San Joachim County about 75 miles from San Francisco, and the gas field on MacDonald Island near Stockton, San Joachim County. The Tracy field was discovered in August 1935, when a well came in making 35,000,000 cubic feet of dry gas per day from 4,063 feet. A second successful well was drilled before the end of the year, indicating a substantial reserve of gas. Twelve miles of 10-inch line were built to connect the wells of the Tracy field to a trunk line that supplies gas to the San Francisco market.

Further drilling in the Semitropic Ridge gas field of Kern County increased the potential open-flow capacity of wells to 100,000,000 cubic feet of gas per day. Three wells were drilled in the Buttonwillow field, Kern County, which brought the total number of wells in the field to 26 and their open-flow capacity to 350,000,000 cubic feet per day. A pipe line was built from the Buttonwillow and Semitropic fields to a trunk gas line south of Belridge that supplies the city of Los Angeles. The Buttonwillow field, which had been shut in since 1933, produced about 15,000,000 cubic feet of gas per day during the last few months of 1935.

In addition to the new gas pipe lines already mentioned, construction was begun on a line from the Mountain View field to a trunk utility gas line north of Lebec. About 46 miles of 22-inch line were built northward from the Milpitas meter station to San Francisco. This line parallels a trunk line already in existence, thereby, increasing capacity and insuring against interruption of gas service. Several branch distributing lines were laid in the Fresno, Visalia, and Hanford areas.

Colorado.—Except for a probable increase in gas production there was little change in the natural-gas industry in Colorado during 1935 according to information furnished by H. J. Duncan, supervisor, U. S. Geological Survey, Casper, Wyo.

The chief source of gas was the Hiawatha field (Colorado portion), Moffat County, which furnished 2,231,749,000 cubic feet to the trunk pipe line to Salt Lake City, Utah, in 1935. About 75 percent of this gas is used for industrial and commercial purposes and 25 percent for domestic requirements. The Berthoud field in Larimer County produced approximately 50,000,000 cubic feet of gas into a public-utility pipe line for use in Cheyenne, Wyo., and nearby Colorado towns. Production of the Craig field, Moffat County, which is used to supply the domestic requirements of the town of Craig, declined about 20 percent to 39,378,000 cubic feet. The remainder of the State's production was withdrawn from the Garcia field, Las Animas County, not far from the New Mexico State line, processed for extraction of natural gasoline, and used locally for fuel.

Seven gas fields in Moffat, Rio Blanco, and Garfield Counties in the northwestern corner of Colorado, remained shut in for lack of a market. No gas-well completions were reported from the old fields, but the first discovery of natural gas in commercial quantity in southwestern Colorado was made in the Red Mesa area of La Plata County, where a well in sec. 27, T. 33 N., R. 12 W., was completed with an open-flow capacity of 2,000,000 cubic feet per day.

It is estimated that 275,000,000 cubic feet of carbon dioxide gas was wasted during the year in connection with oil production in the North and South McCallum fields in Jackson County. No commercial use has been found for this gas because of contamination from association with the oil.

Illinois.—Drilling in Illinois increased in 1935, 34 wells having been completed compared with 26 in 1934, according to information furnished by Alfred H. Bell, geologist and head of the Oil and Gas Division, Illinois State Geological Survey. Of this number, three were gas wells in unproven territory. The largest, with a reported initial open-flow capacity of 500,000 cubic feet per day from the Chester formation at 957 feet, was drilled in sec. 25, T. 6 N., R. 4 W., Bond County. It is about 1 mile west of the Ayers gas field and is probably an extension of that area. The other two wells were in Lamotte Township, Crawford County—one in sec. 10, T. 6 N., R. 11 W., and the other about 3½ miles east of north of it in sec. 21, T. 7 N., R. 11 W. They were completed in the Pennsylvanian with open-flow capacities of 300,000 cubic feet of gas from about 700 feet and 250,000 cubic feet from a depth of 600 feet, respectively.

New gas pools probably will be opened by these discoveries. All three wells remained shut in at the end of the year, as no pipe-line connections had been made. No gas wells were drilled in proven territory in 1935.

The Ayers field, with eight producing wells, continued to supply gas through a 5-mile line to the town of Greenville. Production from that field in 1935 was 13,400,000 cubic feet, the same as in 1934. Other gas production in the State is associated with oil in the southeastern fields in Crawford and adjacent counties. As oil production declined 4 percent in 1935 it is probable that casinghead-gas production was somewhat less than the approximate 1,800,000,000 cubic feet produced in 1934. Almost all of the casinghead gas is processed to obtain its rather high content of gasoline (about 2.5 gallons per thousand cubic feet), the residue being used as fuel in oil production.

There has been a revival of interest recently in the oil and gas possibilities of the Illinois structural basin stimulated by the greater knowledge of subsurface conditions that may be obtained through modern geophysical methods of investigation.

Indiana.—The outstanding gas activity in Indiana during 1935 was the rapid development of the Oaktown gas field in Knox County, according to a report prepared by W. H. Cordell, assistant geologist, Indiana Conservation Department. Fifteen wells with initial open-flow capacities ranging from two to four million cubic feet per day were completed, bringing the total number of gas wells in this field to 28. The drilling campaign was incident to laying a 6-inch pipe line to connect the field with markets in south-central Indiana, which for the first time provided an effective outlet for this production.

A new gas structure was discovered late in the year in Anderson Township, Perry County. By the end of 1935 four wells with a total open-flow capacity of 10,000,000 cubic feet per day had been completed and turned into a pipe line. Drilling is expected to continue during 1936. Another small field was opened by drilling four gas wells in Jefferson Township, Pike County, not far from an existing pipe line.

In all, 61 gas wells were completed in Indiana during 1935, of which 10 are in new areas. Although more drilling was done than in 1934, the resulting new production was not sufficient to arrest the decline of the old fields. An active search for new gas supplies was carried on in Daviess, Pike, and Gibson Counties.

Although production in the Alford field fell to 475,000,000 cubic feet in 1935 from 703,000,000 in 1934, it continued to be the most important source of gas within the State. Several gas wells were completed in the old Trenton field, the gas being used to augment the supply for nearby small towns.

There were about 900 producing gas wells in Indiana at the close of 1935, with more than 700 in the old Trenton field.

Total marketed production of gas in 1935 was 1,400,000,000 cubic feet, about 90 percent of which was used for domestic and commercial purposes. Two glass factories, one at Corydon and one at Vincennes, use natural gas as fuel.

Kansas.—Drilling operations were pushed in Kansas in 1935 as in the 2 preceding years, and a gratifying number of sources of gas were discovered. Data on the results of drilling have been supplied by Kenneth K. Landes, assistant State geologist of the Geological Survey of Kansas.

Forty-six gas wells were completed in Kansas in 1935, of which 8 in the Burrton field of Reno County and 2 in the Chindburg field, McPherson County, produced a small amount of oil with the gas. The total open-flow capacity of the new gas wells was reported as 537,000,000 cubic feet per day, an average of over 11,600,000 cubic feet per well. By far the greater part of the development took place in the vicinity of the "Barton arch" of central Kansas, the Burrton and Otis fields being the most active.

Eight new gas fields were discovered in 1935, of which four were formerly listed as oil fields only. The Hickok discovery well, Kennedy No 1, in Grant County north of the Hugoton field, may prove to be an extension of that great reservoir. It was completed December 30, 1935, with an initial open-flow capacity of 10,000,000 cubic feet per day from the Sumner-Chase (Permian) formation. It indicates a large addition to the known gas reserves of southwestern Kansas and may stimulate the use of Kansas gas for manufacturing carbon black. The Stone well, completed for 10,500,000 cubic feet per day on September 30, 1935, in sec. 10, T. 24 S., R. 4 W., was also later thought to be an extension of the Burrton field, Reno County, rather than the discovery well of a new producing area. The other wildcat gas wells were in Ellsworth, Haskell, Harvey, Pratt, Rice, and Rush Counties.

No important natural-gas pipe line was constructed in Kansas during the year.

It is noteworthy that few wells in Kansas are drilled deeper than 4,000 feet, although the tendency in most oil and gas territory is to go much deeper. This is due to the comparatively thin layer of sedimentary rocks overlying the crystalline rocks of the basement complex.

Kentucky.—Increased demand for Kentucky natural gas in 1935 brought about generally improved conditions in the industry, according to information supplied by C. D. Hunter, geologist, Kentucky-West Virginia Gas Co.; I. B. Browning, geologist and operator of Ashland, Ky.; and N. Shiarella, geologist and operator of Owensboro, Ky.

In the eastern Kentucky fields of Floyd, Martin, Knott, Pike, and Magoffin Counties, 91 gas wells were completed in 1935, with only 3 dry holes. More than 1,400 producing gas wells in these five counties furnished gas to cities in Kentucky, Ohio, and as far east as Washington, D. C. Two 20-inch, one 16-inch, one 12-inch, one 10-inch, and one 8-inch gas lines originate in this important producing area. The object of drilling during the year was to maintain the delivery capacity of existing fields rather than to develop new productive territory. An extension of the field into Knott County around the town of Hindman was the only important addition to developed gas reserves.

On Triplett Creek in Rowan County eight wells were completed in the "Corniferous" line at the shallow depth of 350 feet. Their combined open-flow capacity was about 2,000,000 cubic feet per day, and rock pressure was 45 pounds per square inch. This gas is reported to be marketed in the town of Morehead, 5 miles from the source. In the Devonian shale gas field around Ashland about 30 percent of the wells have been abandoned, owing to depletion. The principal pipe-line gathering systems have been removed from the Weir gas field (Ivyton, Win, and Flat Gap), and production of the entire area has declined to less than 500,000 cubic feet per day.

In the western Kentucky fields near Owensboro drilling was less active than in the previous year. Ohio County was by far the most active, followed by Hancock and McLean. Sixteen gas wells were completed—10 in Ohio County and 6 in Hancock County. No important gas discoveries were reported. In November 1935 a well 7 miles southwest of Livermore in McLean County made 15,000,000 feet of wet gas from the Jett or Tar Springs sand. About 600 wells in 13 counties of northwestern Kentucky produced gas that is sold in Kentucky and in Evansville, Terre Haute, and other towns in Indiana.

Louisiana.—There was a moderate increase in field activity and in natural-gas production in Louisiana during 1935. Natural-gas data have been furnished by Cyril K. Moresi, State geologist of Louisiana, and by B. C. Craft, associate professor of petroleum engineering, Louisiana State University. Gas-well completions numbered 104 in 1935, an increase of 36 over the previous year. Total natural-gas production increased 10 percent over 1934 or to a total of 253,174,592,000 cubic feet. This came from approximately 1,350 gas wells and 100 oil wells from which gas is produced into pipe lines.

The importance of the Monroe field is indicated by the fact that it accounted for 72 percent of the total natural gas produced in Louisiana in 1935. Sixty-three gas wells were completed in the field during the year, bringing its total producing wells to 955 as of December 31, 1935.

Of the new discoveries in 1935, the most important from both an oil and gas standpoint was the discovery of deep production at Rodessa in the northwest corner of the State. An oil and gas field of first magnitude was found at Rodessa in July 1935, when large production was found in the Glen Rose (Upper Trinity) formation, 1 mile north of the gas area.

The success at Rodessa has directed attention to the potentialities of the Glen Rose and caused an active exploratory campaign to be directed toward the deep-seated prospects of the interior salt-dome area. A second important Glen Rose discovery was recorded when the Fowler No. 1 was completed in sec. 10, T. 17 N., R. 4 W., Lincoln Parish, at 5,303 feet. The well produced 71,385,000 cubic feet of wet gas with a rock pressure of 2,140 pounds per square inch. A new gas area was opened in Bossier Parish when the L. A. King No. 1 in sec. 36, T. 23 N., R. 13 W., encountered 5,000,000 cubic feet of gas per day in the Ozan sand at 2,833 to 2,839 feet. In De Soto Parish an important gas discovery was recorded when De Soto No. 1 in sec. 29, T. 12 N., R. 14 W., was completed with an initial capacity of 16,000,000 cubic feet per day from 2,818 to 2,841 feet.

In the Gulf coast portion of Louisiana new discoveries were reported in Rapides and St. Martin's Parishes, which produced small amounts of oil along with wet gas. Both were connected to gas pipe lines. In the Bosco oil field of Acadia Parish two gas wells were completed at a depth of 8,400 feet.

The most important gas-producing area in southern Louisiana is the Iowa oil field in Calcasieu and Jefferson Davis Parishes. A total of 4,599,135,000 cubic feet was produced at Iowa in 1935, a marked increase from the 1934 production of 1,643,986,000 cubic feet. This gas was produced along with the oil from about 40 oil wells.

Distribution of gas produced from the Monroe, Richland, and Epps gas fields [1]

	1934, M cubic feet	1935, M cubic feet
Burned in carbon-black manufacture	53,910,727	54,113,611
Put into gas pipe lines	137,994,095	146,928,933
Utilized in the field	1,490,340	1,051,151
Unaccounted for, losses, etc	2,839,874	1,924,795
Total production	196,235,036	204,018,490

[1] Data furnished by C. K. Moresi, State geologist, Louisiana.

The above table indicates the saving that results from increased efficiency in handling gas production in this territory and discloses the tendency to curtail the utilization of gas for "low-value" purposes in favor of increased pipe-line deliveries as higher-grade markets expand.

Michigan.—Drilling increased in Michigan in 1935 nearly 40 percent over the preceding year, reflecting improved market conditions for both oil and gas. Of the 641 completions reported, 101 were gas wells—more than double the 1934 total. However, of 141 wildcat wells drilled during the year, only 12 were producers; 8 of these were gas wells, and 4 were oil wells. This high proportion of failures in unproven territory is attributable largely to difficulties in interpretation of subsurface geological conditions because of the glacial drift "blanket", which effectively obscures surface indications of structure, and to the generally erratic character of the producing formations. Statistics of production and other field information have been furnished by F. R. Frye, petroleum engineer of the Department of Conservation, State of Michigan.

There was a large increase in gas production in Michigan in 1935. Production from the dry gas fields increased 51 percent to 2,592,420,000 cubic feet, chiefly as a result of larger withdrawals from the Austin field and from the Six Lakes field. Casinghead-gas production is estimated to have more than doubled, reaching a total of nearly 3,000,000,000 cubic feet for the year. Increases are indicated in all the newer oil fields, particularly Porter Township, Mount Pleasant East Extension, and Crystal. A large part of the casinghead gas from wells in the Porter and Mount Pleasant fields continues to be processed for extraction of natural gasoline. Other quantities are used in field operations and repressuring of the oil reservoir. Residue gas from the Porter gasoline plant is used as boiler fuel in a chemical plant in the town of Midland a few miles to the east.

The most important field development of the year took place in the Six Lakes or Tri-Township field of Mecosta and Montcalm Counties about 5 miles west of Edmore. The field was formerly regarded as an extension of the Edmore pool, but drilling in 1935 established the fact that it is a separate producing area. Sixty wells have been drilled, more than 50 of them during the past year. Production is from the Michigan "stray" sand at a depth of about 1,300 feet. Wells range in size from approximately 1,000,000 cubic feet to 30,000,000 cubic feet in initial open-flow capacity. Better sand conditions are found in this field than in others producing from the Michigan "stray" sand. Although the productive limits are not yet defined, 13,500 acres are regarded as proven, and reserves have been estimated at from 20 to 40 billion cubic feet, the largest of any gas field in the State.

Six gas wells have been drilled in a new area in Montcalm County in the southern part of T. 11 N., Rs. 4 and 5 W., and T. 10 N., R. 4 W. Their production comes from the Michigan "stray" sand, as does the gas in all other gas fields of the State, and capacities range from 3,000,000 to 10,000,000 cubic feet per day. The wells are shut in as there is no pipe-line connection.

In the Crystal oil pool of Montcalm County, discovered in March 1935, are a number of wells that found gas in substantial amounts in the Michigan "stray" sand, which was cemented off by the operators in the process of drilling deeper for oil. This is an appreciable increment to known gas reserves that may be exploited in the future.

Gas wells of commercial size were completed during the year in Day, Winfield, and Howe Townships, Montcalm County, and in Aetna Township, Mecosta County. These remained shut in at the year end, no attempts having been made to determine the extent of the productive areas opened.

Extensions were made to the Broomfield, Vernon, and Austin gas fields, but no significant increase in available gas supply was indicated.

Late in the year construction was begun of about 70 miles of 10-inch gas line, running from the Mecosta-Montcalm Counties' gas area to Lansing. In addition, a 6-inch line was completed in September 1935 from the same field to connect with the existing 8-inch line from the Broomfield gas field of Isabella County.

In November 1935 a market for the gas from the Clare field was provided by the laying of a 4-inch line from that area to the Vernon field, a distance of about 13 miles. There it was tied into the 4-inch line supplying gas to the towns of Mount Pleasant, Clare, and Rosebush. Three applications for permission to lay additional gas lines in central Michigan were pending before the Public Utilities Commission as the year closed. The only important waste of gas occurred in connection with the flush oil production in the Crystal field.

Mississippi.—Field activity continued to decline in Mississippi during 1935 as a result of the generally discouraging outcome of wildcatting operations. The number of completions fell to about half the 1934 total, and the only production developed was in the old Jackson field, where five gas wells were brought in. Of the 11 wildcats drilled during the year, 1 in Stone County was abandoned at 7,443 feet and 1 in George County at 6,928 feet; the others were drilled to depths of 3,000 to 4,800 feet. No important shows of oil or gas were reported. Information on 1935 Mississippi developments has been supplied by Henry N. Toler, State oil and gas supervisor.

Total gas production, which continues to come from the Jackson field of Hinds and Rankin Counties and the Amory field in Monroe County, was 10,385,129,000 cubic feet—the largest output recorded in any year in the State; it is due to greater withdrawals from the Jackson field. The Amory field, which accounted for only 94,206,000 cubic feet of the 1935 production, appears to be approaching exhaustion rapidly. Open-flow capacity of the two remaining producing wells has declined to less than 1,000,000 cubic feet per day and the rock pressure to about 100 pounds from an initial of 680 pounds. To the end of 1935 the Amory field had a cumulative total gas production of 1,650,000,000 cubic feet.

Jackson field production increased more than 1 billion cubic feet to 10,290,923,000 cubic feet. Of this amount, 4,200,477,000 cubic feet were marketed outside of the State—in Alabama, Florida, and Louisiana. There were 113 producing gas wells at the year end, with a total open-flow capacity of about 4 billion cubic feet per day. Cumulative gas production of the field to December 31, 1935, was 45,123,781,000 cubic feet, with a resultant decline in rock pressure of the reservoir from an initial of 1,050 pounds to 943 pounds per square inch.

Missouri.—Field activity in Missouri declined about 25 percent in 1935 from the average of the two preceding years according to information supplied by Frank C. Greene, geologist, Missouri Geological Survey. A total of 74 completions was reported, including the deepening of eight old wells. Drilling was confined almost entirely to proven areas and was concentrated in Jackson County, in which 58 of the total completions were recorded. Of these, 24 were gas wells with reported initial open-flow capacity of 7,359,000 cubic feet per day. Only five other gas wells, scattered in nearby western Missouri counties, were drilled during the year.

The most important discovery of gas was in the so-called Bartlesville sand in the Blue Ridge area of Jackson County (sec. 17, T. 49 N., R. 32 W.). The largest well had an initial open-flow volume of 2,000,000 cubic feet.

Montana.—Natural-gas production in Montana in 1935 was about 20,000,000,000 cubic feet, an increase of about 30 percent over 1934 that resulted mainly from greater demands for gas from smelters and other industrial plants at Anaconda and Great Falls. Information has been taken from a report prepared by H. J. Duncan, supervisor, United States Geological Survey, Casper, Wyo.

Twenty gas wells with a combined open-flow capacity of 70,000,000 cubic feet per day were completed in proven territory in Montana during 1935. The only gas discovery for 1935 was on the Bow and Arrow structure in Toole County, when Clark No. 1 well, sec. 24, T. 27 N., R. 1 W., was completed for 5,500,000 cubic feet per day from total depth of 2,080 feet with a closed-in pressure of 580 pounds per square inch. It remains shut in awaiting a pipe-line connection.

There was no trunk pipe-line construction during 1935. A booster station was built on the line from the Kevin-Sunburst and Whitlash fields to Great Falls.

Production and distribution of natural gas in Montana in 1935 [1]

Source		Destination	Quantity delivered, cubic feet
Field	County		
Bowes	Blaine	Havre and Chinook	480,874,000
Boxelder	Hill	do	451,280,000
Bowdoin	Phillips	Malta, Glasgow, Fort Peck, and other towns	766,647,000
Cedar Creek	Fallon	Miles City and Glendive, Mont.; Rapid City, S. Dak.; Bowman, Bismarck, and Williston, N. Dak.; and intervening towns.	6,526,846,000
Cut Bank	Glacier	Cut Bank, Helena, Butte, Anaconda, and intervening towns.	7,275,869,000
Dry Creek	Carbon	Bozeman, Livingston, Big Timber, and intervening towns.	664,256,000
Hardin	Big Horn	Town of Hardin	64,997,000
Kevin-Sunburst	Toole	Shelby, Great Falls, and intervening towns	2,725,613,000
Whitlash	Liberty	Great Falls and intervening towns	655,301,000
			19,611,683,000

[1] Data supplied by H. J. Duncan, supervisor, U. S. Geological Survey, Casper, Wyo.

The only natural-gasoline plant in the State is in the Cut Bank field. It produces about 6,000 gallons per day. There are no carbon-black plants.

Waste of gas from gas fields is estimated at 70,000,000 cubic feet and that incident to oil production at 100,000,000 cubic feet for the year. These comparatively low estimates reflect the efforts of operators to reduce gas losses as far as practicable by improved methods.

There were increases in production over 1934 from all gas fields. The largest gain was made by the Cut Bank field, where output increased by more than 2,200,000,000 cubic feet. The Kevin-Sunburst, Cedar Creek, and Dry Creek fields also produced substantially more gas in 1935.

New Mexico.—Although 1935 was the most active year in oil and gas development in the history of New Mexico only nine natural-gas wells were completed, and there were no important additions to proven gas reserves. Information on southeastern New Mexico has been furnished by E. A. Hanson, U. S. Geological Survey, Roswell, N. Mex., and on northwestern New Mexico by J. A. Frost, district engineer, U. S. Geological Survey, Farmington, N. Mex.

Most of the drilling was in the southeastern portion of the State in connection with the search for oil, other districts being relatively quiet; six of the nine gas-well completions, with a total initial open-flow capacity of 57,800,000 cubic feet per day, were in this area. In addition, a discovery of carbon dioxide gas was reported in the completion of No. 1 Rogers in sec. 4, T. 29 N., R. 29 E., Union County. Total depth was 2,715 feet, and initial open-flow capacity was about 1 million cubic feet per day. The well was shut in for lack of a market.

The Lea County gas supply is closely associated with oil production. Reserves that were already ample to meet the present and near-future demand were augmented by active development of the new Monument oil field, the only important discovery in New Mexico during the past year. Available gas in Eddy County fields, however, is declining because of the lack of new discoveries. As a result of this condition the Pecos Valley Gas Co. has been compelled to build an extension to its pipe-line system to assure an adequate supply of gas for peak loads in the winter months. This consisted of 15 miles of 6-inch line from the Artesia-Carlsbad line to connect with the El Paso Natural Gas Co. north extension terminus at Loving, N. Mex. There was no other natural-gas pipe-line construction of consequence in New Mexico during the year.

Increased demand for gas from the territory served by gas from Lea and Eddy County fields caused a substantial increase in withdrawals. Total marketed production from Eddy County during 1935 was 750,000,000 cubic feet; from Lea County the total was 22,760,000,000 cubic feet, of which 10,900,000,000 feet were dry gas and 11,860,000,000 feet casinghead gas from the Hobbs field. This casinghead gas was processed to extract natural gasoline and then blown into the air, except for about 175,000,000 cubic feet, which were sold for domestic consumption in the towns of Hobbs and Lovington, and approximately 1,500,000,000 cubic feet consumed in field operations.

In northwest New Mexico three gas wells were completed in old fields with a total initial open-flow capacity of about 6,200,000 cubic feet. There was very little waste of gas except for about 12,000,000 cubic feet lost in the Kutz Canyon field in connection with drilling a well. In the Rattlesnake oil field waste of casinghead gas was reduced by returning some of it to the oil sand.

Total sales of gas in 1935 from the producing fields of northwestern New Mexico were as follows, in cubic feet: Blanco 17,717,000, Kutz Canyon 734,779,000 and Ute Dome 680,933,000. This represents an increase of about 22 percent over 1934, to which all three fields contributed.

The New Mexico Oil Conservation Commission was established early in the year by the State legislature and began to function in May. It continued the voluntary proration agreements under which several of the oil pools of the State were being produced and helped to coordinate conservation activities, particularly with regard to reducing the high gas-oil ratios encountered in the southeastern part of the State.

New York.—Exploring for natural gas in New York during 1935 continued at about the same rate as in 1934. According to information supplied by C. A. Hartnagel, assistant State geologist, 59 wells were drilled outside of the old gas fields in 11 counties of the western and central parts of the State. Thirty-three of these were completed as gas wells and 26 as dry holes. At the end of the year 13 wells were drilling, of which 7 were in Allegany County.

The combined initial open-flow capacity of the 33 producers was 278,000,000 cubic feet per day. Of this amount, 95 percent was from 12 Oriskany sand wells drilled in Allegany and Steuben Counties. There has been a marked falling off in production and field activity since 1930 in the old gas fields producing from the Medina and the higher Devonian formations. The development of large high-pressure gas wells in the Oriskany sand in Tioga and Potter Counties, Pa., just south of the New York State line, made available a large new supply of gas at attractive prices in competition with the production of the old small wells. As a result, the movement of natural gas from Pennsylvania into New York State increased from less than 8 billion cubic feet in 1932 to about 25 billion in 1934.

The greatest Oriskany sand development took place in Allegany County, where 10 gas wells were completed and only 8 dry holes. Five producers ranging in size from 7.5 to 34 million cubic feet of daily open flow, were drilled on the Watkins anticline in Willing Township, which borders on Pennsylvania. Total open-flow capacity of these wells was 107 million cubic feet per day. They ranged in depth from 4,500 to 4,900 feet. Three dry holes also were drilled in Willing Township during the year. In Alma Township, which adjoins Willing on the west, five wells were drilled to the Oriskany sand encountered at depths below 4,400 feet. Of these, four were producers with initial capacities of 20, 25, 30, and 34 million cubic feet per day. Nine wells have been drilled to the Oriskany horizon in Allen Township, resulting in four small gas wells and five dry holes.

Of seven Oriskany wells drilled in Steuben County during 1935, five were dry and two were successful. Both gas wells were in the town of Greenwood on the Watkins (Smethport) anticline and were 4,400 to 4,700 feet deep. The initial open-flow capacities of these wells were 35 and 17 million cubic feet per day; the former is thought to be the largest gas well ever drilled in New York.

Interest in natural-gas development in Oneida County was revived by the completion in 1934 of two wells that discovered substantial quantities of gas in the Trenton limestone, topped at approximately 900 feet. During 1935, 19 wells were drilled in search of Trenton gas—11 in the town of Camden, 2 in the adjoining town of Florence, and 6 in Rome, 15 miles southeast. Of these, 13 were completed as gas wells with a combined open-flow capacity of 8 million cubic feet per day. No market outlet was provided during the year, and therefore little is known of the producing ability of any of the Oneida County wells. However, based upon past experience with many Trenton gas wells in the State, these probably would settle down in a short time to relatively small flows that will continue over a period of years.

In the Geneva field, Seneca County, one small additional well was completed in the Niagara limestone. In Lewis County two small Trenton wells were completed in the town of Harrisburg and turned into the pipe line supplying the village of Lowville. In the Wayne-Dundee gas field of Schuyler, Steuben, and Yates Counties, substantial production continues from the eastern sector, where well-spacing followed conservative practice. Depletion is almost complete in the Wayne or western portion, which was subjected to an intensive town-lot drilling campaign. The history of this field presents a prime example of the contrasting results to be obtained from orderly, well-planned development and the wasteful chaos typical of uncontrolled town-lot development.

Ohio.—A decided increase in field development in Ohio during 1935 is indicated by data furnished by A. E. Faine, statistician of the Independent Gas Producers Association of Ohio, and by R. E. Lamborn, of the Geological Survey of Ohio. Drilling was stimulated by a better demand for gas and fundamental improvement in the petroleum industry. There were 1,513 completions, 658 of which are listed as gas wells. This is more than the number of gas wells completed in any other State in the same period and represents more than one-third the total for the United States.

The eastern and southeastern portions of Ohio were the most active areas, owing to continued development of production in the Berea, Clinton, and Oriskany sands. There were 382 completions in the Berea sand, chiefly confined to Athens, Guernsey, Licking, Medina, Meigs, and Columbiana Counties. Of these, about 38 percent were dry.

The largest gas-well completion of the year made 8,500,000 cubic feet from the Clinton sand; it was located in Brushy Creek Township, Muskingum County. Two small gas wells were completed in the Clinton sand in Tallmadge Township, Summit County, and a Clinton sand well in new territory was completed in Franklin Township, Harrison County.

A number of gas completions were recorded in the Oriskany sand field in Guernsey, eastern Muskingum, and Tuscarawas Counties at depths ranging from 3,000 to 3,700 feet. In Madison Township, Columbiana County, a well bottomed at 4,543 feet penetrated 23 feet of Oriskany sand and was completed for about 1,000,000 cubic feet per day from that formation. An Oriskany well with an initial open flow of 648,000 cubic feet was completed in Sugar Creek Township, Stark County.

There was considerable drilling of wells to the shallow sands above the Berea in southeast Ohio, but the percentage of dry holes was high. In the Devonian shale area of Lawrence and Scioto Counties, where very small wells are common, there was little activity, and no important discoveries were made.

A well in Logan County made 110,000 cubic feet from the Trenton limestone at 1,318 feet. This may encourage more drilling in the vicinity.

Estimated production of natural gas in Ohio for 1935 was 53,000,000,000 cubic feet compared with 50,330,000,000 cubic feet in 1934.

Oklahoma.—Drilling in Oklahoma increased about 15 percent in 1935, 110 gas wells being completed, including several important discoveries. Okmulgee, Okfuskee, Pontotoc, and Stevens were the most active counties.

The most important gas discovery well was Franklin no. 1, in sec. 21, T. 10 N., R. 2 W., Cleveland County, which came in on June 26, 1935, with an estimated open flow of 150,000,000 cubic feet of wet gas and a shut-in pressure of 2,750 pounds per square inch. After removal of the distillate, which runs about 1.75 gallons per 1,000 cubic feet, the gas is piped to the Oklahoma City field 4 miles to the north, where it is used chiefly for gas-lift operations.

In August 1935 Jackson no. 1 was brought in in Texas County and made 50,000,000 cubic feet per day. Other gas discoveries reported during the year were as follows: Keaton no. 1, sec. 4, T. 8 N., R. 10 E., Hughes County, had an initial capacity of 4,000,000 cubic feet per day; Haney no. 1, sec. 24, T. 12 N., R. 8 E., Okfuskee County, came in for 15,500,000 cubic feet per day from Wilcox sand; James no. 1, sec. 20, T. 10 N., R. 10 E., Okfuskee County, made 10,000,000 cubic feet from the Hunton lime; Johnson no. 1, sec. 17, T. 1 N., R. 8 W., Stevens County, had an initial open flow of 10,000,000 cubic feet of gas per day; and Bunyard no. 1, sec. 18, T. 7 N., R. 18 W., Pittsburg County, had an initial capacity of 3,500,000 cubic feet per day.

In the Oklahoma City field 40 oil wells were plugged back and completed as gas wells in Pennsylvanian and Simpson sands, with a total capacity of 290,000,000 cubic feet of gas per day. At the end of 1935 about 130 gas wells in the field were producing from these formations.

In the South Burbank oil field, Osage County, a plan of unit operation was put into effect on June 21, 1935, which promises to conserve substantial amounts of gas and oil. Total gas production for the month was 220,834,000 cubic feet, of which 181,702,000 were returned to the producing sand. The operators plan to return as much gas to the reservoir as is withdrawn in connection with the production of oil.

The United States Bureau of Mines "back-pressure" method of determining gas-well capacities was adopted for testing wells in the Oklahoma City and Fitts pools.

There was no important gas pipe-line construction in Oklahoma in 1935.

The Oklahoma Legislature passed laws during the year providing for regulation of well spacing and for consolidating the State's oil and gas activities into one department.

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Pennsylvania.—Field activity in Pennsylvania expanded moderately over 1934 in 1935. Total gas-well completions in 1935 were reported as 177, of which 61 were in southwestern and 116 in northwestern Pennsylvania.

Although the greater part of the drilling was in search of new production from the older shallower sands, it was principally of a routine nature. Chief interest was centered upon attempts to develop additional production from the Oriskany sand. Twenty-seven Oriskany gas wells were completed in three Potter County fields and three in the Farmington field of Tioga County in 1935. Several wells were drilled to the Oriskany in Crawford, Fayette, Greene, and Beaver Counties. The Beaver County well in South Beaver Township was completed as a gas well in the Oriskany at 4,542 to 4,551 in December 1935 after months of difficulty. It developed an open-flow volume of about 1,000,000 cubic feet of gas per day with about 1,900 pounds formation pressure, but salt water broke in from the bottom of the Oriskany sand making it necessary to cement the lower part of the hole. This discovery marks the first flow of Oriskany sand gas of commercial size ever encountered in southwestern Pennsylvania, and is also notable for the fact that substantial amounts of gas were found in the 30-foot and 100-foot sands far to the northwest of other such occurrences. The results obtained from this well in conjunction with the Oriskany sand strikes in Kanawha County, W. Va., northern Pennsylvania, and Columbiana County, eastern Ohio, undoubtedly will stimulate further tests of the Oriskany sand in western Pennsylvania and adjoining areas.

Production of gas from the Oriskany sand in Potter and Tioga Counties increased from 26,129,000,000 cubic feet in 1934 to about 31,000,000,000 in 1935, due entirely to a large increase in production from the Ellisburg field in Genesee and Allegany Townships, Potter County. The Ellisburg field was discovered in 1934 and was actively developed in 1935, when 22 gas wells were drilled, proving about 1,600 acres for production. The field took its place as the third largest Oriskany sand-producing area in the State, Farmington (Tioga County), and Hebron (Potter County) being the two largest.

South Dakota.—The only commercial production of gas in South Dakota continues to be obtained near Pierre and Fort Pierre, where it is consumed locally. The total volume in 1935 was about 8,500,000 cubic feet. Towns in the western part of the State from Rapid City northward continued to be supplied with natural gas by a 12-inch line from the Baker-Glendive gas field in eastern Montana. There was no drilling or pipe-line construction in South Dakota during the year.

Tennessee.—The only commercial natural gas produced in Tennessee occurs with oil in Morgan County; it amounts to a few thousand cubic feet per day and is used in the town of Sunbright. No gas or oil wells were drilled during the year.

During the past 3 years three small gas fields that formerly supplied McMinnville, Fayettesville, and Cookeville were abandoned.

Natural gas used in Memphis and other western Tennessee towns is piped into the State from the Monroe field, Louisiana.

Texas.—Field development in Texas in 1935, which was somewhat more active than in 1934, resulted in the completion of 278 gas wells, of which 80, with a total estimated open-flow capacity of about 2,400,000,000 cubic feet per day, were in the Panhandle field.

The outstanding development of the year was the enactment by the Texas Legislature of house bill 266, prohibiting waste in the production, transportation, and use of natural gas. An immediate result of this law was a substantial reduction in the colossal waste of natural gas in the Panhandle field. During the first 7 months of 1935 more than 1,000,000,000 cubic feet of gas per day had been blown to the air. This was curtailed in the last 5 months to less than 600,000,000 cubic feet per day and was reduced further in early 1936. Litigation over provisions of the law followed its application to field operations, with the result that the conservation section permitting the fixing of gas-oil ratios has been upheld in Federal court, but the ratable-taking provision was held void.

The rock pressure of the Panhandle reservoir, as determined by well tests, declined from an approximate initial of 430 pounds per square inch to about 280 pounds at the end of 1935, indicating that more than one-third of the original gas content of the reservoir already has been withdrawn. There was increasing evidence of water encroachment in the field in 1935, which, with the large pressure drop in the sand, emphasizes the damage already done to this important resource and the real need for methods of proper conservation in the future.

An important gas discovery marked the completion of Davey & Royall no. 1—7 miles southeast of Palestine, Anderson County, which made 50,000,000 cubic feet of gas, with some distillate, from the sub-Clarksville sand. Other Anderson County developments in 1935 were the discovery of 5,300,000 cubic feet of gas, with 130 barrels of distillate, from a deep sand in the Cayuga field and southward extension of the Long Lake gas area. The Cass County extension of the Rodessa (La.) oil field was opened up late in 1935 and has already proved an important source of both oil and gas.

In West Texas a rank wildcat—B. Page no. 1—encountered 13,800,000 cubic feet of wet gas in the Pennsylvanian section at 5,399 to 5,540 feet. The well is in Schleicher County 10 miles southeast of Eldorado, to which the gas was piped. A few miles north of Brady, in McCulloch County, a well was completed for 6,000,000 cubic feet of gas per day from the shallow depth of 635 feet.

Two gas discoveries were reported from Bee County and two from Jim Wells County, southwest Texas. The largest of the Bee County wells was Foley no. 1, which made 20,000,000 cubic feet of gas from the Hockleyensis zone at 3,445 feet. Large additions to available gas reserves were developed on the Texas gulf coast, where 10 oil fields with large gas-producing capacity were discovered.

Several natural-gas pipe lines were built in Texas in 1935, the largest being a 20-inch line from the Long Lake and Cayuga fields to Irving Station just west of Dallas, a distance of 109 miles. Rated capacity of the line is about 100,000,000 cubic feet per day. No pumping stations are needed because of the high reservoir pressure in the producing fields. A line was laid to connect the gas area in the southern part of the East Texas field to a utility trunk line. In the Panhandle 22 miles of 24-inch line were built from the Dumas field, Moore County, to gasoline plants in Hutchinson County.

Thirty-five miles of 4-inch line were laid from the Samfordyce field in the Rio Grande Valley to industrial plants in Hidalgo County.

An interesting operation was carried on in the old Cheaney field 5 miles south of Ranger in Eastland County, where a gas-utility company stored about 1,000,000,000 cubic feet of gas in the sand during the summer for use during the winter period of heavy demand.

Utah.—During 1935 there was very little natural-gas activity in Utah according to information supplied by E. W. Henderson, engineer of the U. S. Geological Survey, Salt Lake City. No gas wells were completed either in proven or wildcat territory in 1935. The growth of the industry is hampered by limited markets and the great expense involved in bringing developed gas to them. On this account the Last Chance field in Emery County and the deep gas in the Clay Basin field in Daggett County, both important discoveries of 1934, remained shut in.

In the Ashley Valley field repairs to the producing wells helped to reduce water troubles and increased the gas pressure in the sand. Ashley Valley was the only field in the State that produced natural gas in 1935. Total 1935 production from this source was 45,663,100 cubic feet, all of which was used for domestic purposes.

The old carbon-black plant, which operated on gas from the Cisco field, Grand County, was dismantled during the year. All the wells probably will be plugged and the field abandoned in 1936.

A plant for the manufacture of liquid and solid carbon dioxide from the carbon dioxide gas produced from the Farnham structure in Carbon County was constructed during 1935. It has a capacity of 10 tons of solid and 15 tons of liquid carbon dioxide in 24 hours. Carbon dioxide production from the Farnham field in 1935 was 22,787,000 cubic feet. All of this was utilized for industrial purposes and represents the total production of such gas in Utah for the year.

Washington.—No significant change took place in the natural-gas situation in Washington during 1935. The following information was supplied by Harold E. Culver, supervisor of geology, Department of Conservation and Development, Pullman, Wash.

The Rattlesnake Hills field, Benton County, continued to be the only source from which natural gas is being withdrawn for use on a commercial scale. A total production of just over 200,000,000 cubic feet, a material increase over 1934, was obtained from 15 wells and piped to seven towns in the Yakima Valley.

Work continued on three wildcat wells in eastern Washington—one at Union Gap, one at Wenatchee, and one on the Frenchman Hills anticline in Grant County. No additional gas was developed in the Shallow Gas field near Bellingham, Whatcom County, in western Washington. A well on the King lease at the south end of the field, however, found shows of gas with salt water from deeper sands.

Work continued on a well near Vesta, Grays Harbor County, and arrangements were made for completing Rosalie No. 1 in Clallam County, which has been standing for some time, having reported a large flow of gas at 2,350 feet.

Carbon dioxide gas is produced from shallow wells drilled near carbon dioxide-producing mineral springs in the canyon of the Klickitat River, Klickitat County, about 2 miles above the town of Klickitat. About 30,000 cubic feet per day were utilized during 1935 in a plant equipped to produce 3 tons per day of "dry ice." Production of "dry ice" was begun in May 1932 and amounted to 199,867 pounds in that year. The 1933 and 1934 production was 414,282 and 630,391 pounds, respectively.

West Virginia.—The most significant natural-gas activity in West Virginia during 1935 was the drilling of a number of successful Oriskany sand wells in Elk, Louden, and Malden districts of Kanawha County. Information is taken from a report prepared by D. D. Reger, consulting geologist, Morgantown, W. Va.

No new gas fields were discovered, but there were important extensions of producing areas in Cabell, Calhoun, Kanawha, Raleigh, Ritchie, Wetzel, and Wood Counties. A total of 417 gas-well completions was reported in 28 counties with a total open-flow capacity of 255,485,000 cubic feet per day. The three most active counties were Ritchie, Calhoun, and Cabell, which accounted for 172 gas wells.

Prior to 1935, five small gas wells and one oil well had been completed in the Oriskany sand in Kanawha County at depths of about 4,800 to 4,900 feet. Because of the small volume of the gas wells no great activity was stimulated until 1934, when an oil well good for 158 barrels per day was completed. This discovery of the first substantial quantity of oil ever encountered in the Oriskany sand was followed by intensive exploratory activity. Sixteen wells were drilled in 1935, including 10 gas wells with a total open-flow capacity of 27,641,000 cubic feet per day and rock pressures up to 1,900 pounds. The remaining six wells were dry holes. Two more gas wells were completed in January 1936, and 16 were drilling. Limits of the field are not yet defined, but development thus far appears to have proven about 7,000 acres for production. The gas accumulation occurs on the northwest flank of the Warfield anticline at a point where a low crossfold intersects it, probably forming a low dome. Vertical reflection shooting with the seismograph has been helpful in determining the structural attitude of the producing sand in advance of drilling. Expansion of the markets for West Virginia natural gas resulted in an increase in deliveries of about 10 percent over 1934. Pipe-line construction was limited to minor extensions.

Wyoming.—The principal development in the natural-gas industry in Wyoming during 1935 was a 20-percent increase in production brought about by better market demand, particularly from industrial consumers. The accompanying information is taken from a report by H. J. Duncan, supervisor, United States Geological Survey, Casper, Wyo.

Although no new gas fields were discovered, Kyle No. 1, the discovery well of the Medicine Bow oil field, Carbon County, opened up a substantial new gas supply. It developed an open-flow volume of 81,000,000 cubic feet with a closed-in pressure of over 1,900 pounds per square inch from the first Sundance sand at 5,157 to 5,207 feet. This well made about 6,000 barrels of oil per day from the second Sundance sand, and its mechanical equipment was arranged to permit production of either oil or gas or both at the same time. As this location is only 5 miles from the Allen Lake-Laramie gas line it is accessible to markets when more gas is needed.

An additional gas supply was developed in the Lance Creek field, Niobrara County, from the basal Sundance sand. The gas is processed for extraction of gasoline and then used for field operations and in the carbon-black plant, which consumed an estimated 2,400,000,000 cubic feet in 1935. A new natural-gas line was laid from Clayton in eastern Wyoming to Scottsbluff and other towns in western Nebraska, a distance of 215 miles. This was necessary to replace an old oil line that had been leased for the transmission of gas during the past few years but which was again required by its owners for the movement of petroleum. The new line consists of various sizes of pipe from 12 inches down to 2⅜ inches (at delivery points).

Only seven gas wells were completed in Wyoming during the year, all in oil fields. As the existing pipe lines have ample reserves of gas to meet their market requirements in this sparsely populated region, there is not much incentive for new gas development.

It is estimated that of the approximate 30,000,000,000 cubic feet of gas produced in Wyoming during 1935 about 8,000,000,000 cubic feet were used for domestic and 15,000,000,000 for industrial and commercial purposes. In the Salt Creek field 10,239,042,000 cubic feet of gas were produced and put through gasoline plants. Of the residue, 6,439,764,000 cubic feet were returned to the oil sands for gas-drive purposes; 1,738,000,000 cubic feet were used as fuel in field operations; and 350,000,000 were piped to domestic and commercial markets. Big Sand Draw, Lance Creek, North Baxter Basin, South Baxter Basin, and Wertz fields produced between 2 and 3 billion cubic feet of gas in 1935. Smaller amounts were produced by 16 other fields within the State.

Generally, operations are well-conducted with due regard for conservation of gas because operators are convinced that it will be of ultimate benefit to them. It is estimated that less than 1,000,000 cubic feet per day of "dry" gas were wasted in the gas fields through drilling losses, blowing water from wells and drips, and miscellaneous leaks in 1935. As a result of improved conservation methods in oil production it is thought that losses of casinghead gas were reduced further during 1935 to little more than 500,000 cubic feet per day.

CONSUMPTION

Treated for natural gasoline.—Most natural gas contains enough of the heavier hydrocarbons to justify extracting the natural gasoline; furthermore, the treating improves the piping qualities of the gas. In most recent years the quantity of natural gas treated for natural gasoline has exceeded the quantity marketed; in other words, the wastage of residue gas has more than balanced the production of "dry" gas too lean to treat.

In 1934 the average yield of natural gasoline from natural gas was 0.86 gallon per thousand cubic feet, with the trend in yields downward. Assuming a yield of 0.85 for 1935, about 1,900,000,000,000 cubic feet of natural gas were treated in that year. This is exceeded only by the totals of 1929 and 1930.

Domestic and commercial.—Domestic sales provide the major portion of the revenue derived from natural gas, although the volume is only equivalent to about 15 percent of the total consumption. Such sales for 1935 have been estimated at 310,200,000,000 cubic feet valued at $230,168,000, increases over 1934 of 8 and 7 percent, respectively. Commercial consumption, which represents quantities used in schools, hotels, libraries, etc., is also believed to have increased substantially in 1935 in both quantity and total value, but the average price probably declined slightly.

Field.—The utilization of natural gas for drilling, pumping, and the many other operations requiring fuel in the oil and gas fields constitutes the largest single element in consumption. In 1934 the field consumption was 554,542,000,000 cubic feet (31 percent of the total); for 1935 it has been estimated as 572,691,000,000 cubic feet (3 percent more than in 1934). This increase is related to an 18-percent gain in number of wells completed and to a 2- or 3-percent gain in number of operating wells.

Carbon black.—No type of black has yet been developed to replace carbon black in the manufacture of tires, inks, and numerous other articles. Furthermore, no better way of producing carbon black has been found than by the channel process, which in producing a black of the quality desired converts only a small fraction of the element carbon into black. Accordingly, the demand of the carbon-black industry for natural gas has kept pace with the increasing consumption of rubber. In 1935 the demand was for 241,589,000,000 cubic feet—not a record, but 5 percent above consumption in 1934.

Petroleum refineries.—The 500 or more petroleum refineries in the United States are large consumers of heat, and natural gas is the primary fuel at many of these plants. In 1925, the first year for which data on fuel consumption at refineries are available, natural gas supplied 15 percent of the total heat utilized; the peak was reached in 1927 at 21.7 percent, but the percentage gradually declined until it reached 12.3 percent in 1933. In 1934 it rose to 14.7 percent, indicating that refiners are finding it more economical to use natural gas than oil and refinery gas, which can be converted into more valuable products. The consumption of natural gas at petroleum refineries in 1935 is estimated at 86,000,000,000 cubic feet, an increase of about 7 percent over 1934.

Electric public-utility power plants.—Natural gas is used as fuel in generating electricity at about 180 public-utility power plants in the United States. According to the United States Geological Survey, which maintains a record of this type of consumption, these plants utilized 125,239,000,000 cubic feet of natural gas in 1935, a slight decline from the consumption in 1934, which had shown a marked increase over 1933. Coal is the primary fuel at these plants, but the use of fuel oil showed the largest increase in 1935 over 1934.

Portland cement plants.—The output of portland cement in 1935 (about 76,751,000 barrels) was slightly below that in 1934; likewise, the consumption of natural gas as fuel declined slightly—from 27,331,-000,000 cubic feet in 1934 to 26,981,000,000 in 1935.

Other industrial.—Large quantities of natural gas are used as fuel in the manufacture of glass, ceramics, terra cotta, steel goods, and numerous other articles where an accurate control of temperature and a virtual absence of foreign material in the fuel are essential. Most of the business commands a price of 10 to 35 cents a thousand, which is probably not much above the cost; however, this business serves to improve the load factor, as considerable is carried through the summer, when the domestic and commercial demands are at their low points. It is estimated that 405,000,000,000 cubic feet of natural gas were consumed for miscellaneous industrial purposes in 1935, an increase of about 11 percent over 1934.

SALES PROMOTION

The industry continued to stress with increasing force the development of broader markets for natural gas and the closely related problem of improving public relations. The most potent ally of the sales campaign in recent years in increasing revenue per customer has been the promotional or inducement type of rate schedule that was more widely used in 1935 than at any previous time. These modern rate schedules are based upon data obtained from detailed surveys of customers in the various income groups, which are analyzed to determine the degree of saturation of markets for each type of load, customers' habits, financial competence, and other pertinent facts. Rates and "demand blocks" of gas are adjusted with definite new-load objectives in view, and a variety of advantages are offered to customers to induce them to use gas for all three principal domestic purposes—cooking, water heating, and space heating. The use of the promotional rate schedule stimulates the use of gas appliances and serves to improve greatly the competitive position of gas with respect to electricity for many domestic purposes. The simplification of rate structures, toward which increased private and public attention was directed during 1935, should also aid in solving marketing problems.

Sales of household gas appliances increased decidedly in 1935 as a result of selling campaigns and closer cooperation with dealers. Renewed efforts were directed toward improved efficiency of commonly used appliances and the creation of new types of industrial equipment which utilize natural gas, through research and cooperative study with manufacturers and potential customers. The varied and rapidly developing processes for heat-treating of metals encompasses a field with great potentialities for expansion of natural-gas sales. Newer uses for natural gas, such as air conditioning, refrigeration, as a raw material in chemical processes, and in enameling sheet steel, are growing factors in demand.

COMPETITIVE POSITION

Natural gas competes with all the other fuels—coal, oil, manufactured gas, wood, electricity, and liquefied petroleum gases—at numerous places and in varying degrees, but the competition is not, in the aggregate, as great as is generally supposed, as most of the natural gas is used near the sources of supply. Volumetrically, the most important use of natural gas is as fuel in drilling and operating wells; otherwise most of this gas probably would be wasted. Some natural gas competes with oil in the fields, but this competition has local importance only. About 13 percent of the total natural gas produced is used in the manufacture of carbon black, in which class of consumption the other fuels cannot compete. About 5 percent is used as fuel at petroleum refineries in competition with oil, refinery gas, and some coal. About 8 percent is used at cement plants and at public-utility power plants in competition with oil generally and with coal in a few areas. A large percentage is used for domestic, commercial, and miscellaneous industrial purposes in States that produce little coal. Considerable natural gas is used for industrial purposes for which coal and perhaps oil would be unsuitable.

Eliminating the natural gas used in the field that otherwise would be wasted and evaluating the competition of natural gas with oil and coal in the major classes of consumption leads to the conclusion that only a minor part of the natural-gas produced competes with coal.

Natural gas owes much of its popularity to its convenience, with price of secondary importance. People would use it in preference to coal for cooking even though the disparity in price were materially greater. Direct competition with coal, therefore, may be reduced to that involving relatively small parts of the domestic and industrial loads, with most of the displacement of coal represented in the industrial sales of a few interstate lines. This displacement is probably not more than 5,000,000 short tons of coal per year, equivalent to 2 or 3 days' output.

The competition of the sister fuels, fuel oil and natural gas, does not invite as much comment as the competition of both of them with coal for several reasons—first, because they are produced by much the same companies; second, because the expansion in fuel-oil sales in the domestic field has occurred mainly beyond the reach of natural-gas lines; and third, because there has been no material overproduction of fuel oil in recent years.

The competition of natural gas with manufactured gas, which in some respects represents competition with coal, has been fairly severe in some areas, but most of the large cities using manufactured gas, like New York, Philadelphia, and Boston, have not been reached by natural-gas lines.

The competition of electricity with oil is of minor importance, but many electric ranges and water heaters may be found within reach of natural-gas lines. Electricity dominates the lighting field regardless of price, but its advances into the heating field have been hard won.

Sales of liquefied gas, a concentrated form of natural gas, have increased rapidly in recent years, but most of this is sold in communities beyond the reach of gas lines and does not compete with natural or manufactured gas. The competition of this fuel does not worry producers of coal and oil, as the quantities involved are not large and the development of polymerization, a process of converting the lighter hydrocarbons into gasoline, forecasts a restriction in supply.

PIPE-LINE DEVELOPMENTS

Natural-gas pipe-line construction in 1935 was confined largely to small extensions and replacements of existing facilities. The largest project was the laying of about 215 miles of 12-inch and smaller pipe from Clayton, Wyo., to western Nebraska to replace an old line being returned to service as an oil line. In Texas a 109-mile, 20-inch gas line was laid from the Long Lake field, Anderson County, to Irving Station west of Dallas; also, 22 miles of 24-inch welded line were laid from the Dumas field, Moore County, to gasoline plants in Hutchinson County. Several gas pipe lines were built in California, the largest of which was a 46-mile, 22-inch line running northward from Milpitas meter station to San Francisco, parallel to an existing line. Further details of gas pipe-line construction in 1935 are given in the review of the natural-gas industry by States.

The interstate movement of natural gas undoubtedly continued to expand in 1935 following the all-time peak registered in 1934. Regulation of this phase of the industry was recommended in the report of the Federal Trade Commission on its investigation of the natural-gas industry.

ACKNOWLEDGMENT

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NATURAL GASOLINE[1]

By G. R. Hopkins

SUMMARY OUTLINE

The natural-gasoline industry had a fairly prosperous year in 1935, and probably more optimism was shown during the last 9 months than during 1933 and 1934 combined. The turning point was reached about the end of March, when most refinery prices of gasoline stiffened perceptibly. At that time, spot natural-gasoline prices were hovering around 2 cents, but before the end of the year they had increased approximately 100 percent. The increase in prices of natural gasoline in the spring of 1935 was initiated by, and moved in sympathy with, the increase in refinery prices of gasoline; however, much of the market strength of natural gasoline in the middle of the year can be attributed to an increased demand, the sales resistance of many refiners who had been reluctant to use even the natural gasoline made by affiliated companies or departments being virtually eliminated. Much of this sales resistance was overcome by a wider public acceptance of a more volatile gasoline and the growing realization by refiners that the desired volatility could be obtained more cheaply from natural gasoline than from cracked and re-formed gasoline. Consequently, the consumption of natural gasoline by refiners increased 10.7 percent in 1935 over 1934.

[1] Figures for 1935 are preliminary; detailed data with final revisions will be released later.

Salient statistics of the natural-gasoline industry, 1934–35

[Thousands of gallons]

	1934	1935[1]	Percent of change in 1935
Production:			
Appalachian	58,601	63,322	+8.1
Illinois, Kentucky, and Michigan	8,570	10,070	+17.5
Oklahoma	355,438	379,428	+6.7
Oklahoma City	102,591	120,336	+17.3
Other districts	252,847	259,092	+2.5
Kansas	27,891	32,177	+15.4
Texas	466,570	504,160	+8.1
Panhandle	256,130	271,635	+6.1
East Texas	46,280	77,907	+68.3
Other districts	164,160	154,618	−5.8
Louisiana	40,558	48,718	+20.1
Arkansas	13,033	13,191	+1.2
Rocky Mountain	58,427	53,550	−8.3
California	506,272	527,420	+4.2
Kettleman Hills	152,434	154,383	+1.3
Other districts	353,838	373,037	+5.4
Total production	1,535,360	1,632,036	+6.3
Stocks:			
At plants and terminals Jan. 1	41,664	56,126	
At plants and terminals Dec. 31	36,100 [2] 56,126	69,090	+23.1
Net change	−5,564	+12,964	
At refineries Jan. 1	112,896	120,960	
At refineries Dec. 31	120,960	86,226	−28.7
Net change	+8,064	−34,734	
Total Jan. 1	154,560	177,086	
Total Dec. 31	157,060 [2] 177,086	155,316	−12.3
Net change	+2,500	−21,770	
Total supply[3]	1,532,860	1,653,806	+7.9
Distribution:			
Blended at refineries:[4]			
East coast	54,894	60,606	+10.4
Appalachian	11,928	13,104	+9.9
Indiana, Illinois, Kentucky, etc	98,616	130,662	+32.5
Oklahoma, Kansas, and Missouri	246,708	264,516	+7.2
Texas inland	171,318	177,912	+3.8
Texas Gulf coast	95,340	102,732	+7.8
Louisiana Gulf coast	9,702	12,516	+29.0
Arkansas and Louisiana inland	22,596	18,354	−18.8
Rocky Mountain	33,726	35,280	+4.6
California	387,324	437,052	+12.8
Total blended at refineries	1,132,152	1,252,734	+10.7
Run through crude-oil pipe lines in California	50,652	31,290	−38.2
Exports Sales to jobbers and retailers	214,242	271,446	+26.7
Losses	135,814	98,336	−27.6
Total distribution	1,532,860	1,653,806	+7.9

[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.

Although the change in the attitude of refiners might have been expected to curtail exports and restrict the activities of natural-gasoline manufacturers selling direct to retailers and jobbers, both classes of shipments also increased in 1935 over 1934.

Although the production of natural gasoline increased from 1,535,-360,000 gallons in 1934 to 1,632,036,000 gallons in 1935, or 6.3 percent, the gain in demand was greater, and stocks were reduced from 177,086,000 gallons at the beginning of 1935 to 155,316,000 gallons on December 31, 1935.

California retained first place among the producing States, although its margin over Texas, which ranked second, was reduced. The leading producing district was the Texas Panhandle, where production gained 6 percent over 1934 despite practically continuous efforts to prevent the "popping-off" of residue gas. However, considerable progress, both technically and legally, was made in laying a sound conservation program in the Panhandle district.

The liquefied-gas industry, which has been built up mainly by manufacturers of natural gasoline, continued its rapid expansion in 1935;

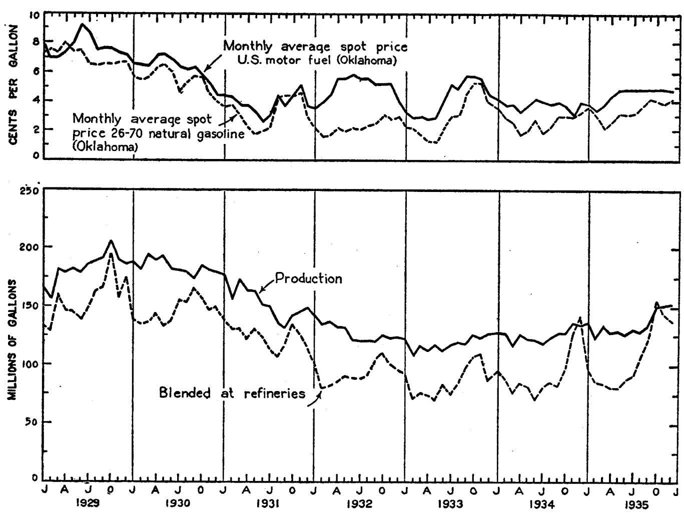

FIGURE 109.—Trends in production, blending at refineries, and prices of natural gasoline, 1929–35, by months.

76,855,000 gallons of propane, butane, and pentane were marketed compared with 56,427,000 gallons in 1934.

PRICES AND MARKET CONDITIONS

In many respects the middle of 1935 marked a turning point for the natural-gasoline industry. For several years prior the industry had been beset almost continually by at least one major problem, such as overproduction due to the discovery of flush oil fields, serious declines in gasoline prices, or threatened loss of markets due to increased cracking, re-forming, and production of absorption gasoline from refinery gas. To obtain relief, the natural-gasoline operators formed "Committee J" of the Planning and Coordination Committee under the code to "see that natural gasoline received due consideration when allocations for motor-fuel production were made." Invalidation of the code dissolved Committee J, but by that time the economic situation had begun to improve. Later gains in prices definitely put most of the plants on a paying basis, hence the industry as a whole has been noticeably silent for the past year on the subject of economic relief.

Data on the average value of natural-gasoline production at the plants are not available for 1935. However, if the relationship that existed between f. o. b. values and spot prices in 1934 was maintained in 1935, the average probably was not far from 4.5 cents per gallon compared with 3.9 cents per gallon for 1934.

A study of spot prices for 26–70 natural gasoline in Oklahoma in 1935 indicates a gradual recession in quotations in the first quarter. This decrease in prices undoubtedly was related to the rapid increase in stocks following the seasonal decline in consumption. Prices strengthened slowly but steadily from April until October, when there was a slight slump in quotations. The loss was recovered in December, when the high quotation for this grade in 1935 (4.25 cents per gallon) was reached. This was more than double the low price (2 cents) in March. The gain in natural-gasoline prices, which was particularly noticeable because it began just before April and May, the low months in demand, was related to the upward trends in motor-fuel prices and gasoline consumption. (See fig. 109.)

Spot price of Oklahoma natural gasoline, grade 26–70, on specified dates in 1935, with monthly and yearly averages, in cents per gallon

[National Petroleum News]

Date	Cents	Date	Cents	Date	Cents
Jan. 1	3.63–3.75	May 6	3.13	Sept. 3	4.13
Jan. 7	3.50–3.63	May 13	3.13	Sept. 9	4.13
Jan. 14	3.50	May 20	3.00	Sept. 16	4.13
Jan. 21	3.50	May 27	3.00	Sept. 23	4.13
Jan. 28	3.50	Average	3.06	Sept. 30	4.13
Average	3.52	June 3	3.00	Average	4.13
Feb. 4	3.50	June 10	3.00	Oct. 7	4.13
Feb. 11	3.13–3.38	June 17	3.00	Oct. 14	4.13
Feb. 18	2.75	June 24	3.13	Oct. 21	4.00
Feb. 25	2.38	Average	3.03	Oct. 28	3.75–3.88
Average	2.97	July 1	3.13	Average	4.02
Mar. 4	2.13–2.25	July 8	3.13	Nov. 4	3.75–3.88
Mar. 11	2.00	July 15	3.13	Nov. 11	3.88
Mar. 18	2.13	July 22	3.13	Nov. 18	4.00
Mar. 25	2.13	July 29	3.13	Nov. 25	4.00–4.13
Average	2.11	Average	3.13	Average	3.94
Apr. 1	2.13	Aug. 5	3.38	Dec. 2	4.13
Apr. 8	2.25–2.38	Aug. 12	3.50	Dec. 9	4.25
Apr. 15	2.50–2.63	Aug. 19	3.75	Dec. 16	4.25
Apr. 22	2.75	Aug. 26	4.00	Dec. 23	4.00
Apr. 29	2.75	Average	3.66	Dec. 30	3.63–3.75
Average	2.50			Average	4.06
				Average, 1935	3.34
				1934	2.60

The close relation between natural-gasoline and motor-fuel prices was illustrated in 1935 by the fact that both increased materially and on about the same dates. Natural-gasoline prices recovered most, hence the differential of 1 to 2 cents in favor of motor-fuel prices was reduced somewhat in 1935.

PRODUCTION BY STATES AND FIELDS

Nearly all the States and all districts but one increased their output of natural gasoline in 1935 over 1934. The only district with a decrease was the Rocky Mountain, where production declined 8.3 percent. The gain in output in 1935 was closely related to the 9.5-percent gain in crude-oil production which made more casinghead gas available for processing, but the gain in the "dry" gas area of the Panhandle should be credited largely to the natural-gasoline industry. In spite of the fact that output of crude oil in the Rocky Mountain district increased in 1935, the supply of natural gas for processing was apparently lower. This decline may have been related to a gain in the relative importance of heavy-oil fields with low gas-oil ratios.

California remained the leading State in production of natural gasoline, but Texas was a close second. Production in Texas increased from 466,570,000 gallons in 1934 to 504,160,000 in 1935 (8.1 percent), whereas output in California rose from 506,272,000 gallons in 1934 to 527,420,000 in 1935 (a gain of only 4.2 percent). Oklahoma continued to rank third in natural-gasoline production; its gain of 6.7 percent in 1935 offset much of the loss incurred from 1931 to 1934. California, Texas, and Oklahoma together produced 86 percent of the total output in 1935.

Texas.—The Texas Panhandle is by far the most important single area in natural-gasoline production. The daily average output in the Panhandle in 1935 was 744,000 gallons compared with 702,000 in 1934. According to A. L. Foster of the National Petroleum News the daily average production of natural gasoline at the "stripper" plants in the Panhandle was about 300,000 gallons in 1935, from which it may be deduced that if the conservation laws of Texas that prohibit the "popping off" of residue gas had been completely effective throughout 1935 the output in the Panhandle would possibly have declined as much as 40 percent. However, the validity of the law forbidding such waste was subjected to court attacks in 1935, and in only 1 month (August) was stripping reduced materially. In that month the "conservationists" scored two major victories, one when a Federal court upheld the validity of the orders promulgated by the Railroad Commission of Texas regulating the production of natural gas from the Agua Dulce field in Nueces County and the other when the Third Court of Civic Appeals granted a temporary order restraining certain stripper companies from exceeding the allowables fixed by the Texas Railroad Commission. Consequently, the daily average production in the Panhandle declined from 745,000 gallons in July to 529,000 in August but rose to 650,000 gallons in September.

Because the East Texas field has a low average gas-oil ratio, at first it was not considered seriously as a producer of natural gasoline, but the field has surprised even the most skeptical by becoming a leading source of supply. Most of this rise to prominence occurred in 1934 and 1935, when East Texas made the largest gains in output of any field of importance. Competition for gas supplies was considerable in East Texas in 1935, and it was the only area in the United States where much new construction was done in that year. Production in East Texas in 1935 was 77,907,000 gallons—68.3 percent more than that in 1934.

California.—In spite of a material increase in crude-oil production in the last half of the year, production of natural gasoline at Kettleman Hills was only about 1.3 percent higher in 1935 than in 1934. More crude oil was produced in both the Long Beach and Santa Fe Springs fields in 1935 than in 1934, but only in Long Beach did this result in an increase in production of natural gasoline.

Oklahoma.—The policy of conserving gas in the Oklahoma City field through improved technique, which was responsible for much of the increase in output in 1934, again influenced production, which rose from 102,591,000 gallons in 1934 to 120,336,000 in 1935. The favorable market in 1935 affected production in the older fields of Oklahoma; for example, output in both the Seminole and Osage fields increased over 1934.

Louisiana.—The gain in output was largest in Louisiana, where production in 1935 (48,718,000 gallons) was 20.1 percent above that in 1934. This increase was somewhat surprising, as nearly all the increase in production of crude oil in Louisiana in 1935 occurred in the coastal fields, where the gas situation has been such as to attract only one natural-gasoline plant.

West Virginia.—The output of natural gasoline in West Virginia continued to reflect the increased demand of pipe-line companies for gas and rose from 41,854,000 gallons in 1934 to 44,468,000 in 1935.

Kansas.—The increase in production in Kansas, which began in 1932, was continued in 1935, when the output (32,177,000 gallons) was 15.4 percent higher than in 1934. The steady rise in the last 4 years undoubtedly has been related to the westward migration of oil producers to areas of higher gas-oil ratios.

CONSUMPTION

Blending at refineries.—The ratio of natural gasoline handled at refineries (including receipts by pipe line) to total gasoline production increased in 1934 over 1933, but declined from 6.75 percent in 1934 to 6.68 in 1935. This decrease, in the face of a material gain in the amount of natural gasoline handled, was due to the fact that total production of gasoline was larger.

The quantities of natural gasoline blended increased in every district except Arkansas-Louisiana Inland. Blending in the Arkansas-Louisiana Inland district declined 18.8 percent in 1935 contrasting with an increase of 32.2 percent in 1934 over 1933. The gains in 1935 ranged from 3.8 percent for Texas Inland to 32.5 percent for Indiana-Illinois, which had gained 31.5 percent in 1934.

The only districts having a consistent trend in the percentages of natural gasoline blended in refinery gasoline are the East Coast and Rocky Mountain. In the East Coast district the ratio has increased from 0.9 percent in 1932 to 2 in 1935. The gain in percentage is small, but when applied to the production of that district the gain in amount of natural gasoline is material. Between 1932 and 1935 the ratio for the Rocky Mountain district declined from 12.4 to 7.9 percent. This decrease reflects principally the decline in gas production at Salt Creek.

Percentage of natural gasoline blended in refinery gasoline, 1932–35, by districts

Year	East Coast	Appalachian	Illinois, Indiana, Kentucky	Oklahoma, Kansas, Missouri	Texas Inland	Texas Gulf Coast	Louisiana Gulf Coast	Arkansas and Louisiana Inland	Rocky mountain	California	Total
1932	0.9	2.2	3.0	9.4	11.5	4.8	5.3	9.6	12.4	14.5	6.71
1933	1.6	1.4	2.8	9.0	11.0	3.5	2.0	4.8	10.1	15.6	6.31
1934	1.9	2.3	4.8	10.5	12.2	2.9	1.6	6.0	9.0	16.2	6.75
1935	2.0	1.6	4.1	10.1	12.5	2.7	1.8	5.7	7.9	16.1	6.68

Pipe-line shipments.—Although information is lacking on shipments of natural gasoline by pipe line east of California, the practice is believed to have expanded materially in the last 5 years, as the major companies have realized that it was an economical means of obtaining volatility. On the other hand, the mixing of natural gasoline with crude or other oils in California for shipment to refineries by pipe line declined materially in 1935, when only 31,290,000 gallons were so moved compared with 50,652,000 gallons in 1934.

Most of the shipping of natural gasoline by pipe line east of California is done by about nine major companies. It is estimated that these companies moved 85,000,000 gallons of natural gasoline by pipe line in 1935; some was mixed with crude and some with gasoline. Of that quantity most was moved to refineries for blending, although probably some was marketed at the terminals as motor fuel.

Water-borne shipments.—Only two classes of water-borne movements of natural gasoline are now important—exports and shipments from the Gulf coast to the East coast. No natural gasoline was moved from California to the East coast in 1935. Exports of natural gasoline (including tank-car sales to Canada), as reported to the Bureau of Mines, totaled 122,241,000 gallons in 1935. This was equivalent to 9.9 percent of the total exports of motor fuel, a somewhat higher ratio than that of the natural-gasoline fraction to refinery gasoline. Exports of natural gasoline were not reported to the Bureau by the companies in 1934, but according to the Bureau of Foreign and Domestic Commerce they rose from 62,748,000 gallons in 1934 to 69,510,000 in 1935, an increase of 10.8 percent. The United Kingdom was the leading purchaser of natural gasoline from the United States in 1935; but the largest increase over 1934 was recorded in exports to Spain, which were nearly 9,000,000 gallons in 1935 compared with none in 1934. Exports to Canada, most of which probably moved by tank car, totaled 20,435,000 gallons in 1935 compared with 28,706,000 in 1934.

Receipts of natural gasoline on the East coast in 1935, of which most was moved in tankers, totaled 61,109,000 gallons. Of this total, 58,739,000 gallons were consigned to refineries for blending. These figures cannot be compared with those for 1934, which are not available, but an increase is indicated in 1935.

Sales to jobbers and retailers.—Most natural-gasoline producers would like to sell their entire output of natural gasoline directly to motorists at retail-gasoline prices. Few if any producers have realized their ambition, although many have tried. The most favorable time for the attempting to do so is when prices are low and refinery men apathetic to blending natural gasoline. However, the discontinuance of refinery outlets is more of a threat to producers than a promise, as the manufacture of a natural gasoline suitable for direct use as motor fuel is costly, as also are its handling and marketing. Consequently, "direct" sales of natural gasoline have increased more slowly than operators hoped; however, the incomplete data at hand indicate a gain in "direct" shipments of natural gasoline from about 105,000,000 gallons in 1934 to 150,000,000 gallons in 1935.

Stabilized natural gasoline is consumed directly for motor fuel in nearly every State but principally in the Mid-Continent area and the North Central States. According to the following table Texas leads both as a shipper and consumer of low-vapor-pressure natural gasoline and Minnesota is the largest nonproducing consumer.

Shipments to jobbers, retailers, and refinery-owned bulk plants by States, 1935

[Thousands of gallons]

Point of delivery	Point of receipt							Total
	Texas	Oklahoma	Minnesota	West Virginia	Arkansas	Ohio	Other	
Texas	13,025	44	5,300			225	12,962	31,556
Oklahoma	294	10,117	3,493		23	94	10,266	24,287
West Virginia				7,693		811	5,831	14,335
Arkansas		423			6,242		475	7,140
Louisiana	701	1,076	24		452	8	2,808	5,069
Pennsylvania				2		1,114	3,809	4,925
Other		78	283	23	37	3,519	25,032	28,972
Total	14,020	11,738	9,100	7,718	6,754	5,771	61,183	116,284

STOCKS

The influence of stocks on prices has been somewhat vague at times, but it is reasonably certain that the decline in stocks in 1935 steadied the market and helped to sustain the price advances initiated largely by the posting of higher quotations for refinery gasoline.

Total stocks of natural gasoline declined from 177,086,000 gallons on January 1 to 155,316,000 on December 31, 1935. The entire decrease was in refinery stocks; in fact, stocks at plants and terminals (stocks at terminals included beginning Jan.1, 1935) increased nearly 13,000,000 gallons during the year. Furthermore, the entire decrease in refinery stocks was in California, where about three-quarters of the refinery stocks of natural gasoline are stored. Most of the plant and terminal stocks are held in Texas, and it is interesting to note that such stocks increased in Texas but declined elsewhere in 1935.

Stocks of natural gasoline in 1935, by months

[Thousands of gallons]

On hand—	At refineries		At plants and terminals		Total
	California	Other States	Texas	Other States	
Dec. 31, 1934	98,490	22,470	29,715	26,411	177,086
Jan. 31, 1935	108,948	19,950	34,020	27,324	190,242
Feb. 28, 1935	109,788	29,190	31,108	30,729	200,815
Mar. 31, 1935	118,356	27,552	40,767	33,892	220,567
Apr. 30, 1935	118,944	29,568	53,211	32,871	234,594
May 31, 1935	114,618	28,098	67,025	41,296	251,037
June 30, 1935	103,026	27,426	70,972	44,317	245,741
July 31, 1935	90,930	26,208	82,283	44,858	244,279
Aug. 31, 1935	86,310	23,016	76,750	48,200	234,276
Sept. 30, 1935	74,550	25,116	74,841	41,079	215,586
Oct. 31, 1935	61,236	20,328	68,513	34,051	184,128
Nov. 30, 1935	60,606	22,344	51,426	30,264	164,640
Dec. 31, 1935	62,790	23,436	48,289	20,801	155,316

LIQUEFIED PETROLEUM GASES

The distribution of liquefied petroleum gases, most of which comprise the light ends of natural gasoline obtained as a byproduct of stabilization, has increased rapidly in recent years. Sales of these gases, which consist of propane (C_3H_8), butane (C_4H_{10}), and pentane

(C_5H_{12}), totaled 76,855,000 gallons in 1935, an increase of 36 percent over the 56,427,000 gallons sold in 1934.

The economic history of the liquefied-gas industry in 1935 has been summarized as follows: [1]

The respective demands for the several liquefied gases * * * all showed substantial gains in 1935 over the previous year. Deliveries of propane increased 34.1 percent, or from 25,845,000 gallons in 1934 to 34,655,000 gallons in 1935, while butane sales showed almost an identical rise, with an increase of 33.4 percent, to a total of 34,084,000 gallons in 1935 compared with 25,553,000 gallons in 1934. The market demand for propane-butane mixtures nearly doubled, increasing from 3,107,000 gallons in 1934 to 5,651,000 gallons in 1935. Sales of pentane totaled 2,465,000 gallons in 1935 against 1,922,000 gallons in 1934.

The industrial use of liquefied petroleum gases was outstanding in 1935 when 47,894,000 gallons (62.3 percent of all deliveries) fell under this classification compared with 32,448,000 gallons (57.5 percent) in 1934. The domestic use of liquefied petroleum gases increased from 17,681,000 gallons in 1934 to 21,380,000 gallons in 1935, but the ratio to total deliveries declined from 31.3 percent in 1934 to 27.8 percent in 1935. The quantity used in gas manufacturing increased from 6,298,000 gallons in 1934 to 7,581,000 gallons in 1935.

The most important present use of propane gas is for domestic purposes, although the requirements in the industrial field are rapidly mounting. In 1935, 18,325,000 gallons of propane (about 53 percent of the total deliveries) were credited to domestic uses, which compares with 15,236,000 gallons (59 percent) in 1934. During the same years the industrial use of propane increased from 10,283,000 gallons (40 percent of total deliveries in 1934) to 15,628,000 gallons (45 percent of the total in 1935).

Butane is used principally as an industrial fuel, 27,689,000 gallons out of total deliveries of 34,084,000 gallons being consumed in 1935 compared with 19,443,000 gallons in 1934 out of a total of 25,553,000 gallons. Sales of butane to gas-manufacturing plants declined from 5,064,000 gallons in 1934 to 5,042,000 gallons in 1935, but deliveries for domestic purposes in 1935, although small in volume, registered a 30-percent gain over 1934.

The use of "bottled gas", usually propane, continued to increase in 1935, as householders, campers, and other consumers, cut off from gas-company mains, became even better acquainted with this convenient fuel. Manufacturers used both propane and butane in rapidly increasing quantities in 1935 in the solution of their heat-application problems, especially in such processes as annealing, brazing, carburizing, metal cutting, and preheating, where controlled temperatures are important. Liquefied petroleum gases are being used as the raw material in the manufacture of an increasing number of chemical products. Petroleum refiners are finding ever-widening uses for propane and butane and are realizing that these products are too valuable to use as refinery fuel. Propane is also used as a solvent and refrigerant in the refining of lubricating oils.

The American Gas Association has furnished the Bureau of Mines with the following data regarding the distribution of liquefied petroleum gases:

> "At the end of 1935, liquefied petroleum gas was being delivered through mains to consumers in 163 communities in 29 States by 68 companies supplying 29,516 customers.
>
> Butane-air gas with heating value ranging from 520 to 900 B.t.u. per cu. ft. was supplied to 105 communities in 28 States by 57 companies. A mixture of undiluted butane and propane gas with a heating value of 2,800 to 3,000 B.t.u. per cu. ft. was supplied to 14 communities in California and Nevada by 6 companies. Undiluted propane gas with a heating value of 2,550 B.t.u. per cu. ft. was supplied to 44 communities in Maryland, Minnesota, New Jersey, North Dakota, and Wisconsin by 5 companies."

The shipment of liquefied petroleum gases in bulk, that is, by tank cars, tank wagons, and pipe lines, showed a 50-percent increase in 1935 compared with 1934, while cylinder and drum shipments remained practically the same in 1935 as in 1934. This was to be expected as the same market conditions prevailed as in 1934 when the larger share of the increase in deliveries was confined to the industrial field where bulk shipments predominate. The tank-car and tank-wagon movement of liquefied petroleum gases totaled 61,457,000 gallons (80.0 percent

[1] Coumbe, A. T., Sales of Liquefied Petroleum Gases Increase in 1935: Min. Market Rept. 457, Bureau of Mines, 1936, 4 pp.

of all deliveries) in 1935 compared with 41,048,000 gallons (72 percent) in 1934. Cylinder and drum shipments were approximately 15,000,000 gallons for both 1934 and 1935, but the percentage of such deliveries dropped from 27.3 percent in 1934 to 20.0 percent in 1935.

* * * A regional analysis of the distribution of liquefied petroleum gases shows deliveries in the Pacific Coast area totaling 17,678,000 gallons in 1935 compared with 11,471,000 gallons in 1934. The increase in the California area of over 6,000,000 gallons was confined largely to industrial uses, although gas companies required about 1,700,000 gallons more of liquefied gases in 1935 than in 1934. The demand for liquefied petroleum gases east of the Rocky Mountains totaled 59,177,000 gallons compared with 44,956,000 gallons in 1934. In this gain of 14,000,000 gallons, propane sales account for about 7,800,000 gallons and butane about 5,300,000 gallons. The industrial demand for liquefied gases in this area increased 11,000,000 gallons in 1935 compared with 1934, while deliveries for domestic use were greater by 3,500,000 gallons in 1935 than in 1934. The use of liquefied petroleum gas by gas companies east of the Rockies declined 420,000 gallons in 1935 from the previous year.

TRENDS IN VAPOR PRESSURES

Beginning January 1, 1935, the Bureau has received monthly information on vapor pressures of natural gasoline in pounds, under the Reid system. The monthly average vapor pressures of all shipments in 1935 were as follows: January, 20.6; February, 21.4; March, 20.3; April, 19.6; May, 19.1; June, 18.6; July, 18.3; August, 18.9; September, 19.8; October, 20.2; November, 21.2; and December, 21.1. In general, these data confirm the fact that the lightest and most volatile natural gasolines are made in the colder months. The average vapor pressures of the major classes of shipments in 1935 were as follows: Refinery, 20.5; exports, 18.7; jobbers, retailers, and refinery-owned bulk plants, 16.1. These figures indicate that the vapor pressure of refinery shipments of natural gasoline, ostensibly for blending, does not have to be as low as that of shipments probably used directly as motor fuel and that foreign buyers prefer the less volatile materials, as they are handled more easily.

NUMBER AND CAPACITY OF PLANTS

For several years prior to 1928 the number and capacity of natural-gasoline plants increased steadily as a result of a material gain in the supply of casinghead gas due to the discovery of a number of flush fields with relatively high gas-oil ratios. From 1928 to date some form of proration has been in force continually, consequently the supply of "wet" gas has been curtailed. The decline in available gas, only partly compensated by increased production in the East Texas field, and depressed prices during most of 1931–34 have eliminated virtually all of the weaker units, so that the number of plants has declined from 1,155 on January 1, 1928, to 793 on January 1, 1936. On the other hand, the total daily capacity of the plants has increased from 8,048,000 gallons on January 1, 1928, to 9,663,000 gallons on January 1, 1936. The high point in total capacity revealed in the biennial figures was 11,387,000 gallons on January 1, 1932.

Number and capacity of natural-gasoline plants, 1928 to 1936

	Number			Capacity per day, thousands of gallons		
	Operating	Shut down	Total	Operating	Shut down	Total
Jan. 1, 1928	1,060	95	1,155	7,754	294	8,048
Jan. 1, 1930	999	36	1,035	10,278	238	10,516
Jan. 1, 1932	859	100	959	10,657	730	11,387
Jan. 1, 1934	741	128	869	9,181	879	10,060
Jan. 1, 1936	694	99	793	9,043	620	9,663

TECHNICAL DEVELOPMENTS

Probably the most important technical advance in natural-gasoline manufacture since fractionation has been the development of polymerization—the process of converting lighter hydrocarbons to heavier ones, or the antithesis of cracking. Experiments in polymerization have been carried on for years, but few results were made public before 1935.

By polymerization the molecules of the light fractions of natural gasoline, generally butane, are reassembled to form a gasoline with exceptional antiknock value. Most of the polymerized gasoline so far produced has been used as a high-grade blending material.

There are two types of polymerization plants, the thermal and the catalytic. According to T. F. Smiley of the Oil and Gas Journal, one plant of each type was operating at the close of 1935, and four catalytic and several thermal plants were under construction. The combined capacity of these plants will be approximately 2,000,000 gallons daily, compared with a daily production of about 5,000,000 gallons of natural gasoline and daily average deliveries of 93,381 gallons of butane as liquefied gas in 1935. It is far to early to predict the future of polymerization, but it is certain that development of the process has greatly enhanced the outlook for butane, once generally regarded as a nuisance.

A pipeline is being constructed for the transportation of natural gasoline, butane, and propane from the East Texas field to a polymerization plant on the Gulf.

CARBON BLACK

By G. R. Hopkins and H. Backus

SUMMARY OUTLINE

The carbon-black industry, which had made marked progress in 1934, enjoyed a profitable year in 1935. Production was 352,749,000 pounds, exceeded only by the totals of 1929 (366,442,000 pounds) and 1930 (379,942,000 pounds). Demand reached a new peak, the

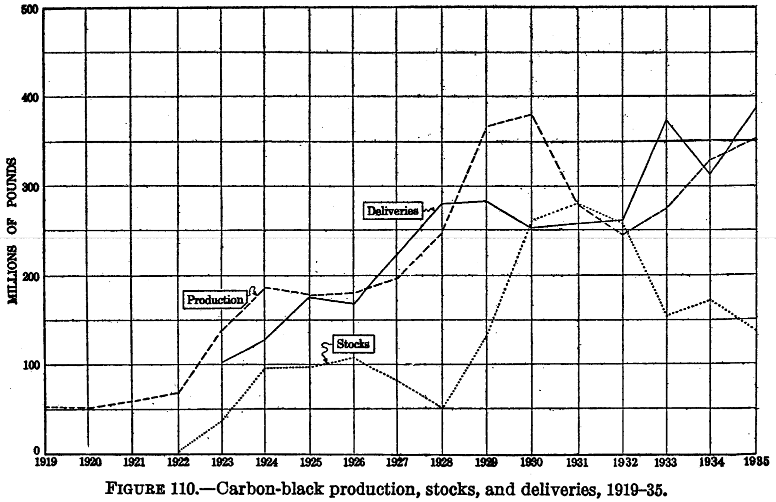

Figure 110.—Carbon-black production, stocks, and deliveries, 1919–35.

total of domestic and export sales being 387,536,000 pounds compared with the previous record of 374,468,000 pounds for 1933. The increase in demand outweighed the gain in production, and stocks were materially reduced. (See fig. 110.) The increase in prices under the code was maintained; in fact, prices were firmer in 1935 than in 1934. The average value at the plants in 1935 was 3.90 cents per pound compared with 3.54 cents in 1934. Exports were substantially higher than in 1934, but the total—142,185,000 pounds—did not equal the record of 1933.

Salient statistics for carbon black made from natural gas in the United States, 1931–35

	1931	1932	1933	1934	1935
Number of producers reporting	26	24	25	25	21
Number of plants	58	50	51	50	54
Quantity produced:					
By States and districts:					
Louisiana pounds	57,485,000	42,260,000	54,470,000	66,538,000	64,875,000
Texas:					
Breckenridge district do	13,332,000	[1] 23,071,000	[1] 24,499,000	[1] 24,887,000	[1] 24,513,000
Panhandle district do	197,546,000	177,369,000	194,156,000	237,403,000	263,361,000
Total Texas do	210,878,000	[1] 200,440,000	[1] 218,655,000	[1] 262,290,000	[1] 287,874,000
Other States do	12,544,000	(1)	(1)	(1)	(1)
Total United States do	280,907,000	242,700,000	273,125,000	328,828,000	352,749,000
By processes:					
Channel process do	255,322,000	224,536,000	238,026,000	293,546,000	316,284,000
Other processes [2] do	25,585,000	18,164,000	35,099,000	35,282,000	36,465,000
Stocks held by producers Dec. 31 pounds	280,010,000 [3] 281,667,000	257,998,000	155,969,000	171,799,000	136,086,000
Losses do	1,716,000	4,814,000	686,000	386,000	926,000
Quantity sold:					
Domestic:					
To rubber companies do	134,315,000	130,380,000	191,358,000	165,446,000	213,708,000
To ink companies do	15,184,000	18,341,000	18,539,000	16,146,000	15,177,000
To paint companies do	6,760,000	7,636,000	6,260,000	5,365,000	6,550,000
For miscellaneous purposes pounds	5,453,000	5,126,000	6,025,000	5,035,000	9,916,000
Total domestic sold do	161,712,000	161,483,000	222,182,000	191,992,000	245,351,000
Export do	96,714,000	100,072,000	152,286,000	120,620,000	142,185,000
Total sold do	258,426,000	261,555,000	374,468,000	312,612,000	387,536,000
Value (at plants) of carbon black produced:					
Total	$8,621,000	$6,664,000	$7,602,000	$11,654,000	$13,755,000
Average per pound cents	3.07	2.75	2.78	3.54	3.90
Estimated quantity of natural gas used M cubic feet	195,396,000	168,237,000	190,081,000	229,933,000	241,589,000
Average yield per M cubic feet pounds	1.44	1.44	1.44	1.43	1.46

[1] Oklahoma and Wyoming included with Breckenridge district, Texas.
[2] 1931: Disk, roller, "special", and thermatomic; 1932–33: Disk, Lewis, roller, "special", and thermatomic; 1934–35: Lewis, roller, "special", and thermatomic.
[3] For comparison with 1932.

PRODUCTION

Production by States, districts, and months.—Production of carbon black outside of the Texas Panhandle decreased slightly in 1935, hence the center of the industry moved closer to the Panhandle.

Production in Louisiana declined from 66,538,000 pounds in 1934 to 64,875,000 pounds in 1935, indicating that the temporary recovery of the industry in that State as evidenced by successive increases in output in 1933 and 1934 had been brought to an end through curtailment in supplies of natural gas. Production in the Texas Panhandle in 1935 was 263,361,000 pounds, a new record for the district and an increase of 11 percent over production in 1934. There were 28 plants operated in the Panhandle in 1935 compared with 25 in 1934.

Production of carbon black by States 1919–35

[Thousands of pounds]

Year	Louisiana	Texas	West Virginia	Other States	Total	Average value per pound (cents)
1919	14,025		29,926	8,106	52,057	7.33
1920	18,566		26,659	6,097	51,322	7.86
1921	31,004		25,073	3,689	59,766	9.11
1922	41,967		20,095	5,733	67,795	8.58
1923	101,399	2,633	20,038	14,193	138,263	8.46
1924	144,602	13,764	15,045	13,461	186,872	6.19
1925	129,840	26,219	10,848	10,510	177,417	5.43
1926	130,377	36,328	3,805	10,066	180,576	5.50
1927	124,188	56,396	2,796	15,049	198,429	5.52
1928	136,320	100,828	697	10,945	248,790	5.54
1929	127,345	228,183	578	10,336	366,442	5.11
1930	96,729	271,749	(1)	11,464	379,942	3.91
1931	57,485	210,878		12,544	280,907	3.07
1932	42,260	[2] 200,440		(2)	242,700	2.75
1933	54,470	[2] 218,655		(2)	273,125	2.78
1934	66,538	[2] 262,290		(2)	328,828	3.54
1935	64,875	[2] 287,874		(2)	352,749	3.90

[1] Included with "Other States."
[2] Oklahoma and Wyoming included with Texas.

According to estimates based on the monthly figures of the National Gas Products Association, the output of carbon black increased as the year progressed, with temporary recessions in daily average output in May, June, and August. The daily average production in January was 908,000 pounds, but by December had risen to 1,094,700 pounds. The new policy of the automobile industry in introducing new models late in the year instead of in the spring may have influenced the trend in carbon-black production in 1935.

Methods and yields.—The industry continued to place chief reliance on the channel process to produce black of desired specifications. The production of channel black in 1935 amounted to 316,284,000 pounds, equivalent to 90 percent of the total output. Although the production of carbon black by other methods was equivalent to only 10 percent of the total in 1935 compared with 11 percent in 1934 the amount produced showed a small increase.

Carbon black produced from natural gas in the United States, 1934–35, by States and by major producing districts

State and district	Producers reporting	Number of plants	Production: Pounds	Value at plant: Total	Value at plant: Average (cents)	Quantity of natural gas used (M cubic feet)	Average yield per M cubic feet (pounds)
1934							
Louisiana: Monroe-Richland district (Morehouse, Ouachita, and Richland Parishes)	11	18	66,538,000	$2,345,000	3.52	53,764,000	1.24
Oklahoma	1	1	(1)	(1)	(1)	(1)	(1)
Texas:							
Breckenridge district (Eastland and Stephens Counties)	4	5	[1] 24,887,000	[1] 1,005,000	[1] 4.04	[1] 13,241,000	[1] 1.88
Panhandle district (Carson, Gray, Hutchinson, and Wheeler Counties)	14	25	237,403,000	8,304,000	3.50	162,928,000	1.46
Total Texas	[2] 15	30	[1] 262,290,000	[1] 9,309,000	[1] 3.55	[1] 176,169,000	[1] 1.49
Wyoming	1	1	(1)	(1)	(1)	(1)	(1)
Total United States	[2] 25	50	328,828,000	11,654,000	3.54	229,933,000	1.43
1935							
Louisiana: Monroe-Richland district (Morehouse, Ouachita, and Richland Parishes)	10	19	64,875,000	2,507,000	3.86	54,021,000	1.20
Oklahoma	1	1	(1)	(1)	(1)	(1)	(1)
Texas:							
Breckenridge district (Eastland and Stephens Counties)	4	5	[1] 24,513,000	[1] 996,000	[1] 4.06	[1] 12,567,000	[1] 1.95
Panhandle district (Carson, Gray, Hutchinson, and Wheeler Counties) [2]	14	28	263,361,000	10,252,000	3.89	175,001,000	1.50
Total Texas	[2] 14	33	[1] 287,874,000	[1] 11,248,000	[1] 3.91	[1] 187,568,000	[1] 1.53
Wyoming	1	1	(1)	(1)	(1)	(1)	(1)
Total United States	[2] 21	54	352,749,000	13,755,000	3.90	241,589,000	1.46

[1] Oklahoma and Wyoming included with Breckenridge district, Texas.
[2] In counting the total number of producers, a producer operating in more than 1 State, district, or county is counted only once.

Monthly carbon-black production in the United States in 1935, in pounds

Month	National Gas Products Association	Bureau of Mines [1]: Total	Bureau of Mines [1]: Daily average	Month	National Gas Products Association	Bureau of Mines [1]: Total	Bureau of Mines [1]: Daily average
January	25,617,000	28,149,000	908,000	August	25,628,000	28,149,000	908,000
February	23,766,000	26,103,000	932,300	September	25,239,000	27,726,000	924,200
March	26,945,000	29,596,000	954,700	October	29,159,000	32,030,000	1,033,200
April	26,603,000	29,243,000	974,800	November	29,112,000	31,994,000	1,066,500
May	26,462,000	29,067,000	937,600	December	30,902,000	33,935,000	1,094,700
June	24,579,000	26,985,000	899,500				
July	27,114,000	29,772,000	960,400		321,126,000	352,749,000	966,400

[1] Monthly figures obtained by allocating the Bureau's annual total proportionately to the Association's monthly data.

The consumption of natural gas by the carbon-black industry rose from 229,933,000,000 cubic feet in 1934 to 241,589,000,000 cubic feet in 1935. The latter figure was equivalent to about 13 percent of the estimated total consumption of natural gas in the United State

The average yield of carbon black, which had remained virtually constant at about 1.44 pounds per thousand cubic feet for several years, rose to 1.46 pounds in 1935; however, this increase is not large enough to indicate any material improvement in operating technique.

Operations at the plants in Texas were influenced by conservation orders of the State Railroad Commission, designed primarily to reduce and prevent waste. As far as the carbon-black industry was concerned, the most important order was that designed to restrict the consumption of carbon black to sour gas. This order is believed to have met with general compliance, although a few operators who had depended upon sweet residue gas from natural-gasoline plants found themselves without an assured supply.

Number and capacity of plants.—Increased demand and higher prices were instrumental in raising the number of operating plants from 50 in 1934 to 54 in 1935 and the daily capacity of the operating plants from 1,315,975 pounds in 1934 to 1,452,125 in 1935. Nevertheless, newcomers to the business were few; in fact, there were only 21 producers in 1935 compared with 25 in 1934. However, the major part of the reduction in number of operating companies resulted from consolidations within companies.

As the average daily production of carbon black in 1935 was 966,400 pounds and the daily capacity of the operating plants 1,452,125 pounds, the plants were operated during 1935 at about 67 percent of their capacity compared with 68 percent in 1934.

Number and daily capacity of carbon-black plants operated in the United States, 1934–35, by counties or parishes

State	County or parish	Number of plants		Total daily capacity (pounds)	
		1934	1935	1934	1935
Louisiana	Morehouse	5	5	74,850	68,850
	Ouachita	12	13	234,275	252,775
	Richland	1	1	14,000	14,000
		18	19	323,125	335,625
Oklahoma	Beckham	1	1	(1)	(1)
Texas	Carson	2	2	[2] 111,000	[2] 111,000
	Eastland	1	1	(1)	(1)
	Gray	9	9	333,400	333,400
	Hutchinson	11	14	441,750	571,300
	Stephens	4	4	[1] 106,700	[1] 100,800
	Wheeler	3	3	(2)	(2)
		30	33	[1] 902,850	[1] 1,116,500
Wyoming	Niobrara	1	1	(1)	(1)
United States		50	54	1,315,975	1,452,125

[1] Oklahoma, Wyoming, and Eastland County, Tex., included with Stephens County, Tex.
[2] Wheeler County included with Carson County.

Producers.—Changes in the list of carbon-black producers in 1935 were as follows: The Century Carbon Co. (operating in Louisiana), the Oklahoma Carbon Industries, Inc. (operating in Oklahoma), and the Eastern Carbon Black Co., the Kosmos Carbon Co., and the Texas Carbon Industries, Inc. (all operating in Texas) were merged with the United Carbon Co. J. Smylie Herkness (operating in Louisiana) changed to C. Eneu Johnson & Co. The Palmer Carbon

Co. (operating in Texas) sold out to the Western Carbon Co. The Combined Carbon Co. was reported operating for the first time in 1935. Two new plants were operated in Texas during the year; these were made from several plants dismantled in Louisiana and Utah and moved to Texas.

Carbon-black producers of the United States, as of Dec. 31, 1935

State and company	County	Nearest town	Process
Louisiana:			
J. M. Huber Corporation, care of J. M. Huber, Inc., 460 West 34th St., New York, N. Y.	Ouachita	Swartz	Channel.
Imperial Oil & Gas Products Co., 1104 Union Bank Bldg., Pittsburgh, Pa.	do	Sterlington	Do.
C. Eneu Johnson & Co., Route 2, Bastrop, La.	Morehouse	Bastrop	Do.
Keystone Carbon Co., Inc., P. O. Box 11, Monroe, La.	Ouachita	Monroe	Do.
Monroe-Louisiana Carbon Co., 45 East 42d St., New York, N. Y.	do	Hancock	Lewis.
Peerless Carbon Black Co., 3003 Grant Bldg., Pittsburgh, Pa.	do	Bourland	"Special."
Southern Carbon Co., 45 East 42d St., New York, N. Y.	Morehouse	Perryville	Channel.
	Ouachita	Fowler	Do.
	do	Swartz	Do.
Texas-Louisiana Producing & Carbon Co., P. O., Box 181, Monroe, La.	Morehouse	Colliston	Do.
Thermatomic Carbon Co., 230 Park Ave., New York, N. Y.	Ouachita	Sterlington	Thermatomic.
United Carbon Co., Inc., 901 Union Bldg., Charleston, W. Va.	Morehouse	Bastrop	Channel.
	do	Dewdrop	Do.
	Ouachita	Guthrie	Do.
	do	Phillips	Do.
	do	Swartz (3 plants)	Do.
	Richland	Archibald	Do.
Oklahoma: United Carbon Co., Inc., 901 Union Bldg., Charleston, W. Va.	Beckham	Sayre	Do.
Texas:			
Cabot Carbon Co, 77 Franklin St., Boston, Mass.	Gray	Pampa	Do.
Cabot Co., 77 Franklin St., Boston, Mass.	Carson	Skellytown	Channel and roller.
Coltexo Corporation, 45East 42d St., New York, N. Y.	Gray	Lefors	Channel.
	Stephens	Parks	Do.
Combined Carbon Co., 901 Union Bldg., Charleston, W. Va.	Hutchinson	Sanford	Do.
Crescent Carbon Co., Point Pleasant, W. Va.	do	Borger	Do.
General Atlas Chemical Co., 60 Wall St., New York, N. Y.	Gray	Pampa	"Special."
J. M. Huber Corporation, care of J. M. Huber, Inc., 460 West 34th St., New York, N. Y.	Carson	Skellytown	Channel.
	Hutchinson	Borger	Do.
Magnolia Petroleum Co., Dallas, Tex.	Gray	Pampa	Do.
	Wheeler	Magic City	Do.
Panhandle Carbon Co., 251 Front St., New York, N. Y.	Hutchinson	Borger	Do.
Peerless Carbon Black Co., 3003 Grant Bldg., Pittsburgh, Pa.	Eastland	Pioneer	"Special."
	Gray	Pampa	Do.
	do	do	Channel.
Texas Elf Carbon Co., 77 Franklin St., Boston, Mass.	Stephens	Eliasville	Do.
United Carbon Co., Inc., 901 Union Bldg., Charleston, W. Va.	Hutchinson	Borger (4 plants)	Do.
	do	Breckenridge (2 plants).	Do.
	do	Sanford (2 plants)	Do.
	do	Stinnett	Do.
Western Carbon Co., 45 East 42d St., New York, N. Y.	Gray	Kings Mill	Do.
	do	Lefors	Do.
	do	Pampa	Do.
	Hutchinson	Borger (2 plants)	Do.
	Wheeler	Lela	Do.
	do	Magic City	Do.
Wyoming: J. M. Huber Corporation, care of J. M. Huber, Inc., 460 West 34th St., New York, N. Y.	Niobrara	Manville	Do.

DEMAND

Total deliveries.—Sales of carbon black by manufacturers to brokers and consumers totaled 387,536,000 pounds in 1935, a new record. Of this total, 245,351,000 pounds (63 percent) were consigned to domestic buyers, and 142,185,000 pounds (37 percent) were exported. Although deliveries differ from actual consumption by the change in buyer's stocks, it is probable that the two were nearly synonymous in 1935, when extreme price changes, such as occurred in 1933, were lacking as an incentive for speculative buying.

Domestic consumption.—Of the domestic deliveries in 1935, 213,708,000 pounds (87 percent) were consigned to rubber companies, 15,177,000 pounds (6 percent) to ink companies, 6,550,000 pounds (3 percent) to paint and varnish companies, and 9,916,000 pounds (4 percent) to companies producing miscellaneous products. (See fig. 111.) These data indicate increases in the percentages utilized in rubber and miscellaneous products, no material change in the ratio utilized by paint companies, but a decrease in the percentage consigned to ink companies.

According to E. G. Holt of the Bureau of Foreign and Domestic Commerce, the total consumption of rubber in the United States in

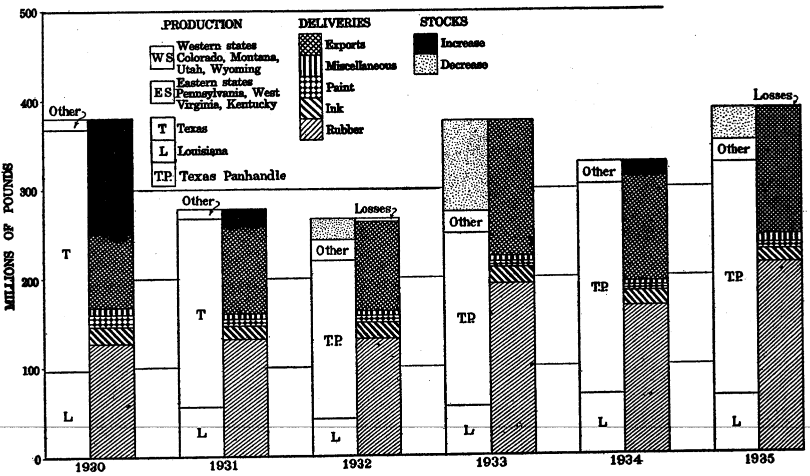

FIGURE 111.—Production and consumption of carbon black, 1930–35.

1935 was 609,000 long tons, including 117,500 tons of reclaimed rubber. The ratio of reclaimed to crude rubber has increased in recent years; in 1935 the increase was above the average. In 1935, as in 1934, the increase in production of motor vehicles exceeded the gain in output of automobile casings. According to the Bureau of Foreign and Domestic Commerce, factory sales of motor vehicles rose from 2,753,111 in 1934 to 4,009,496 in 1935, an increase of 46 percent. On the other hand, figures of the Rubber Manufacturers' Association indicate a gain in production of casings of from 47,216,000 in 1934 to 49,338,000 in 1935, or only 4 percent. As the increase in rubber consumption in the United States in 1935 over 1934 (10 percent) was greater than the increase in casing production, it is quite evident that the trend toward heavier casings was continued in 1935. This assumption appears to be confirmed by the fact that the average consumption of carbon black per casing also increased.

According to Holt, the actual consumption of crude rubber in the world increased in 1935 over 1934, although the "absorption" for

1935 (940,000 long tons) was slightly under "absorption" in 1934 (942,000 long tons). The most probable explanation of this apparent anomaly is that foreign buyers increased the "absorption", or apparent consumption, by speculative buying in 1934 but drew on the accumulated stocks in 1935.

Sales of carbon black to ink companies again showed a small decline, the total for 1935 being 15,177,000 pounds compared with 16,146,000 pounds in 1934. According to preliminary data of the Bureau of Foreign and Domestic Commerce, the domestic consumption of newsprint in the United States in 1935 was 3,273,000 short tons, a small increase over the 3,176,000 short tons consumed in 1934. The fact that sales of carbon black to ink companies declined slightly while the use of newsprint was increasing may indicate that ink manufacturers again drew on their stocks built up in 1933.

Sales of carbon black to paint companies increased from 5,365,000 pounds in 1934 to 6,550,000 pounds in 1935. Although final figures on paint production for 1935 are not available, every indication, chiefly the material increase in automobile production, points to a gain in output as an explanation of the increased purchases of carbon black in 1935.

Sales of carbon black for miscellaneous purposes increased materially in 1935, although the reasons for this gain and the identities of the industries affected are obscure. It has been reported that the use of carbon black in concrete for highways to remove glare increased in 1935.

Losses of carbon black incurred in handling at the plants were reported as 926,000 pounds in 1935 compared with 386,000 pounds in 1934. The material increase probably represents bookkeeping adjustments rather than a decline in technical efficiency.

Exports and imports.[1]—Exports of carbon black, which had declined in 1934 from the peak of 1933, totaled 142,184,802 pounds in 1935, an increase of 18 percent over 1934. The total value of exports rose to $6,673,016 (highest since 1929), an average of 4.69 cents per pound compared with an average of 4.59 cents in 1934.

Carbon black exported from the United States, 1933–35, by countries

Country	1933		1934		1935	
	Pounds	Value	Pounds	Value	Pounds	Value
Argentina	1, 659, 484	$69, 480	1, 602, 208	$79, 294	2, 413, 526	$125, 567
Australia	5, 121, 578	182, 745	7, 821, 796	398, 230	6, 192, 367	271, 932
Belgium	5, 376, 058	192, 064	3, 451, 426	164, 166	3, 916, 519	241, 919
Canada	10, 578, 559	303, 115	11, 669, 472	517, 247	12, 475, 487	559, 397
China	2, 033, 162	75, 677	1, 052, 287	55, 835	1, 243, 204	63, 023
France	32, 417, 013	1, 191, 920	22, 725, 781	1, 016, 457	19, 000, 182	954, 243
Germany	20, 327, 467	745, 052	16, 499, 442	706, 348	23, 105, 613	982, 262
Italy	7, 196, 800	259, 313	4, 475, 344	220, 830	9, 335, 512	437, 541
Japan	9, 335, 065	377, 497	3, 464, 300	155, 445	8, 001, 036	363, 450
Netherlands	6, 690, 947	238, 119	1, 929, 661	85, 144	4, 674, 562	206, 623
Spain	1, 719, 323	59, 649	1, 206, 495	61, 879	2, 204, 538	110, 154
United Kingdom	42, 603, 940	1, 589, 503	37, 696, 893	1, 694, 220	38, 982, 227	1, 771, 123
Other	7, 226, 782	268, 011	7, 025, 114	386, 048	10, 640, 029	585, 782
Total	152, 286, 178	5, 552, 145	120, 620, 219	5, 541, 143	142, 184, 802	6, 673, 016

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

Carbon black exported from the United States in 1935, by months and districts

Month	Pounds	Value	District	Pounds	Value
January	7,511,198	$339,941	Galveston	75,807,504	$3,533,189
February	10,037,515	469,962	New Orleans	42,900,634	2,057,409
March	13,214,492	616,430	Michigan	11,934,569	530,267
April	8,904,187	424,880	Los Angeles	1,177,689	64,798
May	11,356,439	512,238	Sabine	3,287,590	146,755
June	17,406,543	770,096	San Francisco	5,018,724	207,800
July	10,070,279	477,769	New York	1,068,578	86,183
August	10,109,095	464,542	Buffalo	301,067	17,587
September	12,528,715	553,382	Vermont	133,635	6,497
October	8,669,749	417,169	St. Lawrence	94,398	3,896
November	17,796,884	877,621	Philadelphia	314,273	12,795
December	14,579,706	748,986	Other	146,141	5,840
Total	142,184,802	6,673,016	Total	142,184,802	6,673,016

The United Kingdom continued to rank first as a purchaser of carbon black from the United States, but Germany displaced France in second place. In general, the nations that have been the most assiduous in strengthening their defenses showed the largest increases in purchases of carbon black in 1935. For example, exports to Germany, Italy, and Japan increased 40, 109, and 131 percent, respectively, in 1935. Exports of carbon black in 1935 fluctuated considerably from month to month, although, as in the case of production, an upward trend is discernible. Galveston and New Orleans continued to be the principal shipping points. If it is true that Galveston is the shipping port for exports originating in the Texas Panhandle and New Orleans the shipping port for Louisiana, then Louisiana producers export a higher proportion of their total output than the Texas producers.

Imports of "gas black and carbon black" totaled 691,009 pounds valued at $69,087 in 1935. These data indicate a further increase in receipts of these commodities, which are believed to be special blacks such as acetylene black rather than true carbon black.

STOCKS

Stocks of carbon black at the plants, generally acknowledged as having been too high in recent years, were materially reduced in 1935, when the total declined from 171,799,000 pounds on hand the first of the year to 136,086,000 pounds on hand December 31. The stocks as of the close of 1935 represent slightly more than 4 months' supply, the lowest point in terms of days' supply since 1928.

PRICES AND VALUES

Although no changes in the quoted prices for carbon black have been made since January 1, 1934, when the new code prices went into effect, most contract prices were advanced around the beginning of 1935, as the average f. o. b. value as reported to the Bureau of Mines rose to 3.90 cents per pound from an average of 3.54 cents in 1934. The total value in 1935 was $13,755,000, materially above 1934 and more than double the value in 1932. According to trade journals, most contracts for 1935 had a clause covering "adjustments" in prices as of the middle of the year. Few, if any, such "adjustments" were made, indicating that operations were generally profitable to the producers.

Quoted prices of various grades of carbon black in 1934 and 1935, in cents per pound

[Oil, Paint and Drug Reporter]

Date	Standard rubber, ink, and paint qualities (car lots)							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
1934:														
Jan. 1	4.45	4.75	[2] 4.90	4.90	5.05	5.35	5.30	9.0	12.0	16.5	32.0	44.0	65.0	110.0
Apr. 30							5.39							
Aug. 20							5.30							
1935 [3]														

[1] Zone A: Gulf coast ports: Galveston, Houston, Port Arthur, New Orleans, etc.; for coastwise delivery in North America.
Zone B: Arkansas, Colorado, Kansas, part of Missouri, New Mexico, and Texas except coastal ports.
Zone C: Pacific coast.
Zone D: Illinois, Iowa, and Wisconsin.
Zone E: Florida, Georgia, Indiana, Kentucky, Michigan, Ohio, Tennessee, West Virginia, and parts of New York and Pennsylvania.
Zone F: Atlantic seaboard States: Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, parts of Pennsylvania, Rhode Island, South Carolina, Vermont, and Virginia.
Zone G: Mexico.

[2] Revised figure.

[3] No change from 1934 prices.

HELIUM

By C. W. Seibel and H. S. Kennedy

SUMMARY OUTLINE

A review of the demand and use for helium during 1935 is worthy of consideration, as it gives an idea of the future trend and possible new uses for this gas.

After extensive hearings, the Federal Aviation Commission submitted its report [1] in January 1935 that made encouraging recommendations concerning lighter-than-air craft. It advised that the Navy undertake further construction and operation of rigid airships and that the United States participate in a trans-Atlantic airship service by building an airship and leasing it to a commercial operator for such use. The Commission also recommended that the Bureau of Mines be granted authority to sell helium to commercial airship operators to encourage development of privately owned dirigibles.

The governmental demand for helium during the year was reduced by the loss of the *Macon* in February 1935. This left the United States military establishments with no rigid ships in operation, and the demand for helium was reduced to the requirements of nonrigid ships operated by the Army and Navy.

The committee of technical experts, known as the Durand Committee, appointed by the President to investigate and make recommendations pertaining to the Government's operation of airships, issued a report favorable to continued participation of the Government in airship construction and operation. Thus the future outlook is for an increased demand for helium in airship operation if new construction is authorized in accordance with the recommendations of the President's committee.

Helium produced by the Bureau of Mines was used for inflating the balloon in which the second National Geographic Society-Army Air Corps stratosphere flight was made.

Several years ago the Bureau of Mines conducted experiments in the use of helium-oxygen mixtures to mitigate caisson disease in deep-sea diving.[2] Recently helium mixed with oxygen has been used in the treatment of asthma and other respiratory diseases with favorable results. Persistent requests by doctors and hospitals for helium for

[1] Federal Aviation Commission, Report: January 1935; 74th Cong., 1st sess., S. Doc. 15.

[2] Sayers, R. R., Yant, W. P., and Hildebrand, J. H., Possibilities in the Use of Helium-Oxygen Mixtures as a Mitigation of Caisson Disease: Rept. of Investigations 2670, Bureau of Mines, 1925, 17 pp.

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medical use indicate a new and growing demand that must be provided for. The Bureau has supplied about 25,000 cubic feet of helium to the United States Public Health Service, which is cooperating with certain hospitals in the medical use of helium.

Cliffside gas field.—The Government Cliffside helium reserve of 50,000 acres in Potter County, Tex., comprising a whole gas structure owned in fee, was operated during the year to supply helium-bearing natural gas to the Amarillo helium plant. The field produced 4,103,821,000 cubic feet of natural gas from May 16, 1929, to June 30, 1935, which represents only about 2 percent of the total original reserve, as indicated by the small decline in rock pressure since May 16, 1929, when the Bureau began to operate the field.

Amarillo helium plant.—The Bureau of Mines helium plant near Amarillo, Tex., operated during the year to supply all the helium used by the Army and Navy in aeronautics. The Bureau produced 10,218,480 cubic feet of helium to satisfy these requirements, which were considerably larger than those of the previous year due to the demand of the dirigible *Macon* during its active operating life. The wrecking of the *Macon* in February 1935 caused a slackening of demand, and the Amarillo plant was operated intermittently during the remainder of the year with an accompanying reduction in personnel.

From the beginning of operations in May 1929 to June 30, 1935, the plant produced 68,687,620 cubic feet of helium at an expenditure of $796,626.16 for plant and gas-field operation, giving an all-time average gross operating cost of $11.58 per thousand cubic feet of helium for the Amarillo plant. The sale of residue gas returned $188,228.83 to the National Treasury over this period, making a net Government expenditure of $607,397.33, or $8.84 per thousand cubic feet of helium produced.

Government helium production and costs, April 1921 to June 1935

Period	Production[1]	Gross operating cost (expenditures in operation and maintenance)[2]		Return from sale of residue gas	Net operating cost (gross operating cost less return from sale of residue gas)[2]	
		Total	Average per M cubic feet produced		Total	Average per M cubic feet produced
Fort Worth plant:[3]						
Under jurisdiction of Navy Department:	*Cubic feet*					
April to June 1921	260,520	$126,694.05	$486.31			
July to December 1921	1,841,000	320,859.73	174.28			
October 1922 to June 1923[4]	4,069,940	489,299.70	120.22			
July 1923 to June 1924	8,204,665	636,438.38	77.57			
July 1924 to June 1925	9,418,363	451,084.58	47.89			
	23,794,488	2,024,376.44	85.08			
Under jurisdiction of Bureau of Mines:						
July 1925 to June 1926	9,355,623	318,446.40	34.04			
July 1926 to June 1927	6,330,056	277,384.70	43.82			
July 1927 to June 1928	6,687,834	274,210.54	41.00			
July 1928 to Jan. 10, 1929	2,638,894	121,440.65	46.02			
	25,012,407	991,482.29	39.64			
Amarillo plant:[5]						
Under jurisdiction of Bureau of Mines:						
April to June 1929	844,900	27,833.16	32.94	$2,645.32	$25,187.84	$29.81
July 1929 to June 1930[6]	9,805,600	140,146.75	14.30	30,445.43	109,701.32	11.19
July 1930 to June 1931	11,362,730	150,190.53	13.22	32,510.24	117,680.29	10.36
July 1931 to June 1932	15,171,680	148,545.26	9.79	40,862.43	107,682.83	7.10
July 1932 to June 1933	14,749,960	151,165.51	10.25	37,661.70	113,503.81	7.70
July 1933 to June 1934	6,534,270	63,528.33	9.72	17,585.94	45,942.39	7.03
July 1934 to June 1935	10,218,480	114,216.62	11.18	26,517.77	87,698.85	8.58
	68,687,620	795,626.16	11.58	188,228.83	607,397.33	8.84

[1] Production from the Fort Worth plant represents volume of airship gas produced, which had an average helium purity of 93 to 94 percent under Navy jurisdiction and about 95 percent under Bureau of Mines jurisdiction. Production from the Amarillo plant represents actual helium in the airship gas of better than 98-percent purity produced by that plant. Therefore, the advantage of the Amarillo plant from standpoint of cost is about 5 percent greater than a direct comparison of the figures indicates.

[2] Gross operating costs for the Fort Worth plant represent expenditures in operating and maintaining the plant, including current expenditures for natural gas. The Government did not own the gas field that supplied the Fort Worth plant, so there was no return from sale of residue. Gross operating cost for the Amarillo plant represents expenditure in operating and maintaining both the plant and the Government-owned gas properties. This gross operating cost at Amarillo is a measure of the amount that must be available to the Bureau of Mines for current expenditure. Returns from sale of residue gas must be deposited to credit of miscellaneous receipts of the Treasury and therefore are not available for expenditure by the Bureau. As the net operating cost is computed by subtracting current returns from current expenditures, it is a measure of the net withdrawal of funds from the Treasury for operation and maintenance.

[3] Costs at the Fort Worth plant are based on compilations by the Bureau of Efficiency from records of the Navy Department and the Bureau of Mines. (Report of Bureau of Efficiency in hearing on Amarillo helium plant before the Committee on Mines and Mining, House of Representatives, 71st Cong., 2d sess., p. 210.) The costs do not include depreciation or depletion, and those for period of Navy jurisdiction do not include cost of Washington administration.

[4] Plant closed in 1922 from January to September, inclusive, because of lack of funds.

[5] Compiled from Bureau of Mines records. The costs do not include depreciation or depletion.

[6] Plant shut down entire months of December 1929 and February 1930 because the Navy purchased its helium elsewhere at $34 per thousand cubic feet. Stand-by costs for these 2 months were $19,181.14.

ASPHALT AND RELATED BITUMENS

By A. H. REDFIELD [1]

SUMMARY OUTLINE

Coincident with an increase of 16.4 percent in total demand, domestic and foreign, the refinery production of petroleum asphalt increased 15.7 percent from 1934 to 1935. The effect of greater domestic production, together with larger imports and slightly reduced exports, was to increase stocks of petroleum asphalt at refineries nearly 27 percent, especially in the East Coast district, the Oklahoma-Kansas-Missouri district, and California. Domestic demand comprised 93 percent of the total requirements; exports 7 percent. Imports, though considerably larger than in 1934, constituted less than 1.5 percent of the total supply in 1935.

Reduction in road and street construction, especially higher-type hard-surfaced roads, was responsible for a decline in sales of paving asphalt of less than 200 penetration and of natural rock asphalt. Similarly, sales of semiliquid and liquid asphalts, used chiefly in the construction of lighter roads, including road oil, paving flux, cutback asphalts, and emulsions, were 3 percent less in 1935 than in 1934. Revival of building construction caused a considerable increase in sales of roofing and waterproofing asphalts and fluxes, as well as of mastic and asphaltic paints and varnishes and of gilsonite. The manufacture of electrical fittings also required more asphalt molding compounds and gilsonite in 1935 than in 1934.

Prices of asphalt and road oil were lower in 1935 than in 1934. The average sales value of petroleum asphalt declined 9 percent and of road oil 10.1 percent. Prices of gilsonite, however, averaged 6.1 percent higher in 1935 than in 1934, and the price of bituminous rock was 7.5 percent higher.

[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, 1934–35

	1934	1935
SUPPLY		
Native asphalt and related bitumens:		
Produced ... short tons	440,852	347,392
Imported (chiefly lake asphalt) ... do	15,679	53,977
Petroleum asphalt (excluding road oil):		
Produced at refineries from—		
Domestic petroleum ... do	1,444,846	1,801,778
Foreign petroleum ... do	1,395,650	1,485,225
	2,840,496	3,287,003
Stocks, Jan. 1 ... do	276,363	339,237
Total supply ... do	3,573,390	4,027,609
DISTRIBUTION		
Native asphalt and related bitumens:		
Indicated domestic demand ... short tons	425,538	328,168
Exports (unmanufactured) ... do	15,314	19,229
Petroleum asphalt (excluding road oil):		
Indicated domestic demand (including lake asphalt) ... do	2,569,395	3,027,648
Exports ... do	223,906	222,825
Stocks, Dec. 31 ... do	339,237	429,739
Total distribution	3,573,390	4,027,609
VALUES		
Native asphalt and related bitumens:		
Sales	$2,365,750	$2,148,761
Imports (chiefly lake asphalt)	222,372	544,651
Exports (unmanufactured)	581,415	709,709
Petroleum asphalt:		
Sales (excluding road oil) from—		
Domestic petroleum	13,973,765	16,141,162
Foreign petroleum	15,921,674	15,213,516
Total sales	29,895,439	31,354,678
Exports	3,383,443	3,370,559

NATIVE ASPHALT AND BITUMENS

Bituminous rock.—Sales of bituminous rock by producers decreased 23.5 percent in quantity (from 410,453 short tons in 1934 to 314,109 tons in 1935) and 17.7 percent in value (from $1,762,376 in 1934 to $1,449,406 in 1935). The principal decreases occurred in Oklahoma, Kansas, Missouri, New Mexico, California, and Alabama. On the other hand, sales by producers in Kentucky and Texas increased. Producers in Kentucky and Alabama sold 109,179 tons valued at $650,927 in 1935 compared with 90,027 tons valued at $516,673 in 1934. Producers in Oklahoma, Texas, and New Mexico sold 185,013 tons valued at $726,801 in 1935 compared with 290,940 tons valued at $1,152,331 in 1934.

Gilsonite and wurtzilite.—Greater demand for paints, varnishes, and electrical fittings caused sales of gilsonite by producers in northeastern Utah to increase 9.5 percent in quantity (from 30,355 short tons in 1934 to 33,227 tons in 1935) and 16.2 percent in value (from $599,739 in 1934 to $696,601 in 1935.)

The tonnage of wurtzilite sold increased from 44 short tons in 1934 to 61 tons in 1935, but the value decreased from $3,635 in 1934 to $2,754 in 1935.

Exports.—Improved demand in Europe, especially in Germany, the United Kingdom, and Italy, increased exports of natural asphalt and bitumen, unmanufactured, from 15,314 short tons valued at $581,415 in 1934 to 19,229 tons valued at $709,709 in 1935. Smaller increases occurred in exports to Canada, Argentina, Chile, Colombia, and Japan.

Of the 1935 exports, 71.9 percent went to Europe, especially to Germany, the United Kingdom, France, Italy, Belgium, and the Netherlands, compared with 72.5 percent in 1934. Canada received 9.7 percent of the total in 1934 and 8.2 percent in 1935. South American countries, especially Brazil, Argentina, Chile, and Colombia, took 10.3 percent in 1934 and 12.05 percent in 1935.

MANUFACTURED OR PETROLEUM ASPHALT

Domestic demand for asphalt increased 17.8 percent—from 2,569,395 short tons in 1934 to 3,027,648 tons in 1935. Exports of petroleum asphalt decreased slightly—from 223,906 tons in 1934 to 222,825 tons in 1935. In response to an increase of 16.4 percent in total demand, domestic and foreign, refinery production of asphalt increased 15.7 percent—from 2,840,496 tons in 1934 to 3,287,003 tons in 1935. At the same time imports of asphalt and bitumen increased from 15,679 short tons in 1934 to 53,972 tons in 1935. Stocks of asphalt at petroleum refineries increased 90,502 tons in 1935 compared with an increase of 62,874 tons in 1934.

Production.—Of the 1935 production of petroleum asphalt, 45.2 percent was made from foreign crude oil imported from Venezuela, Mexico, Colombia, and Trinidad, compared with 49.1 percent in 1934. Runs to stills of foreign crude petroleum decreased from 34,860,000 barrels in 1934 to 32,131,000 barrels in 1935. However, since a greater proportion of the crudes imported in 1935 consisted of heavy Venezuelan and Mexican oils, the output of asphalt manufactured from foreign crude in refineries of the East Coast and Gulf Coast districts increased from 1,395,650 tons in 1934 to 1,485,225 tons in 1935. Over 91 percent of the asphalt manufactured in East Coast refineries in 1935 and 75.6 percent of the asphalt manufactured in Gulf Coast refineries of Lousiana and Texas was made from foreign crude. At the same time, the production of asphalt from domestic crude increased (especially in the Indiana-Illinois-Kentucky district and in California) from 1,444,846 tons in 1934 to 1,801,778 in 1935. The total refinery output of asphalt in 1935 included 171,885 short tons of other petroleum products blended with the asphalt to produce commercial varieties of the required consistency.

Production, receipts, stocks, consumption, transfers and losses, and sales of asphalt (exclusive of road oil) at petroleum refineries in the United States in 1935, by districts

District	Production	Other petroleum products blended	Receipts from other sources	Stocks	
				Dec. 31, 1934	Dec. 31, 1935
	Short tons	Short tons	Short tons	Short tons	Short tons
East Coast	1,255,663	59,723	22,411	99,667	129,944
Appalachian	101,918			11,114	16,180
Indiana-Illinois-Kentucky	633,280	18,358	4,946	82,580	87,676
Oklahoma-Kansas-Missouri	87,294	22,883	12,086	6,679	35,496
Texas:					
Gulf Coast	185,487			11,294	9,862
Rest of State	50,309			2,520	8,857
Total, Texas	235,796			13,814	18,719
Louisiana-Arkansas:					
Louisiana Gulf Coast	186,929		224	28,440	41,507
Northern Louisiana and Arkansas	103,879	8,516	3,084	44,622	25,687
Total, Louisiana and Arkansas	290,808	8,516	3,308	73,062	67,194
Rocky Mountain	62,429	19,190	7,064	5,328	15,163
California	447,930	43,215	21,188	46,993	59,367
Grand total, 1935	3,115,118	171,885	71,003	339,237	429,739
Total, 1934	2,706,792	133,704	65,152	276,363	339,237

District	Consumption by companies	Transfers and losses	Sales	
			Quantity	Value
	Short tons	Short tons	Short tons	
East Coast	2,635	3,961	1,300,924	$13,846,153
Appalachian		73	96,779	1,229,676
Indiana-Illinois-Kentucky	195	5,287	646,006	6,309,624
Oklahoma-Kansas, Missouri	309	35	93,102	720,574
Texas:				
Gulf Coast	4,967	36,166	145,786	1,370,097
Rest of State			43,972	394,196
Total, Texas	4,967	36,166	189,758	1,764,293
Louisiana-Arkansas:				
Louisiana Gulf Coast	1,675	3,182	169,229	1,790,063
Northern Louisiana and Arkansas	6,506		127,908	1,084,966
Total, Louisiana and Arkansas	8,181	3,182	297,137	2,875,029
Rocky Mountain	3,118	15	75,715	828,563
California	3,154	53,624	443,181	3,780,766
Grand total, 1935	22,559	102,343	3,142,602	31,354,678
Total, 1934	99,936	15,597	2,727,241	29,895,439

Stocks.—Stocks of asphalt held at petroleum refineries amounted to 429,739 short tons on December 31, 1935, an increase of 90,502 tons (26.7 percent) over the inventories of December 31, 1934. The trend of stocks held at the end of the year has been definitely upward, increasing, with interruptions in 1932 and 1933, from 255,215 tons on December 31, 1928, to 429,739 tons on December 31, 1935. The largest increases during 1935 were in the East Coast district, the Oklahoma-Kansas-Missouri district, the Louisiana Gulf Coast district, and California. Only in northern Louisiana and Arkansas were substantial reductions made in asphalt stocks.

Sales.—Sales of asphalt by petroleum refineries increased 15.2 percent in quantity (from 2,727,241 short tons in 1934 to 3,142,602 tons in 1935) but only 5 percent in value (from $29,895,439 in 1934 to $31,354,678 in 1935). The average sales value per short ton decreased from $10.96 in 1934 to $9.98 in 1935.

The gains were general; only in the Appalachian district and in northern Louisiana and Arkansas were decreases shown in asphalt sales. The greatest increase was in the Indiana-Illinois-Kentucky district, where 445,565 tons of asphalt were sold in 1934 and 646,006 in 1935. There were other large increases in California (from 367,824 tons in 1934 to 443,181 tons in 1935); in the Rocky Mountain district (from 31,913 tons in 1934 to 75,715 tons in 1935); in the East Coast district (from 1,261,984 tons in 1934 to 1,300,924 tons in 1935); and in the Oklahoma-Kansas-Missouri district (from 60,090 tons in 1934 to 93,102 tons in 1935).

Asphalt and asphaltic material (exclusive of road oil) sold at petroleum refineries in the United States, in 1935, 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	419, 771	$3, 994, 713	457, 695	$4, 805, 877	877, 466	$8, 800, 590
Roofing	303, 234	3, 170, 647	328, 138	3, 585, 501	631, 372	6, 756, 148
Waterproofing	83, 294	917, 623	65, 821	703, 711	149, 115	1, 621, 334
Blending with rubber	3, 187	40, 663	11, 944	136, 081	15, 131	176, 744
Briquetting	37, 674	416, 870	3, 271	39, 305	40, 945	456, 175
Mastic and mastic cake	192	1, 718	2, 310	25, 393	2, 502	27, 111
Pipe coatings	6, 212	113, 311	1, 728	16, 963	7, 940	130, 274
Molding compounds	6, 856	75, 914	7, 814	85, 016	14, 670	160, 930
Miscellaneous uses	47, 749	500, 746	56, 836	639, 325	104, 585	1, 140, 071
Total	908, 169	9, 232, 205	935, 557	10, 037, 172	1, 843, 726	19, 269, 377
Semisolid and liquid products of more than 200 penetration: [1]						
Flux for—						
Paving	67, 393	581, 032	45, 673	432, 539	113, 066	1, 013, 571
Roofing	225, 195	1, 540, 995	54, 649	616, 485	279, 844	2, 157, 480
Waterproofing	3, 736	58, 480	24, 074	299, 767	27, 810	358, 247
Mastic			32	320	32	320
Cut-back asphalts	378, 054	3, 927, 834	329, 899	3, 481, 445	707, 953	7, 409, 279
Emulsified asphalts and fluxes	22, 412	239, 789	17, 449	119, 861	39, 861	359, 650
Paints, enamels, japans, and lacquers	12, 216	162, 620	8, 528	83, 321	20, 744	245, 941
Other liquid products	91, 942	398, 208	17, 624	142, 605	109, 566	540, 813
Total	800, 948	6, 908, 958	497, 928	5, 176, 343	1, 298, 876	12, 085, 301
Grand total, 1935	1, 709, 117	16, 141, 163	1, 433, 485	15, 213, 515	3, 142, 602	31, 354, 678
Total, 1934	1, 353, 639	13, 973, 765	1, 373, 602	15, 921, 674	2, 727, 241	29, 895, 439

[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 saturing, 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 asphalts.—Asphalts softened or liquefied by mixing them 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.

Nearly three-fifths of the asphalt sold by petroleum refineries in 1935 was used for street and highway construction. Although contracts awarded for street and road construction by the Federal Government and by the States were 4.5 percent lower in value and apparently 3 percent lower in volume in 1935 than in 1934, the tonnage of asphalt sold primarily for highway purposes increased 2.6 percent. The increase occurred, however, in the semiliquid and liquid forms of asphalts used for highway work; sales of paving asphalt of less than 200 penetration decreased 5.1 percent.

All available statistical indexes point to a diminution in rural highway construction from 1934 to 1935. No data are available to show the volume of city-street construction. The mileage of State highways reported by the Association of State Highway Officials decreased from 39,302 miles in 1934 to 25,853 miles in 1935. The length of highways completed under the supervision of the Bureau of Public Roads, through the use of Public Works and Federal-aid funds, declined from 18,690.5 miles in 1934 to 13,016.9 in 1935. At the end of 1935, 2,370.7 miles were under construction and 240.5 miles had been approved for construction. According to the Bureau of Public Roads, employment on Federal and State highways, in both construction and maintenance, decreased 29.4 percent from a monthly average of 421,179 man-months in 1934 to an average of 301,660 man-months in 1935.

In 1935, as in 1934, Federal funds financed by far the greater part of the highway mileage constructed. Federal and State funds available for road and street construction were 4½ percent less in 1935 than in 1934, according to the Bureau of Labor Statistics. Although the total value of highway contracts awarded and force-account work started, financed by Federal funds, increased from $337,615,064 in 1934 to $357,912,615 in 1935, contract awards reported by the States to the Bureau of Labor Statistics decreased from $80,573,556 in 1934 to $52,782,494 in 1935.

Bituminous types constituted 24.4 percent of the total highway mileage reported by the Association of State Highway Officials in 1934 and 19.8 percent of the total in 1935. Of the total of 13,016.9 miles of Federal-aid highways built in 1935, bituminous types constituted 18.1 percent. Low-cost bituminous mixtures were used to surface 1,466.7 miles, bituminous macadam 285.2 miles, and bituminous concrete 590.5 miles. More than two-thirds of the Federal-aid highways built in 1935 were of the lighter types of construction, such as treated and untreated gravel, sand-clay, and macadam, and of grading and draining operations. Only 13.3 percent of the total consisted of hard-surface types other than bituminous.

Decreased construction of high-type, hard-surfaced roads and streets, especially in the Atlantic Coast States, is indicated by a decline of 5.1 percent in sales of paving asphalt of less than 200 penetration (from 924,135 short tons in 1934 to 877,466 tons in 1935). The most marked decrease (from 502,546 tons in 1934 to 433,454 tons in 1935) occurred in refineries of the East Coast district. Sales of paving asphalt by California refineries decreased from 139,566 tons in 1934 to 137,340 tons in 1935. Minor decreases also occurred in sales of paving asphalt by refineries of the Appalachian district; of Oklahoma, Kansas, and Missouri; of Texas Inland; and of the Rocky Mountain district. On the other hand, sales of paving asphalt by refineries of the Indiana-Illinois-Kentucky district increased from 76,188 tons in 1934 to 96,338 in 1935; by refineries of the Gulf coast of Texas and Louisiana from 107,266 tons in 1934 to 118,059 in 1935; and of northern Louisiana and Arkansas from 2,707 tons in 1934 to 37,232 in 1935.

Sales of paving asphalt made from foreign crude petroleum decreased 13.1 percent (from 526,884 tons in 1934 to 457,695 in 1935). On the other hand, sales of paving asphalt made from domestic crude increased 5.7 percent (from 397,251 tons in 1934 to 419,771 in 1935).

In contrast, sales of semiliquid and liquid asphalts for highway purposes increased considerably, chiefly because of greater construction of the lighter types of highway. Sales increased of cut-back asphalts from 624,183 tons in 1934 to 707,953 in 1935; and of emulsified asphalts by petroleum refineries from 32,518 tons in 1934 to 39,861 in 1935.

The greatest gains in sales of cut-back asphalts were in central United States, increasing in refineries of the Indiana-Illinois-Kentucky district from 81,382 tons in 1934 to 117,608 in 1935; of the Oklahoma-Kansas-Missouri district from 33,156 tons in 1934 to 69,417 in 1935; and of the Rocky Mountain district from 22,997 tons in 1934 to 69,986 in 1935. Smaller gains occurred in sales by refineries of Louisiana and Arkansas, in contrast to decreases in sales of cut-back asphalts by refineries of the Appalachian district, Texas, and California. However, East Coast refineries continued to sell more than two-fifths of the national total. They increased their sales of cut-back asphalts from 291,948 tons in 1934 to 307,095 in 1935.

Petroleum refineries sold 32,518 short tons (7,660,736 gallons) of asphalts and fluxes emulsified with water, valued at $496,774, and 39,861 tons (9,390,633 gallons), valued at $359,650, in 1935. In addition, 31,963,798 gallons, valued at $3,120,252, were sold in 1934 by industrial companies that purchased asphalt from petroleum refineries and 33,248,105 gallons, valued at $3,434,877, in 1935. Accordingly, sales of emulsified asphalts and fluxes increased 7.6 percent in quantity (from 39,624,534 gallons in 1934 to 42,638,738 gallons in 1935) and 4.9 percent in value (from $3,617,026 in 1934 to $3,794,527 in 1935).

Twenty-eight percent of the asphalt sold by petroleum refineries in 1934 and nearly 29 percent in 1935 was used for the manufacture of prepared roofing. Revival of building construction was responsible for an increase of 21.2 percent in sales of roofing asphalt and flux—from 751,790 short tons in 1934 to 911,216 in 1935. This is indicated by statistics released by the Bureau of the Census, which show an increase of 12.8 percent in factory shipments of prepared roofing and asphalt brick siding and of 30.1 percent in factory shipments of dry roofing felt. The chief increases in sales of roofing asphalt and flux occurred in the Indiana-Illinois-Kentucky district (from 180,085 tons in 1934 to 280,314 in 1935) and the East Coast district (from 289,330 tons in 1934 to 353,349 in 1935). Smaller increases in the California district (from 97,667 tons in 1934 to 106,265 in 1935) and in the Appalachian district counterbalanced declines in the Oklahoma-Kansas-Missouri district, in Texas, and in Louisiana.

Building construction was responsible for the demand for 4.9 percent of the asphalt sold in 1934 and 6.6 percent of that sold in 1935 in the form of waterproofing asphalt and flux, mastic and mastic flux, and paints, enamels, japans, and lacquers. Such sales increased 58.7 percent—from 126,172 tons in 1934 to 200,203 in 1935. This coincided with an increase of 66.2 percent in the floor space of building contracts awarded in 37 States, as compiled by the F. W. Dodge Corporation.

While the manufacture of coal briquets increased 22.1 percent (from 704,856 short tons in 1934 to 860,707 in 1935) sales of briquetting asphalt increased only 9.1 percent (from 37,544 tons in 1934 to 40,945 in 1935). Continued economy in the use of binders was apparently responsible for this lower rate of increase.

Although the consumption of rubber, crude and reclaimed, in the United States increased 10 percent in 1935 over 1934, according to the Survey of Current Business, refinery sales of asphalt for blending with rubber declined 8.9 percent—from 16,606 tons in 1934 to 15,131 in 1935.

Improvement in the demand for electrical equipment led to greater sales of asphaltic molding compounds—from 11,120 tons in 1934 to 14,670 in 1935.

The major varieties of asphalt declined in price during 1935. The average sales value of paving asphalt decreased from $10.77 per short ton in 1934 to $10.03 in 1935; of roofing asphalt, from $10.76 in 1934 to $10.70 in 1935; of waterproofing asphalt, from $10.99 in 1934 to $10.87 in 1935; and of cut-back asphalts, from $12.06 in 1934 to $10.46 in 1935. On the other hand, the average sales value of briquetting asphalt increased from $10.99 per short ton in 1934 to $11.14 in 1935; of pipe coatings, from $14.24 in 1934 to $16.41 in 1935; and of roofing flux, from $7.52 in 1934 to $7.71 in 1935.

DOMESTIC DEMAND

The indicated domestic demand for petroleum asphalt (including small quantities of imported lake asphalt and grahamite) was 17.8 percent greater in 1935 than in 1934. It increased from 191,337 short tons a month in 1933 and 214,116 in 1934 to 252,304 in 1935.

In terms of the long-time trend the indicated demand for asphalt was 13 percent below the expected demand for 1935 compared with 23.5 percent below the expected demand for 1934; that is, if the national demand for asphalt had continued the average rate of growth it manifested from 1908 to 1931, it would have averaged 270,246 tons a month in 1933, 280,061 tons a month in 1934, and 290,035 tons a month in 1935. Using these averages as a standard of comparison, the indicated demand of 214,116 tons a month in 1934 was 76.5 percent of the expected demand (280,061 tons) in 1934, and the indicated demand of 252,304 tons a month in 1935 was 87 percent of the expected demand (290,035 tons) in 1935.

However, the demand for asphalt is seasonal to a marked degree, reaching its maximum in August and its minimum in February. Normally, 62 percent of the refinery sales occur in the 6 months from May 1 to October 1; from 1932 to 1935, 69 percent of the annual total was sold in these months. Consequently, to furnish an adequate standard of comparison, the monthly trend values are multiplied by a "seasonal factor" for each month.

Demand for asphalt was lowest in the first 3 months of 1935, averaging 62 percent of the long-time trend multiplied by seasonal factors compared with 48 percent in the first 3 months of 1934. In the second quarter of 1935 it continued to recover, averaging 83 percent of the expected demand for these months compared with 80 percent during the second quarter of 1934. From July to September 1935 domestic demand exceeded the trend for the first time since the third quarter of 1930, averaging 101 percent of the expected demand compared with 86 percent in the same months of 1934. In the last

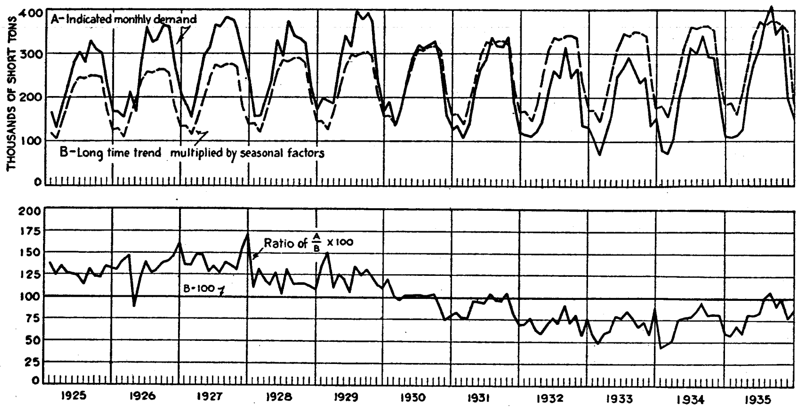

FIGURE 112.—Relation of indicated monthly demand for asphalt, 1925–35, to long-time trend, 1908–31, multiplied by seasonal factors. The long-time trend is expressed by the formula, log Y=1.095818+0.944148 log X, in which Y equals the average monthly demand for petroleum and lake asphalt during each year and X equals the number of years, beginning with 1907 as zero. The coefficient of correlation for this formula is 0.955. The seasonal factors were calculated for 1925–31 by the method of link relatives.

quarter of 1935 the indicated demand averaged 89 percent of the expected demand compared with 77 percent of the expected demand in the last 3 months of 1934.

Relation of indicated asphalt demand to basic trend multiplied by seasonal factors, 1934–35

Month	1934			1935		
	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	180,633	79,668	44.10	188,610	109,484	58.05
February	154,976	74,098	47.81	161,579	111,281	68.87
March	204,741	105,912	51.73	213,147	129,315	60.67
April	267,377	201,766	75.46	277,941	227,962	82.02
May	328,299	253,525	77.22	340,763	280,178	82.22
June	360,942	314,410	87.11	374,088	318,315	85.09
July	356,795	301,841	84.60	368,607	374,109	101.49
August	363,296	341,563	94.02	375,394	411,849	109.71
September	362,628	291,937	80.51	374,146	345,421	92.32
October	354,105	291,560	82.34	364,807	365,543	100.20
November	246,279	199,613	81.05	253,346	199,966	78.93
December	183,028	113,502	62.01	188,001	154,225	82.03
	------------	2,569,395	------------	------------	3,027,648	------------

DISTRIBUTION BY RAIL

The tonnage of asphalt (natural, byproduct, or petroleum) terminated by class I railroads in the United States increased 11.1 percent—from 2,760,126 short tons (revised figure) in 1934 to 3,067,116 in

1935—according to freight-commodity statistics compiled by the Interstate Commerce Commission. In spite of smaller deliveries in northern New England, the gains were greatest north of the Potomac and Ohio Rivers and east of the Mississippi and Illinois Rivers. There were also substantial gains west of the Mississippi River and Lake Michigan, especially north of St. Louis, Kansas City, Amarillo, and El Paso. Less asphalt was terminated, however, in the South Atlantic States in 1935 than in 1934 and slightly less by certain railroads operating in Missouri, Oklahoma, and northern Texas.

Fifty-four percent of the asphalt (petroleum, lake, and natural rock) terminated in the United States by land carriers in 1935 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 motor trucks terminated 1,897,239 short tons of asphalt in this district in 1934 and 2,046,889 in 1935. 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 340,416 tons in 1934 to 374,300 in 1935. In the Southwestern district west of the Mississippi and Pearl Rivers and south of St. Louis, Kansas City, and Amarillo, asphalt deliveries by rail and truck increased from 175,973 tons in 1934 to 189,699 in 1935. The principal gain was in the North Central district—from 277,553 tons in 1934 to 424,988 in 1935. In the Pacific-Rocky Mountain district west of Great Falls, Cheyenne, Denver, Albuquerque, and El Paso, the tonnage of asphalt terminated by land carriers increased from 304,397 tons in 1934 to 319,855 in 1935.

Supply and distribution of asphalt (petroleum, lake, and natural rock), exclusive of road oil in continental United States, by districts, in 1935, in short tons

	Northeastern district	Southeastern district	Southwestern district	North Central district	Pacific-Rocky Mountain district
SOURCE					
Produced within district	1,783,044	395,077	821,098		635,120
Imported	27,142	23,542	3,139		129
Received by rail from:					
Northeastern district		31,215	3,500	288,203	
Southeastern district	363,567				
Southwestern district	89,388	278,420		110,143	19,871
Pacific-Rocky Mountain district	[1] 32,513		54,958	27,456	
Received by water (coastwise, intraport, and river)	192,941	25,838	3,309		30,606
	2,488,595	754,092	886,004	425,802	685,726
DISTRIBUTION					
Shipped by rail:					
Within district	1,972,553	353,300	133,744	424,998	287,509
To Northeastern district		363,567	89,388		[1] 32,513
To Southeastern district	31,215		278,420		
To Southwestern district	3,500				54,958
To North Central district	288,203		110,143		27,456
To Pacific-Rocky Mountain district			19,871		
Shipped by water (coastwise, intraport, and river)	23,500	9,445	96,099		123,650
Shipped by motor truck	74,336	21,000	55,955		32,346
Exported	33,912	1,030	100,217	804	106,085
Added to stocks	61,376	5,750	2,167		21,209
	2,488,595	754,092	886,004	425,802	685,726

[1] Shipped chiefly by water.

Through the cooperation of the Bureau of Railway Economics, a survey was made of asphalt (natural, byproduct, and petroleum) originated and terminated by the principal class I railroads, by

States of origin and destination, together with receipts from deliveries to connecting carriers. These data, supplemented by information from the files of the Interstate Commerce Commission regarding the smaller railroads, have made it possible to estimate with a reasonable degree of accuracy the quantities terminated by rail in each State and to bring down to date the terminations by States published in the asphalt chapter of Mineral Resources of the United States, 1928, part II, page 413. These figures, however, do not include petroleum or natural asphalt delivered to consumers by motor truck or by water. They include for 1935 about 88 percent of the asphalt, native and manufactured, delivered to consumers in continental United States.

There are, accordingly, certain limitations on any comparison between the quantities terminated in any particular State in 1928 and in 1935. For instance, the sharp drop in Texas from 1928 to 1935 apparently is due to the noninclusion of shipments by motor truck and by water and to shipments of natural-rock asphalt by rail under other designations. Moreover, paving activities in any particular State fluctuate considerably from year to year. Significant comparisons may be made with more assurance between groups of States in either year or between the apparent requirements of a group of States in 1928 and in 1935.

Asphalt (natural, by product, and petroleum) terminated by class I and class II railroads in the United States, 1928 and 1935, by States, in short tons

Districts and States	1928	1935
New England:		
Maine	7,061	8,460
New Hampshire	9,190	3,971
Vermont	6,933	5,273
Massachusetts	152,282	119,600
Rhode Island	5,694	3,679
Connecticut	43,843	43,305
Total, New England	225,003	184,288
Middle Atlantic:		
New York	286,510	248,723
New Jersey	211,557	141,906
Pennsylvania	289,168	324,366
Total, Middle Atlantic	787,235	714,995
South Atlantic:		
Delaware	5,869	3,047
Maryland	22,456	28,564
District of Columbia	988	13,233
Virginia	26,775	87,436
West Virginia	22,448	31,726
North Carolina	29,474	42,437
South Carolina	25,311	22,844
Georgia	59,925	27,360
Florida	58,815	17,489
Total, South Atlantic	252,061	274,136
East North Central:		
Ohio	329,262	554,285
Indiana	136,602	158,466
Illinois	391,057	333,301
Michigan	131,516	108,604
Wisconsin	44,976	119,782
Total, East North Central	1,033,413	1,274,438
East South Central:		
Kentucky	39,799	58,813
Tennessee	43,675	30,558
Alabama	38,863	18,713
Mississippi	15,496	15,924
Total, East South Central	137,833	124,008
West North Central:		
Minnesota	51,857	78,180
Iowa	14,587	23,502
Missouri	66,062	44,830
North Dakota	4,116	11,054
South Dakota	768	15,142
Nebraska	13,906	12,240
Kansas	8,977	18,174
Total, West North Central	160,273	203,122
West South Central:		
Arkansas	7,019	12,187
Louisiana	65,887	47,237
Oklahoma	18,671	13,853
Texas	118,248	25,312
Total, West South Central	209,825	98,589
Mountain:		
Montana	7,115	31,456
Idaho	118	5,958
Wyoming	3,152	30,206
Colorado	8,912	30,265
New Mexico	2,521	1,173
Arizona	8,527	2,968
Utah	3,166	16,079
Nevada	670	12,619
Total, Mountain	34,181	130,724
Pacific:		
Washington	10,909	28,462
Oregon	8,950	19,619
California	153,471	119,723
Total, Pacific	173,330	167,804
United States	3,013,154	3,172,104

FOREIGN TRADE

Imports.—Imports of asphalt and bitumen into the United States increased from 15,679 short tons valued at $222,372 in 1934 to 53,972 tons valued at $544,651 in 1935. The principal gain was in receipts of lake asphalt from Trinidad, which increased from 9,606 tons valued at $108,442 in 1934 to 38,824 tons valued at $403,117 in 1935. Imports of grahamite from Cuba increased from 5,861 tons valued at $99,042 in 1934 to 6,011 tons valued at $99,667 in 1935. For the first time petroleum asphalt was received from the Netherland West Indies in 1935 to the amount of 8,809 tons valued at $25,950.

Atlantic coast ports, chiefly New York, Baltimore, and Norfolk, received 41,163 tons valued at $382,858 in 1935 compared with 14,220 tons valued at $189,840 in 1934; and Gulf coast ports (Mobile, New Orleans, and Galveston) received 12,659 tons valued at $158,437 in 1935 compared with 1,014 tons valued at $17,293 in 1934.

Petroleum asphalt exported from the United States, 1933–35, by countries

Country	1933		1934		1935	
	Short tons	Value	Short tons	Value	Short tons	Value
North America:						
Canada	3,492	$67,665	2,937	$63,113	4,203	$78,707
Other North America	5,461	91,884	6,927	109,509	8,105	118,709
	8,953	159,549	9,864	172,622	12,308	197,416
South America:						
Argentina	5,900	89,300	2,120	40,729	421	7,846
Brazil	2,233	35,077	3,713	64,970	3,321	55,785
Other South America	3,200	51,111	2,599	42,159	2,070	34,594
	11,333	175,488	8,432	147,858	5,812	98,225
Europe:						
Belgium	3,778	56,775	4,183	66,578	3,918	58,666
Denmark	121	3,253	1,781	30,356	144	4,590
France	11,160	153,225	14,815	217,956	6,228	100,580
Germany	4,880	79,837	5,031	89,599	1,954	44,311
Italy	26,863	331,491	28,765	417,273	27,365	424,815
Netherlands	6,656	98,026	7,136	120,091	1,272	20,779
Spain	4,595	60,802	4,819	65,981	4,773	60,842
United Kingdom	17,141	334,145	22,107	461,624	25,578	516,325
Other Europe	3,239	47,883	4,511	80,291	4,021	65,211
	78,433	1,165,437	93,148	1,549,749	75,253	1,296,119
Asia:						
Ceylon	5,141	69,004	6,788	76,210	2,992	44,094
China	5,367	77,734	3,816	59,695	8,059	112,811
East Indies:						
British:						
India	13,635	174,473	7,984	123,082	17,068	231,513
Malaya	5,441	78,579	7,566	114,403	9,185	139,250
Netherland	18,586	204,518	24,012	284,354	12,700	170,109
French Indo-China	2,572	40,870	3,612	48,306	7,757	103,323
Hong Kong	2,347	35,402	3,276	51,967	2,443	35,197
Japan	3,704	59,380	4,003	61,705	4,880	77,932
Philippine Islands	9,368	94,683	9,989	108,736	13,846	143,789
Other Asia	1,999	37,801	142	2,646	343	6,350
	68,160	872,444	71,188	931,104	79,273	1,064,368
Africa:						
Algeria and Tunisia			42	659		
Mozambique	1,422	22,863	5,526	85,518	2,708	42,657
Union of South Africa	8,117	132,470	7,541	118,555	8,264	128,746
Other Africa	739	14,802	1,436	28,114	8,540	130,400
	10,278	170,135	14,545	232,846	19,512	301,803
Oceania:						
Australia	24,965	293,596	23,065	298,678	24,385	329,180
New Zealand	1,821	22,950	3,505	48,438	6,229	82,201
Other British	89	1,365	159	2,148	53	1,247
	26,875	317,911	26,729	349,264	30,667	412,628
	204,032	2,860,964	223,906	3,383,443	222,825	3,370,559

Exports.—Exports of petroleum asphalt were slightly less in 1935 than in 1934. Smaller shipments to northern and western Europe and to eastern South America were largely counterbalanced by greater sales (especially to the Far East) to northern and eastern Africa and to countries bordering the Indian Ocean. The decline in asphalt exports to France, the Netherlands, and Germany may be attributed to greater production of petroleum asphalt in those countries as well as to competition by Rumanian and Mexican refineries. In contrast to the countries of continental Europe, the United Kingdom imported more asphalt from all sources and received more petroleum asphalt from the United States in 1935 than in 1934. The increase in exports to the Mediterranean area was due almost entirely to unprecedented shipments to Italian Africa and Ethiopia; shipments to Italy, chief purchaser in the Mediterranean area, declined 5 percent. The greatest gain was in the exports to the Far East. Increased sales to China, French Indochina, the Philippine Islands, New Zealand, British Malaya, Australia, and Japan more than offset a decline in shipments to Netherland India. The gain in exports to the Indian Ocean region was due almost entirely to increased sales to British India, in contrast to decreased shipments to Ceylon and Mozambique.

Of the petroleum asphalt exported from the United States, 100,503 short tons passed through Pacific coast ports in 1935 compared with 87,521 in 1934; 90,214 tons through Gulf coast ports in 1935 compared with 89,847 in 1934; and 29,063 tons through Atlantic coast ports in 1935 compared with 43,780 in 1934.

ROAD OIL

Sales of road oil by petroleum refineries in the United States decreased 11.7 percent—from 7,702,753 barrels in 1934 to 6,798,932 barrels in 1935. This decrease, however, is more apparent than real; if the sales of road oil are taken in connection with sales of cut-back asphalts, emulsified asphalts, and paving flux, there was a loss of 3 percent in the total sales of liquid and semiliquid asphalts used primarily for highway construction—from 12,702,692 barrels in 1934 to 12,316,545 in 1935. So far as these grades of liquid and semiliquid asphalts can be defined with precision, the decrease in sales of road oil and the increase in sales of cut-back asphalts may represent either changes in specifications or changes in demand for definite products.

The principal decreases occurred in the Rocky Mountain district, in the Indiana-Illinois-Kentucky district, and in the Gulf coast of Texas. A decrease of 378,949 barrels in road oil sold by Rocky Mountain refineries was partly compensated for by an increase of 258,440 barrels in sales of cut-back asphalts; and a decrease of 344,622 barrels in sales of road oil in the Indiana-Illinois-Kentucky district by an increase of 204,743 barrels of cut-back asphalts sold. On the other hand, a decrease of 104,919 barrels in sales of road oil by refineries of the Texas Gulf coast was paralleled by a decrease of 52,844 barrels in sales of cut-back asphalt.

In contrast to the general decline, sales of road oil by refineries of the East Coast, and of Louisiana, showed marked increases. An increase of 63,792 barrels in road-oil sales by East coast refineries was paralleled by an increase of 94,996 barrels in sales of cut-back

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asphalts; and an increase of 242,516 barrels in sales of road oil by Louisiana refineries by an increase of 106,205 barrels in sales of cut-back asphalts.

In California, a decrease of 36,651 barrels in sales of road oil was paralled by a decrease of 171,314 barrels in sales of cut-back asphalts.

Road oil sold by petroleum refineries in the United States, 1934–35, by districts

District	1934		1935	
	Barrels	Value	Barrels	Value
East coast	938,053	$1,392,665	1,001,845	$1,614,179
Appalachian	88,195	186,298	34,035	64,437
Indiana-Illinois-Kentucky	1,984,414	2,390,175	1,957,569	2,439,100
Oklahoma-Kansas-Missouri	942,072	1,071,260	597,450	547,789
Texas:				
Gulf coast	204,888	274,188	99,969	153,069
Rest of State	79,969	79,963	22,772	35,775
Total Texas	284,857	354,151	122,741	188,844
Louisiana-Arkansas:				
Louisiana Gulf coast	52,464	95,089	68,203	103,334
Northern Louisiana and Arkansas	157,992	158,104	384,769	357,745
Total Louisiana and Arkansas	210,456	253,193	452,972	461,079
Rocky Mountain	1,023,434	1,431,920	644,485	1,032,907
California	2,231,272	3,662,336	1,987,835	2,194,621
Grand total	7,702,753	10,741,998	6,798,932	8,542,956

Of the road oil sold in the United States in 1935, only 813,308 barrels, valued at $572,160, were made from foreign petroleum imported from Venezuela and Mexico. Of the road oil made from foreign crude, 87.5 percent was sold by refineries of the Atlantic seaboard in 1934 and 88.7 percent in 1935; the remainder was made in Gulf coast refineries of Louisiana and Texas.

Petroleum refineries in the United States reported the production of 6,030,491 barrels of road oil in 1935 compared with 6,210,390 in 1934. The refinery output of road oil was augmented in 1935 by 1,399,656 barrels of other petroleum products, chiefly fuel oil, transferred to road-oil stocks compared with 1,456,354 barrels similarly transferred in 1934. Stocks of road oil and of transferred oils held at refineries increased from 663,847 barrels on December 31, 1934, to 731,965 on December 31, 1935. Consumption of road oil at refineries in their own operations, transfers, losses, and adjustments took 563,097 barrels during 1935 compared with 132,882 in 1934.

Local prices of road oil showed marked changes in 1935 compared with 1934. The average value of road oil sold by petroleum refineries in the United States declined from $1.39 per barrel in 1934 to $1.26 per barrel in 1935. The principal declines were in California, from $1.64 per barrel in 1934 to $1.10 in 1935; in the Oklahoma-Kansas-Missouri district, from $1.14 in 1934 to $0.91 in 1935; and in northern Louisiana and Arkansas, from $1 in 1934 to $0.93 in 1935. On the other hand, the average sales value in the East Coast district rose from $1.48 in 1934 to $1.61 in 1935; in the Indiana-Illinois-Kentucky district from $1.20 in 1934 to $1.25 in 1935; and in the Rocky Mountain district from $1.40 in 1934 to $1.60 in 1935.

CEMENT [1]

By B. W. BAGLEY

SUMMARY OUTLINE

As compiled from annual reports of the producers, supplemented by a few estimates, production of portland cement in 1935 amounted to 76,751,419 barrels, a decline of 1 percent compared with 1934. Shipments were 75,238,594 barrels valued at $113,504,670, a decrease of 1 percent in quantity and nearly 3 percent in gross value compared with the preceding year.

The general average value of shipments for the whole country was $1.51 per barrel, 3 cents less than in 1934.

In 1935 two new plants, the first for many years, began producing portland cement—one in Idaho, the other in eastern Pennsylvania.

Many improvements also were made to existing plants in 1935, as in 1934, to increase plant efficiency and reduce cost of production. Among the reported additions to plant equipment were the following: New clinker coolers, new rock-storage facilities and cement-storage silos, air separators and dust-collecting equipment, cement-conveying pumps, waste-heat boiler, additional equipment for the manufacture of high-early-strength cement, electrical testing and control devices to reduce cost of purchased power, equipment for manufacture of solid carbon dioxide (dry ice) as a cement-kiln byproduct from kiln gas, additional slurry basin, and a Lepol kiln system, the first of its kind in the United States though widely used in Europe and other parts of the world.

Production of natural and puzzolan-lime cements, including masonry cements of the natural-cement class, increased in 1935 and exceeded the output in 1934 by 49.8 percent. Shipments of these cements increased 49.1 percent in quantity and 49.6 percent in gross value.

CHIEF HYDRAULIC CEMENTS

Shipments of portland and other (masonry, natural, and puzzolan-lime) cements from mills in the United States in 1935 decreased 0.4 percent in quantity and more than 2 percent in value compared with

[1] Figures for 1935 are subject to slight revision based upon completion of detailed tabulations of final returns.

1934. Statistics of the output of alumina cement, representing the operations of only one manufacturer in the United States, are not included in the tables of this report.

The accompanying table gives statistics of output of portland and other (natural and puzzolan-lime) hydraulic cements from 1931 to 1935.

Principal hydraulic cements produced and shipped in the United States, 1931–35

Year	Number of active plants	Production				
		Portland cement (barrels)	Masonry, natural, and puzzolan cements		Total	
			Number of active plants	Barrels	Number of active plants	Barrels
1931	160	125,429,071	12	1,241,803	172	126,670,874
1932	160	76,740,945	15	456,785	175	77,197,730
1933	152	63,473,189	13	466,632	165	63,939,821
1934	150	77,747,765	14	671,588	164	78,419,353
1935	150	76,751,419	13	1,006,064	163	77,757,483

Year	Shipments					
	Portland cement		Masonry, natural, and puzzolan cements		Total	
	Barrels	Value	Barrels	Value	Barrels	Value
1931	127,150,534	$140,959,906	1,226,850	$1,619,920	128,377,384	$142,579,826
1932	80,843,187	82,021,723	524,844	696,474	81,368,031	82,718,197
1933	64,282,756	85,600,717	432,415	571,648	64,715,171	86,172,365
1934	75,901,279	116,921,084	678,204	960,732	76,579,483	117,881,816
1935	75,238,594	113,504,670	1,011,411	1,437,542	76,250,005	114,942,212

PORTLAND CEMENT

PRODUCTION, SHIPMENTS, AND STOCKS

The production of portland cement in the United States amounted to 76,751,419 barrels, a decline of 1 percent compared with 1934. Shipments were 75,238,594 barrels valued at $113,504,670, a decrease of 1 percent in quantity and nearly 3 percent in gross value compared with the preceding year. The average factory value per barrel in bulk was $1.51—3 cents lower than in 1934.

The production—76,751,419 barrels of 376 pounds net—is equivalent to 307,005,676 sacks, 12,883,274 long tons, or 14,429,267 short tons. In 1935 production exceeded shipments by 1,512,825 barrels.

In the following table the statistics are arranged by States so far as permissible and by 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.

Portland cement produced, shipped, and in stock in the United States, 1934–35, by States and districts

	Active plants		Production			Shipments							Stock at mills (Dec. 31)		
			Barrels		Increase or decrease in 1935 (percent)	1934		1935		Average factory value per barrel		Increase or decrease in quantity, 1935 (percent)	Barrels		Increase or decrease, 1935 (percent)
	1934	1935	1934	1935		Barrels	Value	Barrels	Value	1934	1935		1934 (revised)	1935	
STATE															
Alabama	6	5	2,208,279	2,493,291	+13	2,181,513	$3,017,329	2,483,616	$3,521,418	$1.38	$1.42	+14	485,559	495,234	+2
California	10	10	8,721,854	7,974,201	−9	8,395,037	12,449,389	8,140,802	11,183,953	1.48	1.37	−3	1,437,533	1,270,932	−12
Illinois	4	4	4,124,805	3,367,512	−18	3,908,107	5,498,568	3,276,990	4,621,856	1.41	1.41	−16	805,804	896,326	+11
Iowa	5	5	3,180,546	3,519,558	+11	3,340,049	5,094,922	3,203,301	5,072,098	1.53	1.58	−4	1,445,613	1,761,870	+22
Kansas	6	6	2,497,911	2,337,444	−6	2,425,867	3,734,493	2,487,888	3,778,104	1.54	1.52	+3	995,963	845,519	−15
Michigan	10	10	4,103,902	4,578,966	+12	3,945,375	5,920,214	4,325,134	5,971,720	1.50	1.38	+10	1,797,062	2,050,894	+14
Missouri	5	5	4,033,859	3,392,140	−16	3,779,125	5,449,606	3,291,332	4,933,751	1.44	1.50	−13	822,335	923,143	+12
New York	10	10	4,760,609	4,285,458	−10	4,730,257	7,503,270	4,240,461	6,612,399	1.59	1.56	−10	1,580,585	1,625,582	+3
Ohio	10	9	4,045,854	3,886,021	−4	3,674,384	5,565,525	3,701,127	5,320,994	1.51	1.44	+.7	1,561,837	1,746,731	+12
Pennsylvania	25	26	15,323,116	15,502,086	+1	15,435,648	23,138,676	15,034,441	21,917,366	1.50	1.46	−3	4,544,585	5,012,230	+10
Tennessee	6	6	2,481,379	2,702,622	+9	2,305,578	3,645,659	2,733,726	4,203,601	1.58	1.54	+19	590,903	559,799	−5
Texas	9	9	3,537,734	3,786,716	+7	3,418,781	5,995,677	3,715,300	6,422,807	1.75	1.73	+9	671,360	742,776	+11
Other States [1]	44	45	18,727,917	18,925,404	+1	18,361,558	29,907,756	18,604,476	29,944,603	1.63	1.61	+1	4,726,420	5,047,348	+7
	150	150	77,747,765	76,751,419	−1	75,901,279	116,921,084	75,238,594	113,504,670	1.54	1.51	−1	21,465,559	22,978,384	+7
DISTRICT															
Eastern Pennsylvania, New Jersey, and Maryland	22	23	14,917,633	14,581,492	−2	14,939,237	22,395,697	14,190,795	20,777,257	1.50	1.46	−5	3,579,843	3,970,540	+11
New York and Maine	11	11	5,015,615	4,582,936	−9	5,010,637	7,998,640	4,505,376	7,072,216	1.60	1.57	−10	1,676,779	1,754,339	+5
Ohio, western Pennsylvania, and West Virginia	19	18	7,355,563	7,310,330	−1	6,963,534	10,547,449	6,950,234	10,060,942	1.51	1.45	−.2	3,033,233	3,393,329	+12
Michigan	10	10	4,103,902	4,578,966	+12	3,945,375	5,920,214	4,325,134	5,971,720	1.50	1.38	+10	1,797,062	2,050,894	+14
Wisconsin, Illinois, Indiana, and Kentucky	11	11	9,079,458	8,204,274	−10	8,899,493	12,872,160	8,220,851	12,003,189	1.45	1.46	−8	2,043,275	2,026,698	−1
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	18	17	7,560,020	7,656,504	+1	7,257,757	11,173,407	7,675,206	11,709,897	1.54	1.53	+6	1,735,094	1,716,392	−1

[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.

Portland cement produced, shipped, and in stock in the United States, 1934–35, by States and districts—Continued

	Active plants		Production			Shipments							Stock at mills (Dec. 31)		
			Barrels		Increase or decrease in 1935 (percent)	1934		1935		Average factory value per barrel		Increase or decrease in quantity, 1935 (percent)	Barrels		Increase or decrease, 1935 (percent)
	1934	1935	1934	1935		Barrels	Value	Barrels	Value	1934	1935		1934 (revised)	1935	
DISTRICT—continued															
Eastern Missouri, Iowa, Minnesota, and South Dakota	11	11	7,786,482	7,876,617	+1	7,826,458	$11,646,388	7,442,709	$11,424,100	$1.49	$1.53	−5	2,458,774	2,892,682	+18
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	12	12	5,837,914	5,966,245	+2	5,549,945	8,789,590	6,059,932	9,350,994	1.58	1.54	+9	1,992,523	1,898,836	−5
Texas	9	9	3,537,734	3,786,716	+7	3,418,781	5,995,677	3,715,300	6,422,807	1.75	1.73	+9	671,360	742,776	+11
Colorado, Montana, Utah, Wyoming, and Idaho	8	9	2,181,218	2,336,204	+7	2,101,796	3,788,362	2,173,926	3,974,692	1.80	1.83	+3	449,903	612,181	+36
California	10	10	8,721,854	7,974,201	−9	8,395,037	12,449,389	8,140,802	11,183,953	1.48	1.37	−3	1,437,533	1,270,932	−12
Oregon and Washington	9	9	1,650,372	1,896,934	+15	1,593,229	3,344,111	1,838,329	3,552,903	2.10	1.93	+15	590,180	648,785	+10
	150	150	77,747,765	76,751,419	−1	75,901,279	116,921,084	75,238,594	113,504,670	1.54	1.51	−1	21,465,559	22,978,384	+7

The following table of production, shipments, and stocks of finished portland cement, by districts and by months for 1935, has been compiled from monthly reports on the operation of all but one plant. The table also gives monthly totals in 1934 compiled from reports for all but three plants in February, two plants in March and April, and one plant in the other months of the year, estimates have been included for these plants. Although the figures may differ slightly from the totals in other tables, which are based on final annual reports from the producers, they reflect accurately fluctuations in the industry during the year. In the colder part of the United States the production of portland cement necessarily is curtailed somewhat by the temperature during December, January, and February, as are also demand and, hence, shipments from the mills. Moreover, mills often close for repairs during the winter when the demand is lowest. As the quantity of clinker or unground cement produced and in reserve at the mills awaiting manufacture into finished cement is of interest, a table is given showing these statistics, compiled from the manufacturers' estimates.

Summary of monthly estimates of portland cement produced, shipped, and in stock at mills in the United States in 1935, 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	547	535	883	1,415	1,695	1,681	1,468	1,192	1,138	1,417	1,402	791
New York and Maine	0	3	141	444	664	587	577	544	592	543	283	193
Ohio, Western Pennsylvania, and West Virginia	54	61	248	542	783	996	917	817	903	895	685	403
Michigan	116	118	112	322	495	551	595	561	536	481	478	266
Wisconsin, Illinois, Indiana, and Kentucky	458	422	487	600	974	1,092	656	522	797	825	848	535
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	345	439	589	701	664	953	740	645	667	623	606	679
Eastern Missouri, Iowa, Minnesota, and South Dakota	467	372	393	368	848	907	905	930	724	612	676	677
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	295	255	267	430	671	725	687	695	400	516	508	552
Texas	294	221	278	347	355	275	470	261	259	283	327	435
Colorado, Montana, Utah, Wyoming, and Idaho	113	77	152	125	269	256	277	201	181	280	243	202
California	471	461	634	565	661	563	643	669	729	788	854	936
Oregon and Washington	42	89	115	277	143	139	86	198	247	247	183	134
United States, 1935	3,202	3,053	4,299	6,136	8,222	8,725	8,021	7,235	7,173	7,510	7,093	5,803
1934	3,779	4,168	5,257	6,544	8,554	8,813	8,144	7,842	7,680	6,675	5,779	4,447
SHIPMENTS												
Eastern Pennsylvania, New Jersey, and Maryland	471	432	919	1,309	1,601	1,469	1,347	1,486	1,302	1,577	1,125	764
New York and Maine	77	72	218	386	571	581	519	512	476	548	342	203
Ohio, Western Pennsylvania, and West Virginia	221	226	394	514	649	807	801	770	795	860	587	317
Michigan	75	81	177	288	386	495	535	572	617	676	321	173
Wisconsin, Illinois, Indiana, and Kentucky	181	231	458	539	764	878	1,052	1,091	1,043	1,073	566	349
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	461	458	594	671	733	796	724	778	639	665	619	527
Eastern Missouri, Iowa, Minnesota, and South Dakota	179	227	416	540	717	840	900	866	928	1,073	452	308
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	259	293	535	634	555	523	619	577	593	646	421	411
Texas	240	229	327	331	340	313	387	354	257	314	313	318
Colorado, Montana, Utah, Wyoming, and Idaho	128	105	116	161	170	182	183	231	305	289	174	142
California	482	467	555	634	738	569	589	693	663	932	917	899
Oregon and Washington	72	130	169	191	204	179	157	175	181	141	139	103
United States, 1935	2,846	2,951	4,878	6,198	7,428	7,632	7,813	8,105	7,799	8,794	5,976	4,514
1934	3,778	2,952	4,618	6,492	8,784	8,541	7,898	8,249	7,388	8,439	5,674	3,104

STOCKS (END OF MONTH)												
Eastern Pennsylvania, New Jersey, and Maryland	3, 659	3, 766	3, 729	3, 835	3, 930	4, 142	4, 263	3, 969	3, 805	3, 646	3, 923	3, 971
New York and Maine	1, 611	1, 542	1, 465	1, 522	1, 615	1, 621	1, 677	1, 712	1, 828	1, 823	1, 764	1, 754
Ohio, Western Pennsylvania, and West Virginia	2, 860	2, 703	2, 528	2, 556	2, 690	2, 882	2, 997	3, 045	3, 154	3, 189	3, 281	3, 393
Michigan	1, 869	1, 905	1, 839	1, 873	1, 982	2, 033	2, 092	2, 080	1, 994	1, 799	1, 956	2, 051
Wisconsin, Illinois, Indiana, and Kentucky	2, 331	2, 522	2, 551	2, 612	2, 821	3, 035	2, 639	2, 071	1, 824	1, 576	1, 859	2, 027
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	1, 619	1, 600	1, 596	1, 627	1, 558	1, 715	1, 731	1, 593	1, 619	1, 578	1, 565	1, 716
Eastern Missouri, Iowa, Minnesota, and South Dakota	2, 728	2, 873	2, 851	2, 679	2, 810	2, 877	2, 882	2, 945	2, 742	2, 281	2, 505	2, 892
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	2, 009	1, 971	1, 703	1, 499	1, 601	1, 803	1, 871	1, 989	1, 797	1, 665	1, 752	1, 899
Texas	725	717	666	682	688	651	734	641	642	611	625	743
Colorado, Montana, Utah, Wyoming, and Idaho	412	384	420	377	476	550	644	613	489	482	551	612
California	1, 402	1, 396	1, 476	1, 406	1, 330	1, 324	1, 378	1, 354	1, 420	1, 276	1, 213	1, 271
Oregon and Washington	560	520	465	551	490	450	379	403	469	575	619	649
United States, 1935	21, 785	21, 899	21, 289	21, 219	21, 991	23, 083	23, 287	22, 415	21, 783	20, 501	21, 613	22, 978
1934	19, 547	20, 762	21, 422	21, 557	21, 301	21, 600	21, 852	21, 424	21, 734	19, 972	20, 078	21, 466

[1] Revised figures.

Summary of monthly estimates of clinker (unground portland cement) produced and in stock at mills in the United States in 1935, 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	581	584	1,053	1,442	1,641	1,618	1,559	1,161	1,024	1,288	1,324	737
New York and Maine	0	0	75	447	677	679	657	583	525	465	275	200
Ohio, western Pennsylvania, and West Virginia	55	28	240	512	882	997	927	829	968	721	626	367
Michigan	123	110	137	291	483	560	576	522	510	475	420	257
Wisconsin, Illinois, Indiana, and Kentucky	450	354	512	629	1,006	1,089	689	521	729	770	791	534
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	358	431	495	552	727	998	757	740	651	628	565	483
Eastern Missouri, Iowa, Minnesota, and South Dakota	532	398	352	401	882	966	869	856	656	585	658	683
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	320	295	239	394	667	757	744	704	371	522	524	550
Texas	262	250	280	352	375	299	322	216	271	274	340	516
Colorado, Montana, Utah, Wyoming, and Idaho	73	80	160	158	241	308	269	219	208	266	242	199
California	560	520	645	596	640	588	565	594	632	698	791	890
Oregon and Washington	57	55	98	119	236	202	167	163	148	268	194	126
United States, 1935	3,371	3,105	4,286	5,893	8,457	9,061	8,101	7,108	6,693	6,960	6,750	5,542
1934	3,981	4,174	5,615	6,802	8,224	8,888	8,276	7,548	7,300	6,726	5,853	4,370
STOCKS (END OF MONTH)												
Eastern Pennsylvania, New Jersey, and Maryland	690	741	922	950	914	864	965	948	840	719	658	637
New York and Maine	340	337	272	280	299	394	484	523	461	388	381	391
Ohio, Western Pennsylvania, and West Virginia	643	607	599	571	673	686	691	706	771	610	549	514
Michigan	778	771	796	771	763	792	788	755	755	771	722	502
Wisconsin, Illinois, Indiana, and Kentucky	353	285	312	340	371	370	403	402	334	278	221	220
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	649	627	547	402	468	518	538	637	624	631	593	402
Eastern Missouri, Iowa, Minnesota, and South Dakota	510	537	500	535	579	638	609	543	484	467	457	444
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	367	404	376	341	331	364	427	437	391	397	416	413
Texas	184	218	219	229	244	284	139	94	107	101	118	204
Colorado, Montana, Utah, Wyoming, and Idaho	22	25	33	62	35	88	80	98	125	111	111	109
California	1,441	1,489	1,475	1,500	1,454	1,443	1,340	1,294	1,204	1,119	1,069	1,081
Oregon and Washington	341	307	292	141	234	300	385	342	272	299	312	309
United States, 1935	6,318	6,348	6,343	6,122	6,365	6,741	6,849	6,779	6,368	5,891	5,607	5,226
1934	5,919	5,936	6,318	6,565	6,304	6,424	6,588	6,332	5,975	6,055	6,213	6,166

Producers' stocks of portland cement reported on hand at the mills increased each month except March and April in 1935 compared with the corresponding month in 1934. Reserves at the end of 1935 were more than 7 percent higher than those at the end of 1934 and nearly 3 percent above the average for the 5 preceding years (22,332,602 barrels). Totals by States and districts are given in the preceding tables. The following table gives stocks on December 31 and the monthly range, 1931 to 1935.

Producers' stocks of finished portland cement and clinker (unground cement) on hand at mills in the United States on Dec. 31 and monthly range, 1931–35

		Dec. 31 (barrels)	Monthly range			
			Low		High	
			Month	Barrels	Month	Barrels
1931	Cement	24,342,446	October	21,218,000	April	29,715,000
	Clinker	7,035,000	do	6,021,000	do	13,854,000
1932	Cement	20,351,058	do	17,084,000	March	27,545,000
	Clinker	5,995,000	November	5,938,000	April	10,511,000
1933	Cement	19,605,323	October	19,502,000	August	22,078,000
	Clinker	5,717,000	December	5,717,000	April	7,146,000
1934	Cement	[1] 21,465,559	January	19,547,000	July	21,852,000
	Clinker	6,137,000	do	5,919,000	do	6,588,000
1935	Cement	22,978,384	October	20,501,000	do	23,287,000
	Clinker	5,226,000	December	5,226,000	do	6,849,000

[1] Revised figures.

DOMESTIC CONSUMPTION

The total consumption of portland cement in the United States may be estimated by adding the imports to the shipments and subtracting the exports from the sum. Of course, at any time a variable but considerable quantity of cement is in transit, in warehouses at distributing points, and awaiting use at jobs, so that the estimate thus made is at best only approximate. Another item requiring careful interpretation is the fact that the cement imported and exported is classed as hydraulic; hence, the records do not discriminate between portland and other cements and probably include some plaster also. Portland cement, however, constitutes by far the greater part of the exports. The apparent domestic consumption decreased 0.2 percent in 1935 compared with 1934.

Portland cement available for consumption in the United States, 1931–35, in barrels

Year	Shipments	Imports	Exports	Available for consumption
1931	127,150,534	457,238	429,653	127,178,119
1932	80,843,187	462,496	374,581	80,931,102
1933	64,282,756	472,550	680,307	64,074,999
1934	75,901,279	261,844	566,171	75,596,952
1935	75,238,594	617,022	416,099	75,439,517

The following table of monthly shipments from portland-cement mills into States in 1935 has been compiled from monthly reports of producers but includes estimates of the distribution of shipments from one plant for January, February, March, May, and June.

Portland cement shipped from mills into States in 1935, by months, in barrels [1]

Shipped to—	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Alabama	85,084	65,390	67,729	96,949	125,624	138,049	105,145	132,834	100,679	73,468	122,120	99,265
Alaska	132	1,588	1,385	1,292	3,606	2,911	3,199	2,292	857	334	132	405
Arizona	17,885	16,491	17,528	22,051	25,304	29,807	22,218	25,040	24,949	34,896	38,758	38,394
Arkansas	34,062	42,333	52,457	49,810	45,982	30,346	42,263	50,882	56,781	53,578	48,212	30,174
California	339,386	360,366	476,831	544,178	625,651	492,178	521,594	593,886	544,526	771,275	764,226	739,297
Colorado	31,312	30,801	44,198	49,795	46,922	48,748	49,355	46,828	51,827	66,384	65,551	64,966
Connecticut	16,359	17,528	44,031	83,903	85,474	79,855	84,991	103,114	91,619	114,010	73,453	39,492
Delaware	7,425	7,005	15,766	23,872	16,101	18,886	11,516	20,864	14,238	14,106	12,842	8,520
District of Columbia	35,783	36,507	68,517	81,020	86,975	66,721	82,679	82,749	70,140	94,483	77,676	49,049
Florida	59,973	54,051	65,735	61,651	72,599	77,243	73,284	66,627	61,908	86,305	84,531	90,171
Georgia	44,636	46,181	83,098	101,377	133,220	97,310	81,920	127,639	141,258	123,618	100,839	85,247
Hawaii	30,129	34,756	31,588	20,496	18,015	12,585	9,978	14,871	16,595	16,302	12,005	25,975
Idaho	5,028	5,343	13,644	22,159	19,887	20,828	19,795	23,118	29,341	31,943	18,519	11,920
Illinois	133,855	159,240	304,977	352,243	414,793	460,779	675,717	701,896	627,998	613,827	304,021	183,527
Indiana	42,793	49,847	165,272	112,689	184,260	270,703	320,488	315,188	308,737	333,169	155,181	81,564
Iowa	27,054	33,454	105,062	156,608	221,903	258,873	255,219	198,781	240,838	315,799	62,821	42,284
Kansas	60,540	67,982	128,846	161,810	126,450	145,962	194,735	124,419	116,845	120,303	94,244	96,312
Kentucky	35,012	33,817	65,020	70,274	84,807	92,233	86,536	99,151	155,170	179,911	98,015	52,552
Louisiana	48,233	49,374	59,995	58,818	95,508	77,777	96,395	113,190	89,471	124,880	117,840	98,116
Maine	2,781	2,682	5,478	20,740	26,798	30,631	30,759	32,836	30,586	36,156	16,472	8,724
Maryland	48,618	33,884	74,697	90,865	123,296	102,149	91,580	105,431	83,589	104,978	80,063	44,280
Massachusetts	39,098	35,667	96,228	162,892	195,075	157,475	165,878	177,197	156,658	188,878	118,469	79,530
Michigan	55,021	60,452	125,537	213,323	325,652	388,582	390,785	432,487	472,668	515,745	261,662	138,704
Minnesota	18,886	29,915	76,326	117,261	189,755	224,024	179,841	193,029	229,383	333,981	76,120	50,311
Mississippi	35,029	27,488	35,453	51,224	49,027	57,885	45,768	39,909	42,774	55,515	48,710	27,847
Missouri	71,721	77,486	147,071	154,777	139,741	185,560	241,883	287,220	259,108	232,514	178,879	146,143
Montana	27,077	16,396	42,471	58,133	86,222	59,625	63,009	72,714	72,324	85,178	54,710	46,663
Nebraska	13,186	25,557	64,916	120,758	115,588	120,153	123,302	163,256	269,681	227,999	57,533	38,898
Nevada	146,814	72,592	24,408	52,504	74,407	23,351	14,192	38,414	28,982	23,076	25,101	21,840
New Hampshire	5,964	5,917	14,295	23,726	30,588	26,211	18,979	26,396	25,316	29,201	19,325	11,134
New Jersey	64,354	60,036	145,437	212,855	249,411	250,449	231,219	239,406	209,997	254,939	183,792	140,009
New Mexico	26,954	18,293	25,998	22,101	20,974	22,590	26,049	25,433	24,471	28,559	29,947	29,930
New York	200,557	176,911	434,962	648,373	874,362	866,247	836,461	879,610	816,484	956,807	655,845	423,555
North Carolina	40,442	44,070	69,516	81,696	85,776	93,280	77,277	72,023	64,466	77,251	70,668	51,867
North Dakota	2,500	5,132	10,075	27,564	37,007	45,148	41,869	31,736	29,770	25,558	3,837	3,371
Ohio	110,874	109,373	219,921	291,780	361,372	423,901	361,795	352,216	359,644	397,927	290,985	157,649
Oklahoma	80,070	84,613	131,675	154,220	121,880	109,697	141,858	130,934	118,468	110,530	115,403	146,778
Oregon	46,266	87,156	82,295	93,008	91,156	77,596	84,400	81,937	74,899	68,245	53,832	40,899
Pennsylvania	140,209	127,574	242,064	370,860	499,612	544,986	451,792	423,903	388,182	433,880	294,383	149,871
Puerto Rico	10,225	14,456	16,656	16,325	15,275	17,975	18,175	39,717	6,475	3,191	5,625	14,418
Rhode Island	5,551	4,779	20,534	32,427	47,797	68,831	41,243	25,491	23,988	30,253	16,731	11,330
South Carolina	26,273	30,173	29,992	28,490	30,160	26,397	32,195	27,215	31,582	37,561	38,211	26,101
South Dakota	4,823	10,950	24,259	32,117	59,267	60,275	66,814	39,966	41,431	58,829	10,758	9,549
Tennessee	142,481	151,904	170,556	171,928	108,450	170,175	185,174	173,145	117,942	122,431	134,434	127,961
Texas	233,622	248,022	357,298	336,631	332,437	307,021	366,594	342,533	239,817	290,001	286,435	300,053
Utah	10,146	14,633	17,843	23,641	27,384	32,876	32,165	38,629	42,323	44,442	27,011	18,801

Vermont	2,096	3,638	6,295	15,114	23,016	18,347	18,373	26,081	29,085	32,186	12,882	4,455
Virginia	53,143	50,523	90,579	105,008	137,335	140,039	133,147	129,843	118,857	121,863	94,816	64,911
Washington	28,998	50,006	88,104	102,226	118,215	107,164	84,189	111,019	145,873	153,584	163,611	136,784
West Virginia	28 038	40,328	45,384	70,578	104,581	113,551	126,186	118,552	148,504	128,918	100,683	67,817
Wisconsin	25,411	33,063	73,405	156,593	224,122	281,966	263,241	260,619	286,277	275,426	122,979	61,932
Wyoming	3,809	5,154	12,273	14,865	13,731	19,278	19,146	34,136	17,865	33,846	12,670	8,037
Unspecified	8,364	35,097	0	9,188	11,846	18,347	34,577	38,877	27,875	64,805	23,815	11,432
	2,814,082	2,905,974	4,833,680	6,154,786	7,384,396	7,613,576	7,776,942	8,055,279	7,779,121	8,752,844	5,937,383	4,458,814
Foreign countries	31,918	45,026	44,320	43,214	43,604	18,424	36,058	49,721	19,879	41,156	38,617	55,186
Total shipped from cement plants	2,846,000	2,951,000	4,878,000	6,198,000	7,428,000	7,632,000	7,813,000	8,105,000	7,799,000	8,794,000	5,976,000	4,514,000

[1] Includes estimated distribution from one plant for January to March and for May and June.

PRICES

At factories.—The average selling value of portland cement f. o. b. factories, with the price of containers excluded and cash discounts deducted where allowed, as reported to the Bureau of Mines, is stated in the table of shipments by States and districts during 1934 and 1935 on page 791.

The average factory value of portland cement may be higher in certain States than 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 cements now manufactured in many States. Statistics of shipments of high-early-strength portland cement appear on page 801.

Average factory value per barrel in bulk of portland cement in the United States, 1931–35

1931	$1.11	1934	$1.54
1932	1.01	1935	1.51
1933	1.33		

At markets.—Data showing the position of cement prices among those of other structural materials are summarized in the following table:

Comparative prices of building materials in December 1934–35 [1]

[Percentage of increase or decrease from 1926 average]

	1934	1935
Building materials in general	−14.9	−14.5
Lime, building, at plant (composite price)	−19.4	−20.8
Plate glass, 3 to 5 square feet, New York	−38.5	−38.5
Turpentine, New York	−44.3	−49.1
Brick, common, building, at plant (composite price)	−8.6	−12.4
Linseed oil, raw, New York	−21.3	−9.6
Douglas fir, no. 1, common, at mills	−2.9	−2.9
Yellow pine, flooring, at mills	−24.5	−22.8
Oak, plain, white, no. 1, common, Cincinnati	−28.8	−31.8
Portland cement, at plant (composite price)	−6.1	−4.5

[1] Bureau of Labor Statistics, U. S. Department of Labor, Wholesale Prices of Commodities: Rept. for December and year 1935, pp. 31–34.

CAPACITY

At the end of 1935 the 150 active shipping plants and 16 plants inactive in 1935 but producing within the 6 previous years had a combined capacity to produce 261,915,000 barrels of finished portland cement per year, according to manufacturers' reports supplemented by a few estimates. The figures include the capacity of two new plants that began producing in 1935. The total output for 1935 was 29.3 percent of the indicated capacity at the close of the year, based on producers' reports; the corresponding figure for 1934 was 29.6 percent.

Portland cement-manufacturing capacity of the United States, 1934–35, by commercial districts

District	Estimated capacity (barrels)		Percent of capacity utilized	
	1934	1935	1934	1935
Eastern Pennsylvania, New Jersey, and Maryland	55,063,000	56,262,000	27.1	25.9
New York and Maine	18,402,000	17,024,000	27.3	26.9
Ohio, western Pennsylvania, and West Virginia	28,227,000	28,077,000	26.1	26.0
Michigan	17,180,000	17,080,000	23.9	26.8
Wisconsin, Illinois, Indiana, and Kentucky	30,216,000	29,816,000	30.0	27.5
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	25,588,000	25,556,000	29.5	30.0
Eastern Missouri, Iowa, Minnesota, and South Dakota	23,267,000	23,217,000	33.5	33.9
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	17,559,000	17,409,000	33.2	34.3
Texas	10,925,000	11,072,000	32.4	34.2
Colorado, Montana, Utah, Wyoming, and Idaho	6,057,000	6,217,000	36.0	37.6
California	22,830,000	22,790,000	38.2	35.0
Oregon and Washington	7,395,000	7,395,000	22.3	25.7
	262,709,000	261,915,000	29.6	29.3

The following estimates (based on monthly reports of producers) of the relation between production of finished portland cement and manufacturing capacity of the industry for each month in 1935 and for the 12 months ended with each month indicate the seasonal changes in utilizing capacity.

Ratio (percent) of finished portland cement produced to manufacturing capacity of the United States, 1934–35

	Monthly		12 months ended—			Monthly		12 months ended—	
	1934	1935	1934	1935		1934	1935	1934	1935
January	16.6	14.1	23.9	28.8	July	35.7	35.3	26.9	27.7
February	20.2	14.9	24.4	28.4	August	34.5	31.8	26.8	27.4
March	23.0	18.9	25.0	28.0	September	34.8	32.6	27.6	27.3
April	29.6	27.9	25.9	27.9	October	29.3	33.1	28.3	27.6
May	37.5	36.1	26.7	27.7	November	26.2	32.2	28.7	28.1
June	39.8	39.6	27.1	27.7	December	19.5	25.6	29.0	28.6

HIGH-EARLY-STRENGTH PORTLAND CEMENT

There are included in the shipment figures on portland cement for 1935 (p. 791) approximately 2,109,000 barrels of high-early-strength cement with an estimated mill value of $4,032,000 reported as manufactured at 47 of the portland cement plants located as follows: One each in Alabama, Kentucky, Maine, Missouri, Oklahoma, Tennessee, West Virginia, and Wyoming; two each in Colorado, Illinois, Indiana, Iowa, Michigan; three each in Ohio, Texas, and Washington; four each in Kansas and New York; five in California; and seven in Pennsylvania. These statistics may not represent complete data as reports may be lacking from one or two plants manufacturing this type of cement.

High-early-strength portland cement shipped from mills in the United States in 1935

1935	Number of shipping plants	Quantity (barrels)	Estimated mill value
First quarter	41	306,000	$587,000
Second quarter	45	638,000	1,223,000
Third quarter	46	608,000	1,165,000
Fourth quarter	46	557,000	1,057,000
Year	47	2,109,000	4,032,000

MANUFACTURING CONDITIONS

Plants.—In 1935 portland cement was manufactured at 149 plants, and shipments were made from 150 plants compared with 147 producing and 150 shipping plants in 1934. Two plants began producing portland cement in 1935, the only new plants put into operation in the United States since 1929. Both reported as wet-process plants and are as follows:

Washington-Idaho Lime Products Co., plant at Orofino, Clearwater County, Idaho.

National Portland Cement Co., plant at Brodhead, Northampton County, Pa.

An additional plant was reported partly completed in Arkansas.

Fuels.[2]—The following quantities of fuel were consumed at portland-cement plants in the United States in 1935 in the production of 76,751,419 barrels of finished cement and 75,327,000 barrels of clinker (unground cement): Coal, 3,456,303 short tons; oil, 1,381,463 barrels (58,021,446 gallons); and natural gas, 26,980,651,392 cubic feet. Corresponding figures for 1934 are: Finished cement produced, 77,747,765 barrels, and clinker produced, 77,757,000 barrels; fuels consumed—coal, 3,500,486 short tons; oil, 1,862,589 barrels (78,228,738 gallons); and natural gas, 27,330,962,027 cubic feet.

As the annual statistics of the Bureau of Mines on portland cement deal principally with the finished product, estimates of fuel consumption generally are compared with the output of finished cement.

In addition to the foregoing fuels, one plant reported the use of manufactured gas in 1935 and four the use of petroleum coke with other fuels. The quantity of petroleum coke consumed at cement plants in 1935 was 15,889 short tons compared with 23,170 short tons in 1934.

NATURAL, MASONRY (NATURAL), AND PUZZOLAN CEMENTS

The term "masonry cement" is used here to designate certain cements made by grinding calcined calcareous rock (as are natural cements) and used largely in mortar for laying brick and stone, although other hydraulic cements also are suitable for masonry and are being manufactured for this purpose in increasing quantities.

Natural cement (including masonry cement of the natural-cement class and hydraulic lime) was produced at and shipments were made from 12 plants in 1935. The plants engaged in the manufacture of natural cement are located at Graystone, Ala.; Utica, Ill.; Speed, Ind.; Fort Scott, Kans.; Kosmosdale, Ky.; Austin and Mankato, Minn.; Brixment and Rosendale, N. Y.; Lisbon, Ohio; and Siegfried, Pa.

[2] Data on fuels for 1934 and 1935 compiled from monthly estimates o fthe producers.

Two producers (with one plant each, located, respectively, at Riverton, Va., and Highcliff, Wis.) reported an output of hydraulic lime in 1935.

Two manufacturers (with one plant each, located, respectively, at Birmingham and Graystone, Ala.) reported an output of puzzolan-lime or slag-lime cement in 1935. One of the producers of puzzolan-lime cement also reported an output of masonry cement.

The following table on natural, masonry (natural), and puzzolan cements from 1931 to 1935 shows a production of 1,006,064 barrels in 1935, an increase of 49.8 percent over 1934. Shipments from mills increased 49.1 percent in quantity and 49.6 percent in gross value in 1935. Stocks at mills at the end of the year were 3 percent lower in 1935 than in 1934. The average factory value per barrel of the cement shipped from mills was $1.42 in 1935 and 1934.

Like portland cement, these cements are packed four sacks to the barrel, and each sack holds about 1 cubic foot of cement. The lower specific gravity of the non-portland cements accounts for their lighter weight per barrel. In 1935 the weights reported ranged from 220 to 300 pounds. For statistical purposes, however, the output has been expressed in terms of 376-pound barrels to correspond with the figures for portland cement.

Producers reported that 18,175 short tons of coal and 71 short tons of coke were consumed in 1935 in manufacturing these cements; they also reported the use of a small quantity of gas having a total fuel value equivalent to about 24 short tons of coal. The fuel consumed in 1934 consisted of 9,181 short tons of coal and a small quantity of gas having a total fuel value equivalent to about 23 short tons of coal.

At natural-cement plants in the United States where coal was reported as the only fuel used, the average consumption of coal per barrel of cement (376 pounds) was 46 pounds in 1935 compared with 51 pounds in 1934.

Natural, masonry (natural), and puzzolan cements produced, shipped, and in stock at mills in the United States, 1931–35

Year	Production		Shipments		Stock (Dec. 31)
	Active plants	Barrels (376 pounds)	Barrels (376 pounds)	Value	Barrels (376 pounds)
1931	12	1,241,803	1,226,850	$1,619,920	224,100
1932	15	456,785	524,844	696,474	150,164
1933	13	466,632	432,415	571,648	182,686
1934	14	671,588	678,204	960,732	[1] 175,865
1935	13	1,006,064	1,011,411	1,437,542	170,518

[1] Revised figures.

FOREIGN TRADE IN CEMENT [3]

Imports.—The figures in the following tables cover imports of hydraulic cement of all kinds. Total imports in 1935 increased nearly 133 percent compared with 1934.

The average of the values assigned to imports, supposed to represent values in the foreign countries from which the material is exported,

[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.

including the cost of the containers or coverings, ranged from $0.55 per barrel for imports from the U. S. S. R. (Russia) in Europe to $3.83 per barrel for imports from the United Kingdom.

an, portland, and other hydraulic cemenis imported into the United States, 1934–35, by countries and districts

	1934		1935	
	Barrels	*Value*	*Barrels*	*Value*
COUNTRY				
Belgium	106,326	$95,548	238,356	$228,925
Canada	2,334	7,245	1,430	4,145
Denmark	92,195	97,356	213,909	236,136
France	403	464	4,722	11,215
Germany	2,516	3,246	74,545	59,258
Italy	6	13		
Japan	18,901	20,248	21,261	19,803
Mexico	306	705	564	1,155
Norway	8,105	6,287	20,125	14,434
Poland and Danzig	7,037	6,827	9,271	7,610
U. S. S. R. (Russia) in Europe	14,658	8,250	30,212	16,560
United Kingdom	9,057	7,586	2,527	9,675
Yugoslavia			100	160
	261,844	253,775	617,022	609,076
DISTRICT				
Alaska	93	246		
Dakota			14	51
Florida	10,063	12,360	94,799	111,070
Galveston	600	516	1,175	964
Georgia			800	597
Hawaii	16,918	18,170	20,859	19,299
Los Angeles	1,853	1,994	402	504
Maine and New Hampshire	1,634	5,379	792	2,561
Maryland			300	244
Massachusetts	77,146	65,840	88,152	85,170
Mobile	1,397	1,212	8,240	7,776
New Orleans	200	172	1,171	964
New York	91,645	91,970	230,446	233,209
North Carolina			2,490	3,243
Oregon	7,901	6,129	16,896	12,990
Philadelphia	25	17	4,180	3,777
Puerto Rico	44,912	41,813	127,104	104,222
Sabine	2,996	2,600		
Saint Lawrence	418	1,035	620	1,523
San Antonio	3,456	3,438	6,486	5,850
San Diego	127	97		
San Francisco	136	97	1,273	1,628
Vermont	177	491	3	10
Virgin Islands			5,415	9,522
Virginia			500	622
Washington	147	199	4,905	3,280
	261,844	253,775	617,022	609,076

In addition to the imports listed in the preceding table, "white, nonstaining portland cement" was reported "imported for consumption" as follows: 1935, 2,381 barrels valued at $6,790, of which 1,369 barrels valued at $3,195 came from France; 1934, 4,153 barrels valued at $10,641, of which 3,646 barrels valued at $8,668 came from France.

Hydraulic cement imported for consumption in the United States, 1931–35

Year	Barrels	Value	Year	Barrels	Value
1931	469,598	$535,773	1934	265,997	$264,416
1932	468,139	363,247	1935	619,403	615,866
1933	477,193	400,153			

Exports.—In 1935 total exports of hydraulic cement (mostly portland cement) to foreign countries, the Philippine Islands, and the Virgin Islands of the United States decreased more than 25 percent in quantity and 23 percent in value compared with 1934. The destinations in 1935 were approximately as follows: South America, 135,000 barrels; Central America, 155,000 barrels (of which 111,000 barrels went to Panama, including the Canal Zone); Mexico, 75,000 barrels; Cuba, 8,000 barrels; other West Indies (excluding the Virgin Islands of the United States) and the Bermudas, 15,000 barrels; Canada, 7,000 barrels; and other countries, 21,000 barrels.

Although the United States is the major cement-producing country of the world, its export trade has never attained large proportions; since 1925 it has been under 1,000,000 barrels.

The total exported in 1935 was 0.5 percent of the total quantity of hydraulic cement shipped from mills during the year.

The value of exports of domestic cement is their actual cost, when exported, at United States ports of export, as declared by the shipper on the export declarations. The average value at the ports was $2.43 a barrel in 1935 compared with $2.36 a barrel in 1934.

Hydraulic cement exported from the United States, 1934–35, by countries

Country	1934		1935	
	Barrels	*Value*	*Barrels*	*Value*
North America:				
Bermuda	1,046	$1,762	287	$605
Canada	6,350	27,922	6,536	31,630
Central America:				
British Honduras	1,955	2,793	1,234	4,003
Costa Rica	2,782	5,230	152	271
Guatemala	1,046	3,255	892	2,258
Honduras	29,420	37,633	40,233	56,279
Nicaragua	1,138	2,828	605	2,000
Panama	238,936	516,971	111,484	210,612
Salvador	106	502	125	586
Mexico	74,610	166,603	75,137	156,242
Newfoundland and Labrador	924	1,737	988	1,545
West Indies:				
British:				
Jamaica	96	439	102	537
Trinidad and Tobago	12	88	707	1,339
Other British	3,202	5,560	2,938	5,726
Cuba	3,425	11,837	8,132	31,318
Dominican Republic	5,893	10,275	2,561	4,729
French	25	44	105	114
Haiti	495	1,240	799	1,547
Netherland	14,114	23,235	7,507	12,232
Virgin Islands of the United States [1]	857	1,605	(1)	(1)
	386,432	821,559	260,524	523,573
South America:				
Argentina	22,183	94,472	23,560	98,857
Bolivia	95	491	680	2,020
Brazil	12,711	62,939	10,228	45,512
Chile	2,419	14,146	4,898	25,307
Colombia	32,341	71,402	9,362	31,287
Ecuador	802	3,799	1,159	5,066
Guiana: French	330	710	660	1,420
Paraguay	50	256	140	718
Peru	1,139	3,921	2,142	8,379
Surinam			177	330
Uruguay	3,388	14,773	5,270	23,630
Venezuela	85,220	153,170	76,815	154,230
	160,678	420,079	135,091	396,756

[1] Beginning January 1935, shipments to the Virgin Islands not classed as exports but as shipments to "noncontiguous territory of the United States." (See following table.)

Hydraulic cement exported from the United States, 1934–35, by countries—Continued

	1934		1935	
	Barrels	*Value*	*Barrels*	*Value*
Europe:				
Azores and Madeira Islands	10	$58		
Belgium	614	2,844	1,509	$6,910
Germany	60	188		
Greece	3	15		
Irish Free State	357	1,504	330	1,440
Netherlands	453	2,580	858	3,041
Norway	163	973	35	240
Portugal			34	238
Sweden	16	88	6	33
United Kingdom	5,019	19,742	4,883	18,992
	6,695	27,992	7,655	30,894
Asia:				
Aden	25	150		
Arabia	25	131	666	2,651
China	576	3,384	122	660
East Indies:				
British:				
India	2,228	10,953	2,343	12,473
Malaya	641	2,943	408	1,909
Netherland	79	376	68	282
Hong Kong			154	850
Iran (Persia)	375	1,706		
Japan	59	649	107	459
Kwantung	40	222		
Palestine	6,462	33,638	5,734	30,567
Philippine Islands	168	963	86	447
Other Asia	625	3,156	480	2,123
	11,303	58,271	10,168	52,421
Africa:				
British:				
Union of South	100	540	478	2,533
Egypt			22	125
Portuguese:				
Mozambique			20	120
Other Portuguese	1	3		
	101	543	520	2,778
Oceania:				
British:				
Australia	546	2,535	891	3,735
New Zealand	416	2,402	828	1,864
French			422	921
	962	4,937	2,141	6,520
	566,171	1,333,381	416,099	1,012,942

Domestic hydraulic cement shipped to noncontiguous territory of the United States, 1934–35

	1934		1935	
	Barrels	*Value*	*Barrels*	*Value*
Alaska	20,494	$56,352	25,174	$71,285
American Samoa			159	427
Hawaii	232,959	467,596	238,241	477,999
Puerto Rico	233,721	323,318	253,609	343,516
Virgin Islands [1]	(1)	(1)	4,652	7,243
Wake Islands			200	378
	487,174	847,266	522,035	900,848

[1] Prior to January 1935 shipments to the Virgin Islands classed as exports. (See preceding table.)

Hydraulic cement exported from the United States, 1931–35

Year	Barrels	Value	Percent of total shipments from mills	Year	Barrels	Value	Percent of total shipments from mills
1931	429,653	$1,220,600	0.3	1934	566,171	$1,333,381	0.7
1932	374,581	802,205	.5	1935	416,099	1,012,942	.5
1933	680,307	1,487,707	1.1				

Cement in Canada.—The mill shipments of portland cement from plants in Canada in 1935 showed relatively slight decreases in both quantity and value from those of the preceding year. Sales totaled 3,648,086 barrels valued at $5,580,043 compared with 3,783,226 barrels valued at $5,667,946 in 1934—decreases of 3.6 percent in quantity and 1.6 percent in value. The average selling price per barrel over the whole Dominion, computed from the total quantity sold and the total value as given, was $1.53 in 1935 and $1.50 in 1934.

The Canadian cement industry reports a considerable improvement in the use of cement for buildings and small uses, but on the other hand there was a falling off in road and street paving and in municipal work generally. While the increase in the one and the decline in the other nearly balanced, there was, on the whole a small decrease in consumption.

Cement is produced in the Provinces of Quebec, Ontario, Manitoba, Alberta, and British Columbia. In 1935 mills in Quebec contributed 48 percent of the total Canadian shipments; in Ontario, 34 percent; in Manitoba, 7 percent; in Alberta, 6 percent; and in British Columbia, 5 percent.

In 1935 the Canadian cement industry consumed 818,442 tons of limestone and 21,612 tons of gypsum. At the close of 1935 the plants had on hand 1,402,017 barrels of cement or 160,484 barrels less than the quantity on hand at the beginning of the year.

Imports of portland cement into Canada totaled 17,738 barrels, valued at $60,079, compared with 14,341 barrels, valued at $45,548, in 1934.

Exports of portland cement amounted to 55,607 barrels valued at $44,365 in 1935 compared with 70,046 barrels valued at $55,181 in 1934.

Summary statistics of the cement industry in Canada, 1934–35 [1]

	1934		1935	
	Barrels	*Value*	*Barrels*	*Value*
Output	3,484,233		3,487,602	
Sales:				
Quebec	1,613,641	$2,294,847	1,751,012	$2,472,008
Ontario	1,702,128	2,403,590	1,243,836	1,752,148
Manitoba	181,166	411,247	266,457	604,857
Alberta	163,946	326,253	219,555	436,914
British Columbia	122,345	232,009	167,226	314,116
	3,783,226	5,667,946	3,648,086	5,580,043
Stocks, Dec. 31	1,562,501		1,402,017	
Imports:				
Portland	14,341	45,548	17,738	60,079
Manufactures		4,167		17,102
		49,715		77,181
Exports	70,046	55,181	55,607	44,365
Apparent consumption	3,727,521		3,610,217	

[1] Dominion Bureau of Statistics.

STONE [1]

By Oliver Bowles, Carl A. Gnam, and A. T. Coons

SUMMARY OUTLINE

The stone industries, after recovering somewhat from the depression in 1934, declined 15 percent in quantity and 17 percent in value of output in 1935. Each major variety of stone shared in the decline. Granite dropped 9 percent in quantity and 4 percent in value, basalt and related rocks 24 percent in quantity and 27 percent in value, marble 31 percent in quantity and 10 percent in value, limestone 7 percent in quantity and 12 percent in value, and sandstone 21 percent in quantity and 17 percent in value.

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 figures given for sales. The figures do not, however, include stone made into abrasives (such as grindstones) or that used in the manufacture of lime and cement. These are reported in terms of finished products in the Abrasive Materials, Lime, and Cement chapters of this volume. The following table shows production of stone by kinds for the past 5 years.

Stone sold or used by producers in the United States, 1931–35, 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
1931	8,068,470	$25,973,510	12,552,880	$13,822,835	350,420	$10,419,834	66,751,040	$71,875,886
1932	5,118,550	15,978,363	9,328,580	8,879,702	342,830	7,532,309	46,913,520	48,015,748
1933	4,422,250	11,327,371	7,394,290	6,596,248	224,670	6,399,004	45,922,280	44,499,311
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 [1]	6,190,000	14,248,000	8,828,000	8,234,000	122,000	3,020,000	53,606,000	47,255,000

[1] Subject to revision.

[1] Figures for 1935 are preliminary; detailed data with final revisions will be released later.

Stone sold or used by producers in the United States, 1931–35, by kinds—Contd.

Year	Sandstone		Other stone [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1931	4, 581, 780	$7, 575, 320	5, 628, 590	$5, 418, 242	97, 933, 180	$135, 085, 627
1932	2, 973, 040	4, 081, 804	5, 967, 790	4, 575, 682	70, 644, 310	89, 063, 608
1933	2, 799, 920	4, 145, 329	9, 458, 800	7, 978, 345	70, 222, 210	80, 945, 608
1934	3, 605, 420	4, 714, 284	12, 344, 940	10, 944, 881	92, 063, 830	98, 979, 936
1935 [1]	2, 831, 000	3, 896, 000	6, 802, 000	5, 837, 000	78, 379, 000	82, 490, 000

[1] Subject to revision.
[2] Includes mica schist, conglomerate, argillite, various light-colored volcanic rocks, serpentine not used as marble, soapstone sold as dimension stone (1932–34), and such other stone as cannot properly be classed in any main group.

The following table of production by uses indicates a substantial gain in the quantity of building stone sold in 1935, although the value declined greatly. Sales of paving block show a large increase, while those of monumental stone, curbing, flagging and rubble show little change. Sales of riprap and crushed stone decreased decidedly. The large increases in sales of fluxing and refractory stone reflect the increased activity in iron and steel plants during 1935. A gain of nearly 40 percent in quantity and 55 percent in value of agricultural limestone is noteworthy.

Stone sold or used by producers in the United States, 1934–35, by uses

Use	1934		1935 [1]	
	Quantity	Value	Quantity	Value
Building stone ......cubic feet..	9, 026, 270	$8, 538, 847	9, 914, 000	$7, 012, 000
Approximate equivalent in short tons..	711, 090	----------	774, 000	----------
Monumental stone ......cubic feet..	2, 291, 890	6, 226, 986	2, 284, 000	6, 391, 000
Approximate equivalent in short tons..	186, 920	----------	185, 000	----------
Paving blocks ......number..	5, 895, 270	618, 041	9, 270, 000	849, 000
Approximate equivalent in short tons..	63, 740	----------	77, 000	----------
Curbing ......cubic feet..	984, 400	885, 040	875, 000	833, 000
Approximate equivalent in short tons..	78, 590	----------	71, 000	----------
Flagging ......cubic feet..	299, 820	190, 335	289, 000	232, 000
Approximate equivalent in short tons..	23, 440	----------	23, 000	----------
Rubble ......short tons..	293, 430	317, 640	286, 000	369, 000
Riprap ......do....	6, 052, 970	5, 894, 259	5, 324, 000	5, 007, 000
Crushed stone ......do....	60, 567, 920	56, 466, 607	51, 076, 000	45, 758, 000
Furnace flux (limestone) ......do....	9, 230, 880	6, 297, 579	11, 110, 000	7, 364, 000
Refractory stone [2] ......do....	677, 410	863, 078	780, 000	1, 043, 000
Agriculture (limestone) ......do....	1, 612, 380	1, 788, 142	2, 250, 000	2, 773, 000
Manufacturing industries (limestone and marble) short tons..	5, 373, 110	4, 493, 530	} 6, 423, 000	4, 859, 000
Other uses [3] ......do....	7, 191, 950	6, 399, 852		
Total (quantities approximate, in short tons)....	92, 063, 830	98, 979, 936	78, 379, 000	82, 490, 000

[1] Subject to revision.
[2] Ganister, mica schist, soapstone, and dolomite.
[3] Includes 6,358,580 tons of stone valued at $4,381,731 used as road base (of which 5,371,370 tons valued at $4,050,447 were from Pennsylvania) and 85,410 tons of roofing granules valued at $687,386. There were also produced 123,290 tons of slate granules valued at $902,078 used for roofing and included in the chapter on Slate in Minerals Yearbook, 1935; 1935, details not available.

CONSTRUCTION DATA

Stone, sand and gravel, cement, lime, gypsum, and some other nonmetallic mineral commodities are used principally for construction, therefore conditions and trends in all branches of building have a direct bearing on activity in these industries. For this reason the following data on construction are introduced. To avoid repetition the material is confined to the chapter on Stone, and when pertinent relationships are to be emphasized in other chapters references are made to the data herein.

General conditions in 1935.—The increase in volume of construction during 1935 is encouraging, but with the index compiled by the Federal Reserve Board still at the low level of 37 obviously much greater activity will be necessary before conditions are normal. The greatest advances in construction during 1935 were in residential building. After declining for 7 years and in 1934 reaching the lowest level since 1918, home building so improved in 1935 that the volume was at least double that of 1934. The gain was expected, as the volume had declined in the past few years in spite of an increase in the number of families and a constant loss of existing structures through obsolescence and destruction, the combined effect of which was to create an appreciable deficit of homes.

General improvement in business in 1935 was reflected in a substantial gain in nonresidential building. Many office buildings and factories that have been used little in the past few years have deteriorated or have been destroyed and revival of business activity accompanied by newly developed processes and products made necessary accommodations that in many instances could be obtained only through replacement and new construction. An increase in population has created a demand for more schools, churches, and public institutions, and the construction of such buildings has been further encouraged to increase employment.

Engineering projects showed no remarkable gains, but with the assistance of Government funds this branch of construction remained at the relatively high level of the last few years. Complete figures are not available, but it is estimated that road construction, which annually receives large public allotments, was less in 1935 than in 1934. However, this and other losses were more than compensated by increases in public and commercial building, sewerage-plant construction, and river, harbor, and flood-control projects. Publicly financed construction increased slightly in 1935 and private undertakings considerably. The failure of building-materials prices to rise doubtless encouraged private building. Although the average was still above that of all commodities the Bureau of Labor Statistics index shows a decline in prices of building materials of about 1 point in 1935.

Building construction.—The following table shows values of construction-contract awards grouped by classes, as reported by the F. W. Dodge Corporation for the 37 States east of the Rocky Mountains. All types of building construction except factory increased during 1935, whereas construction other than building—public works and public utilities—declined. The greatest gain in 1935 was in residential building, which increased 92.4 percent but was only 17.2 percent of that in 1928. Total construction, which was 19.5 percent greater in 1935 than in 1934, was only a little over one-fourth of the total for 1928.

Construction-contract awards in the 37 States east of the Rocky Mountains, 1928 and 1933–35, in millions of dollars [1]

Type of construction	1928	1933	1934	1935	Percent of change in 1935 from—	
					1934	1928
Residential	2,788.3	249.3	248.8	478.8	+92.4	−82.8
Commercial	884.6	99.4	150.6	164.5	+9.2	−81.4
Factories	508.8	127.5	116.1	108.9	−6.2	−78.6
Public works	980.1	499.5	625.0	578.5	−7.4	−41.0
Public utilities	484.4	103.2	126.2	111.7	−11.5	−76.9
Educational	399.0	40.0	117.5	173.4	+47.6	−56.5
Hospitals and institutions	164.7	37.3	37.3	47.0	+26.0	−71.5
Public buildings	76.2	50.9	55.7	97.8	+75.6	+28.3
Religious and memorial	127.9	17.7	18.3	23.7	+29.5	−81.5
Social and recreational	214.1	31.1	47.6	60.2	+26.5	−71.9
Total construction	6,628.1	1,255.9	1,543.1	1,844.5	+19.5	−72.2

[1] F. W. Dodge Corporation.

Residential and nonresidential building.—Building permits for residential and nonresidential building, as reported by the Bureau of Labor Statistics for 811 cities, increased 88.5 percent in value over

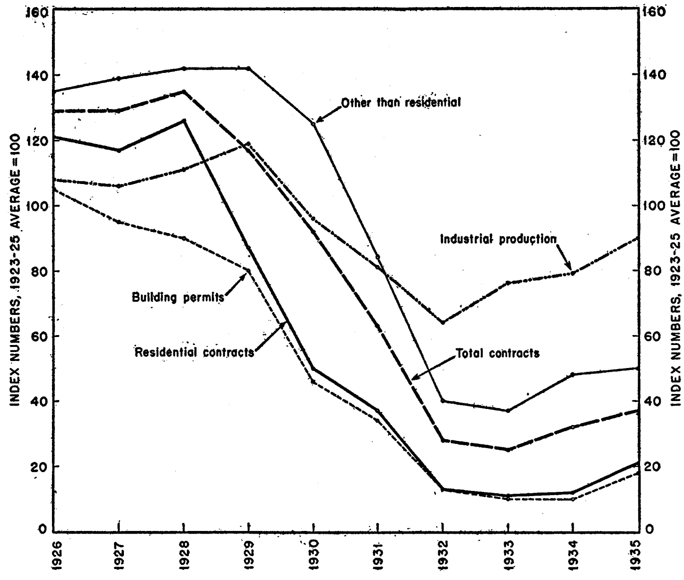

FIGURE 113.—Trends in construction-contract awards, cost of building permits, and industrial production, 1926–35. (Index numbers, 1923–25 average=100.)

1934. The value of residential construction permits was 171.8 percent greater and that of nonresidential 47 percent greater in 1935 than in 1934. Expenditures for additions, alterations, and repairs increased 35.6 percent.

The trend in annual values of building permits issued, as shown in figure 113, follows rather well, except for 1928, the trend in residential contract awards; the relationship to total contracts is not so close owing to the inclusion of general engineering construction, such as highways, bridges, railroads, and similar projects.

The value of building permits in 215 cities, reported by Dun & Bradstreet, Inc., was 71.3 percent greater in 1935 than in 1934; New York City gained only 70.4 percent.

Engineering construction.—The following table shows expenditures for engineering construction in 1934 and 1935. The chief gains were in sewerage projects and in both public and private building. Street and road construction, the largest item in the list, gained only 6 percent. Notwithstanding a 9-percent increase in construction of public works the proportion classified as engineering dropped to 77 percent in 1935 compared to 82 percent in 1934. Federal Government expenditures, although increasing 1 percent, were only 23 percent of the total in 1935 compared with 27 percent in 1934. These changes in percentages of the total were due to the 54-percent increase in private construction.

Engineering construction contracts, 1934–35, in thousands of dollars[1]

Type of construction	1934	1935	Percent of change in 1935	Type of construction	1934	1935	Percent of change in 1935
Public works:				Private:			
Waterworks	92,495	80,677	−13	Bridges, private	10,044	11,072	+10
Sewerage	61,068	99,935	+64	Buildings, industrial	105,192	172,467	+64
Bridges, public	88,800	86,861	−2	Buildings, commercial	80,685	108,817	+35
Earthwork and waterways	266,431	258,740	−3	Unclassified, private	45,342	78,783	+74
Streets and roads	345,066	325,263	−6	Total private construction	241,263	371,139	+54
Buildings, public	204,185	297,858	+46	Total construction	1,360,596	1,590,151	+17
Unclassified, public	61,288	69,678	+14				
Total public works	1,119,333	1,219,012	+9				
Federal projects included	360,166	362,263	+1				

[1] Data from Engineering News Record.

Highway construction.—The number of miles of roads built or improved in 1935 was probably greater than in 1934, but expenditures for road construction in 1935 may have been a little less than in 1934 owing to a relatively larger mileage of the less expensive types of construction.

Federal expenditures allotted to road construction, included in the following table of value of contracts financed from Federal funds, were 13 percent greater in 1935 than in 1934, but expenditures from other sources decreased in value in 1935. The amounts awarded for streets and roads, as shown in the preceding table of engineering-construction contracts, indicate a decline of 6 percent in 1935; contract awards for highways reported for all States by the United States Bureau of Labor Statistics—$52,782,494 in 1935 and $80,573,556 in 1934—place the loss at 34 percent; and concrete-paving contract awards published by the Portland Cement Association (valued at $45,108,000 in 1934 and $43,426,000 in 1935) show a decline of only 4 percent.

Construction with Federal funds.—The following table shows construction financed by Federal funds in 1934 and 1935. The total for 1935 was $1,605,499,388, an increase of $299,723,158 over 1934. (Regular Government appropriations include only the last half of 1934.) Public Works Administration projects, although considerably less than in 1934, still constituted the largest item. Over a third of the amount spent by that agency was allotted to building construction, and the greatest share of the remainder went to roads and streets, although water and sewerage systems and river, harbor, and flood control received appreciable amounts. The Works Program that was begun in July 1935 started projects valued at $405,204,313, the greatest share being appropriated to river, harbor, and flood control, reclamation, and roads. Regular Government appropriations show principal expenditures to have been for naval vessels, roads, buildings, and river, harbor, and flood control.

Value of contract awards and force-account work started on construction financed from Federal funds, 1934–35, by originating agency and type of construction[1]

Originating agency and type of construction	1934	1935
Public Works Administration:		
Federal	$641,193,391	$373,559,347
Non-Federal	517,129,127	[2] 529,803,120
Total P. W. A.	1,158,322,518	903,362,467
Regular Government appropriations [3]	147,453,712	296,932,608
The Works Program [4]		405,204,313
Total construction	1,305,776,230	[2] 1,605,499,388
Types of construction:		
Building	245,755,146	445,724,538
Forestry	4,197,340	15,264,918
Naval vessels	152,950,782	123,408,736
Public roads:		
Roads	271,923,304	283,312,162
Grade-crossing elimination		23,980,502
Railroad construction and repair	190,176,518	14,671,395
Reclamation	92,093,122	169,103,566
River, harbor, and flood control	141,386,306	281,501,363
Streets and roads [5]	65,691,760	74,600,453
Water and sewerage systems	100,674,891	135,804,814
Miscellaneous	40,927,061	38,126,941
Total construction	1,305,776,230	[2] 1,605,499,388

[1] Bureau of Labor Statistics, Division of Construction and Public Employment.
[2] Includes $7,831,811 for low-cost housing projects (Housing Division, P. W. A.).
[3] Contracts awarded since July 1934.
[4] Began July 1935; does not include data for that part of the Works Program operated by the Works Progress Administration.
[5] Other than those reported by the Bureau of Public Roads.

Employment and pay rolls in the construction industries.—Employment and pay-roll indexes of the Bureau of Labor Statistics generally continued to improve in the principal building-materials industries in 1935. However, owing to the failure of the construction industry to improve as rapidly as industry in general, these indexes were still considerably below the averages of all employment and all pay rolls. Employment in the structural and ornamental metalwork trade declined slightly from 56.8 to 56.6, but pay rolls rose to 42.1 from 38.9. The other industries considered (lumber, brick and tile, and cement) show increases both in employment and pay rolls. Trends are shown graphically in figures 114 and 115.

Trends in building-materials prices.—Prices of building materials, as measured by the Bureau of Labor Statistics index of wholesale prices (1926=100), declined from 86.2 in 1934 to 85.3 in 1935. Indexes for various classes of building materials in recent years are shown in the following table. Increases that occurred in the indexes for cement and structural steel were more than offset by reductions in brick and

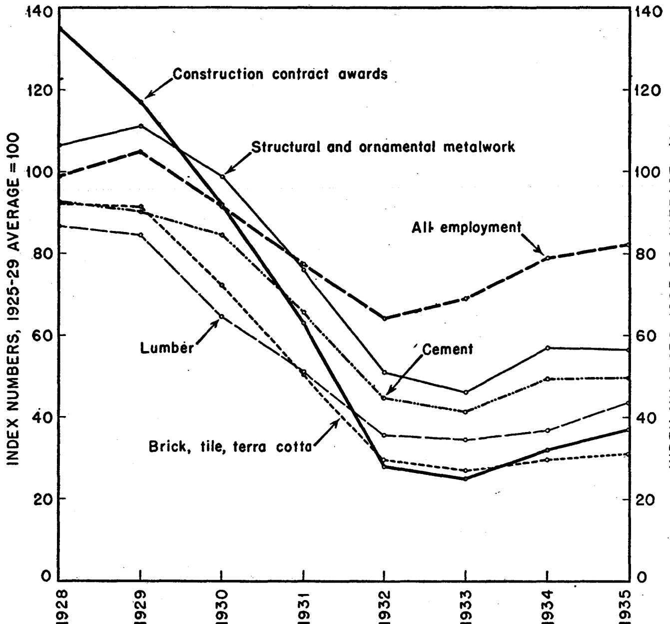

FIGURE 114.—Trends in employment in selected building-materials industries, 1928–35. (Indexes, 1923–25 average=100, compiled by Bureau of Labor Statistics.)

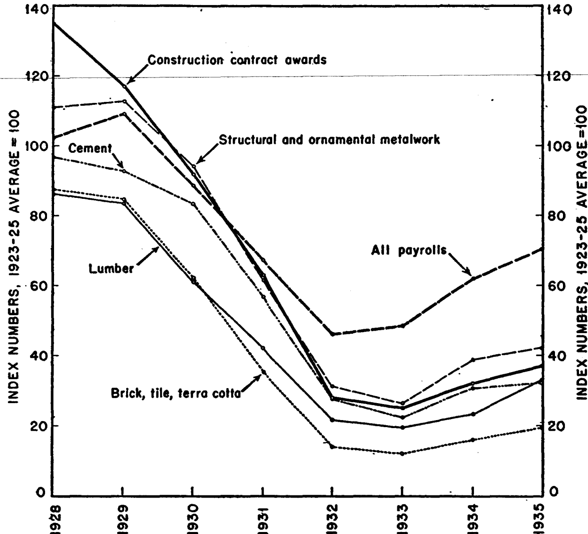

FIGURE 115.—Trends in pay rolls in selected building-materials industries, 1928–35. (Indexes, 1923–25 average=100, compiled by Bureau of Labor Statistics.)

tile, lumber, and plumbing and heating equipment. Despite the slight drop in 1935, prices of building materials remained higher than the index for all commodities, which was 80. Recent trends are shown in figures 116 and 117.

Index numbers of wholesale prices, 1926–35 [1]

[1926=100]

	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935
All commodities	100.0	95.4	96.7	95.3	86.4	73.0	64.8	65.9	74.9	80.0
Building materials	100.0	94.7	94.1	95.4	89.9	79.2	71.4	77.0	86.2	85.3
Brick and tile	100.0	95.7	95.6	94.3	89.8	83.6	77.3	79.2	90.2	89.4
Cement	100.0	96.7	95.9	91.8	91.8	79.4	77.2	86.1	93.2	95.3
Lumber	100.0	93.1	90.5	93.8	85.8	69.5	58.5	70.7	84.5	81.1
Paint	100.0	96.3	93.1	94.9	90.5	79.4	71.1	73.3	79.5	79.8
Plumbing and heating	100.0	92.0	95.1	95.0	88.6	84.7	66.8	67.1	72.6	68.9
Structural steel	100.0	94.7	95.2	98.1	87.3	83.1	80.9	83.1	90.8	92.0
Other building materials	100.0	95.4	96.7	97.7	93.3	84.8	79.5	82.7	90.3	90.1

[1] Data from Bureau of Labor Statistics.

DIMENSION STONE

Although 1934 was about the worst year in the history of the dimension-stone industries, the decline continued in some branches, notably the marble and granite industries, in 1935. According to preliminary figures, all kinds of stone sold as blocks or slabs increased nearly 7 percent in quantity and decreased about 2 percent in value compared with 1934. Sales totaled approximately 1,519,500 tons valued at about $18,005,000.

The principal kinds of dimension stone are granite, marble, limestone, sandstone, basalt, and slate. Although the slate industry is reviewed in a separate chapter, the figures for slate are included in the table of salient statistics of this chapter to show total sales of dimension stone.

Dimension-stone producers may be divided into three main groups on the basis of plant operation; the first group includes operators who quarry stone and sell it as rough blocks or slabs; the second group quarries and manufactures stone into finished products; and the third buys sawed or rough stock and manufactures products but does not operate quarries.

The Bureau of Mines statistical canvass covers the first and second groups, but as the third group includes manufacturers rather than producers it is canvassed by the Bureau of the Census. Bureau of Mines statistics are compiled from reports of tonnages and values of original sales. It is evident therefore that the figures include some material sold as rough blocks and some sold as finished products.

The following table of salient statistics shows final figures for sales of dimension stone in 1934, preliminary figures for sales in 1935, and the percentage of change from 1934 for each kind of stone by principal products.

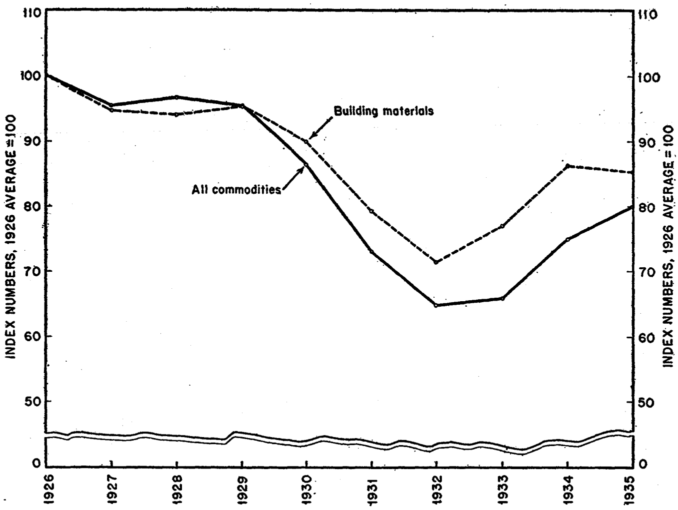

FIGURE 116.—Trends in wholesale prices of building materials and of all commodities, 1926–35. (Index numbers, 1926=100, compiled by Bureau of Labor Statistics.)

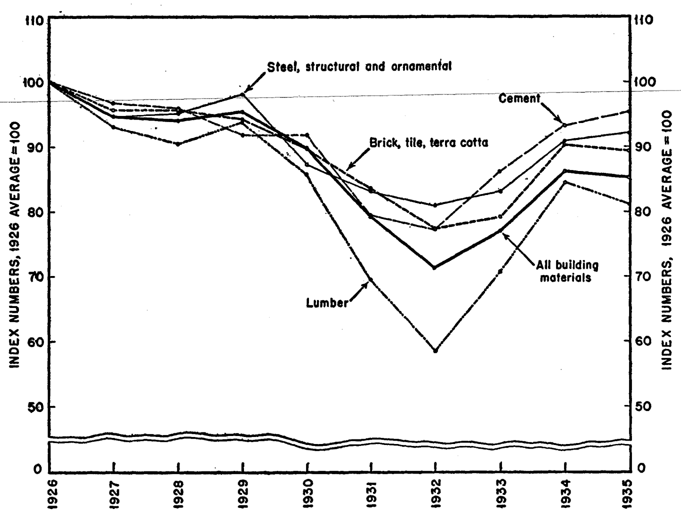

FIGURE 117.—Trends in wholesale prices of all building materials and of selected groups of building materials, 1926–35. (Index numbers, 1926=100, compiled by Bureau of Labor Statistics.)

Dimension stone sold or used by producers in the United States, 1934–35, by kinds and uses

Kind and use	1934	1935 [1] Total	1935 [1] Percent of change
Granite:			
Building stone:			
Rough construction short tons	121,740	121,000	−0.6
Value	$231,505	$237,000	+2.4
Average per ton	$1.90	$1.96	+3.2
Cut stone, slabs, and mill blocks cubic feet	1,130,650	675,000	−40.3
Value	$2,411,113	$1,447,000	−40.0
Average per cubic foot	$2.13	$2.14	+.5
Monumental stone cubic feet	1,826,980	2,000,000	+9.5
Value	$4,751,560	$4,950,000	+4.2
Average per cubic foot	$2.60	$2.48	−4.6
Rubble short tons	66,310	42,000	−36.7
Value	$74,047	$50,000	−32.5
Paving blocks number	5,838,120	8,980,000	+53.8
Value	$613,879	$826,000	+34.6
Curbing cubic feet	621,190	680,000	+9.5
Value	$603,397	$663,000	+9.9
Total:			
Quantity approximate short tons	543,360	510,000	−6.1
Value	$8,685,501	$8,173,000	−5.9
Basalt and related rocks (trap rock):			
Building stone short tons	7,760	6,000	−22.7
Value	$10,388	$7,000	−32.6
Average per ton	$1.53	$1.17	−23.5
Rubble short tons	3,530	27,000	+664.9
Value	$2,544	$16,000	+528.9
Total:			
Quantity short tons	11,290	33,000	+192.3
Value	$12,932	$23,000	+77.9
Marble:			
Building stone (cut stone, slabs, and mill blocks) cubic feet	500,010	352,000	−29.6
Value	$1,719,456	$1,467,000	−14.7
Average per cubic foot	$3.44	$4.17	+21.2
Monumental stone cubic feet	464,910	284,000	−38.9
Value	$1,475,426	$1,441,000	−2.3
Average per cubic foot	$3.17	$5.07	+59.9
Total:			
Quantity approximate short tons	81,720	54,000	−33.9
Value	$3,194,882	$2,908,000	−9.0
Limestone:			
Building stone:			
Rough construction short tons	156,000	276,000	+76.9
Value	$179,337	$348,000	+94.0
Average per ton	$1.15	$1.26	+9.6
Cut stone, slabs, and mill blocks cubic feet	3,158,660	3,218,000	+1.9
Value	$3,212,118	$2,802,000	−12.8
Average per cubic foot	$1.02	$0.87	−14.7
Rubble short tons	190,080	183,000	−3.7
Value	$179,791	$280,000	+55.6
Flagging cubic feet	116,610	65,000	−44.3
Value	$49,886	$30,000	−39.9
Total:			
Quantity approximate short tons	585,510	695,000	+18.7
Value	$3,621,132	$3,460,000	−4.4
Sandstone:			
Building stone:			
Rough construction short tons	23,680	15,000	−36.7
Value	$50,133	$29,000	−42.2
Average per ton	$2.12	$1.93	−9.0
Cut stone, slabs, and mill blocks cubic feet	339,570	355,000	+4.5
Value	$481,244	$421,000	−12.5
Average per cubic foot	$1.42	$1.19	−16.2
Rubble short tons	14,030	31,000	+121.0
Value	$21,310	$20,000	−6.1
Paving blocks number	57,150	290,000	+57.5
Value	$4,162	$23,000	+452.6

[1] Subject to revision.

Dimension stone sold or used by producers in the United States, 1934–35, by kinds and uses—Continued

Kind and use	1934	1935 Total	1935 Percent of change
Sandstone—Continued.			
Curbing .... cubic feet	363, 210	195, 000	—46. 3
Value	$281, 643	$170, 000	—39. 6
Flagging .... cubic feet	183, 210	224, 000	+22. 3
Value	$140, 449	$202, 000	+43. 8
Total:			
Quantity .... approximate short tons	106, 900	110, 000	+2. 9
Value	$978, 941	$865, 000	—11. 6
Miscellaneous stone: [2]			
Building stone .... cubic feet	102, 870	126, 000	+22. 5
Value	$243, 553	$254, 000	+4. 3
Average per cubic foot	$2. 37	$2. 02	—14. 8
Rubble .... short tons	19, 480	3, 000	—84. 6
Value	$39, 948	$3, 000	—92. 5
Total:			
Quantity .... approximate short tons	28, 430	14, 000	—50. 8
Value	$283, 501	$257, 000	—9. 3
Dimension stone, exclusive of slate, by uses:			
Building stone:			
Rough construction .... short tons	309, 180	418, 000	+35. 2
Value	$471, 363	$621, 000	+31. 7
Cut stone, slabs, and mill blocks .... cubic feet	5, 231, 760	4, 726, 000	—9. 7
Value	$8, 067, 484	$6, 391, 000	—20. 8
Monumental stone .... cubic feet	2, 291, 890	2, 284, 000	—. 3
Value	$6, 226, 986	$6, 391, 000	+2. 6
Paving blocks .... number	5, 895, 270	9, 270, 000	+57. 2
Value	$618, 041	$849, 000	+37. 4
Curbing .... cubic feet	984, 400	875, 000	—11. 1
Value	$885, 040	$833, 000	—5. 9
Flagging .... cubic feet	299, 820	289, 000	—3. 6
Value	$190, 335	$232, 000	+21. 9
Rubble .... short tons	293, 430	286, 000	—2. 5
Value	$317, 640	$369, 000	+16. 2
Total:			
Quantity .... approximate short tons	1, 357, 210	1, 416, 000	+4. 3
Value	$16, 776, 889	$15, 686, 000	—6. 5
Slate as dimension stone [3] .... approximate short tons	66, 570	103, 500	+55. 5
Value	$1, 641, 828	$2, 319, 000	+41. 2
Grand total:			
Quantity .... approximate short tons	1, 423, 780	1, 519, 500	+6. 7
Value	$18, 418, 717	$18, 005, 000	—2. 2

[2] Includes soapstone, mica schist, volcanic rocks, argillite, and other varieties that cannot properly be classed in any main group.
[3] Details of production, by uses, are given in the chapter on Slate in Minerals Yearbook, 1936.

Granite.—The granite industry failed to maintain in 1935 the upward trend of 1934. The drop of about 6 percent both in quantity and value was due principally to the decided shrinkage in sales of cut stone and rubble, which was compensated partly by increases in sales of monumental stone, paving blocks, and curbing. The industry is suffering severely from a decline in the demand for cut stone to be used in buildings. This is due partly to the slow recovery of the building trades and partly to the use of lower-priced building materials.

The following table shows sales by principal uses. Sales of crushed and broken stone are included in this table and in corresponding tables for other kinds of stone, but these classes are discussed later in this chapter.

Granite sold or used by producers in the United States in 1935, by uses [1]

Use	Quantity	Value
Building stone (rough and dressed) cubic feet	2,035,000	$1,684,000
Approximate equivalent in short tons	177,000	
Monumental stone cubic feet	2,000,000	4,950,000
Approximate equivalent in short tons	161,000	
Paving number of blocks	8,980,000	826,000
Approximate equivalent in short tons	74,000	
Curbing cubic feet	680,000	663,000
Approximate equivalent in short tons	56,000	
Rubble short tons	42,000	50,000
Riprap do	860,000	730,000
Crushed stone do	4,800,000	5,300,000
Other uses do	20,000	45,000
Total (quantity approximate, in short tons)	6,190,000	14,248,000

[1] Subject to revision.

Trap rock.—There was a large gain in sales of basalt and related rocks for building purposes, but the increase was entirely in the rough type classed as rubble.

Basalt and related rocks (trap rock) sold or used by producers in the United States in 1935, by uses [1]

Use	Quantity	Value
Building stone cubic feet	70,000	$7,000
Approximate equivalent in short tons	6,000	
Rubble short tons	27,000	16,000
Riprap do	1,111,000	987,000
Crushed stone do	7,650,000	7,210,000
Other uses do	34,000	14,000
Total (quantity approximate, in short tons)	8,828,000	8,234,000

[1] Subject to revision.

Marble.—Although the marble industry declined nearly 34 percent in quantity sold during 1935 compared with 1934 the decline in value was only 9 percent. The material advance in value per cubic foot of building stone from $3.44 to $4.11 and of monumental stone from $3.17 to $5.07 is encouraging. The quantity of marble sold in 1935 was only about 9 percent of that sold in 1928.

Marble sold by producers in the United States in 1935, by uses [1]

Use	Quantity	Value
Building stone cubic feet	352,000	$1,467,000
Monumental stone do	284,000	1,441,000
Total building and monumental do	636,000	2,908,000
Approximate equivalent in short tons	54,000	
Marble for other uses (byproducts) short tons	68,000	112,000
Total marble, approximate in short tons	122,000	3,020,000

[1] Subject to revision.

Limestone.—Limestone sales gained nearly 19 percent in quantity but declined about 4 percent in value. There was a large increase in sales of rough construction stone, and prices obtained advanced from $1.15 to $1.26 a cubic foot. Sales of cut stone increased about 2 percent in quantity but declined nearly 13 percent in value. Nearly all limestone sold as blocks or slabs is used as building stone, and the limestone industry will probably revive when building construction becomes more active. The following table shows sales by principal uses. Figures are not yet available in sufficient detail to compile the customary table of miscellaneous uses.

Limestone sold or used by producers in the United States in 1935, by uses [1]

Use	Quantity	Value
Building stone [2] .... cubic feet..	6,788,000	$3,150,000
Approximate equivalent in short tons	507,000	....
Curbing, flagging, and paving .... cubic feet..	65,000	30,000
Approximate equivalent in short tons	5,000	....
Rubble .... short tons..	183,000	280,000
Riprap .... do....	2,283,000	2,268,000
Crushed stone .... do....	31,525,000	27,120,000
Fluxing stone .... do....	11,110,000	7,364,000
Sugar factories .... do....	408,000	593,000
Glass factories .... do....	241,000	396,000
Paper mills .... do....	194,000	281,000
Agriculture .... do....	2,250,000	2,773,000
Other uses .... do....	4,900,000	3,000,000
Total (quantity approximate, in short tons)	53,606,000	47,255,000

[1] Subject to revision.
[2] Figures for building stone include small amounts of monumental stone.

Indiana produces a large share of the building limestone used in the United States. Statistics of production in the State for a series of years follow.

Limestone sold by producers in the Indiana oolitic limestone district, 1931–35

Year	Construction		Other		Total	
	Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
1931	7,865,210	$8,570,563	313,100	$200,754	883,330	$8,771,317
1932	5,927,350	5,491,276	136,130	85,957	565,860	5,577,233
1933	4,858,660	4,817,822	150,140	80,961	502,400	4,898,783
1934	2,795,510	2,687,182	183,510	94,611	386,510	2,781,793
1935	2,764,870	1,747,245	160,000	107,000	367,000	1,854,245

Limestone sold by producers in the Indiana oolitic limestone district in 1935, by classes

Class	Quantity	Value
Construction:		
Rough blocks .... cubic feet..	1,585,150	$423,741
Sawed and semifinished .... do....	591,850	359,942
Cut .... do....	587,870	963,562
Total construction .... do....	2,764,870	1,747,245
Other stone .... short tons..	160,000	107,000
Grand total (quantity approximate, in short tons)	367,000	1,854,245

Considerable stone is sold by quarry operators to independent finishing mills in the district, and a few quarry companies that operate mills obtain rough stone from other quarries, mill it, and resell it. Duplication is avoided by including the milled product in the table showing output of the mills in the district, whereas the rough stone is included in the quarry report of the producing company.

Indiana limestone sold by mills not operated by quarry companies and by mills of quarry companies from stock obtained at quarries other than their own, 1931–35

Year	Cubic feet	Value	Year	Cubic feet	Value
1931	1,394,130	$2,930,978	1934	648,750	$1,131,677
1932	1,404,310	2,375,274	1935	596,630	855,621
1933	1,198,430	1,900,414			

Indiana limestone sold by mills not operated by quarry companies and by mills of quarry companies from stock obtained at quarries other than their own, 1934–35, by classes

Sales by mills—	Sawed		Cut		Total	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
	1934					
Not operated by quarry companies	36,670	$60,623	256,070	$530,177	292,740	$590,800
Of quarry companies from stock obtained at quarries other than their own	22,270	14,761	333,740	526,116	356,010	540,877
	58,940	75,384	589,810	1,056,293	648,750	1,131,677
	1935					
Not operated by quarry companies	6,490	$4,151	329,890	$474,130	336,380	$478,281
Of quarry companies from stock obtained at quarries other than their own	53,460	19,058	206,790	358,282	260,250	377,340
	59,950	23,209	536,680	832,412	596,630	855,621

Alabama, Colorado, Kentucky, Minnesota, Missouri, and Texas also produce considerable building limestone.

Sandstone.—Total sales of sandstone in the form of dimension stone increased about 3 percent in 1935 compared with 1934, but the value declined nearly 12 percent. Sales of sandstone classed as cut stone, rubble, paving blocks, and flagging increased in 1935, but the unit values of cut stone and rubble were much lower than in 1934. Stone sold for rough construction and that used in curbing declined sharply.

Sandstone sold or used by producers in the United States in 1935, by uses [1]

Use	Quantity	Value
Building stone ... cubic feet	543,000	$540,000
Approximate equivalent in short tons	43,000	----------
Paving blocks ... number	290,000	23,000
Approximate equivalent in short tons	3,000	----------
Curbing ... cubic feet	195,000	170,000
Approximate equivalent in short tons	15,000	----------
Flagging ... cubic feet	224,000	202,000
Approximate equivalent in short tons	18,000	----------
Crushed stone ... short tons	1,710,000	1,825,000
Rubble ... do	31,000	20,000
Riprap ... do	420,000	482,000
Refractory stone (ganister) ... do	525,000	674,000
Other uses ... do	66,000	50,000
Total (quantity approximate, in short tons)	2,831,000	3,896,000

[1] Subject to revision.

Miscellaneous stone.—Production of various types of stone that do not fall in any of the groups already discussed is shown in the accompanying table.

Miscellaneous varieties of stone[1] *sold or used by producers in the United States in 1935, by uses*[2]

Use	Quantity	Value
Building stone...cubic feet..	126,000	$254,000
Approximate equivalent in short tons...	11,000	...
Riprap and rubble...short tons..	653,000	543,000
Crushed stone...do..	5,391,000	4,303,000
Refractory stone (mica schist and soapstone)...do..	19,000	156,000
Other uses...do..	728,000	581,000
Total (quantity approximate, in short tons)...	6,802,000	5,837,000

[1] Includes mica schist, conglomerate, argillite, various light-colored volcanic rocks, serpentine not used as marble, soapstone used as dimension stone, and such other stone as cannot properly be classed in any main group.
[2] Subject to revision.

Trends in the use of building stone.—The dimension-stone industries depend for their markets primarily upon the building industries, principally the nonresidential classes. The decline in sales of dimension stone in 1935, despite the substantial gains in construction of educational, religious, memorial, and public buildings, as shown in the table of construction contract awards on page 812, indicates a trend toward the substitution of other building materials for stone. As the trend is generally toward lower-priced and less substantial materials, a lowering of the architectural standards of our most imposing structures is threatened. Such a tendency is to be deplored. A more complete discussion of such trends was published recently.[2]

Figure 118 compares trends in sales of building limestone and sandstone with total and nonresidential building for a 10-year period. While building has shown a modest recovery since 1933, sales of limestone and sandstone continue to decline. Figure 119 shows a similar comparison for marble and granite. They also have failed to respond to the upturn in building.

Trends in sales of memorial stone.—Granite sold as memorial stone gained more than 9 percent in quantity and more than 4 percent in value in 1935 compared with 1934. Sales of marble, however, declined 39 percent in quantity and 2 percent in value.

RECENT DEVELOPMENTS

Light-weight building materials.—Continued interest is shown in development of new, light-weight products to be used either as concrete aggregates or as building units. Several new types have been described recently.

"Tuff-Lite", a cellular product manufactured by the Victor Chemical Works, Chicago, Ill., at its West Nashville (Tenn.), plant weighs only 41 to 45 pounds per cubic foot in coarse-aggregate form and 65 to 71 pounds per cubic foot in fine grains. Concrete in which it is used as aggregate is about one-third lighter in weight than that made

[2] Bowles, Oliver, and Gnam, Carl A., The Use of Stone in Residential Building: Stone, vol. 57, no. 2, February 1936, pp. 60–62.

with stone or gravel and is strong enough for all ordinary uses. It has good heat- and sound-insulating qualities and is nailable.

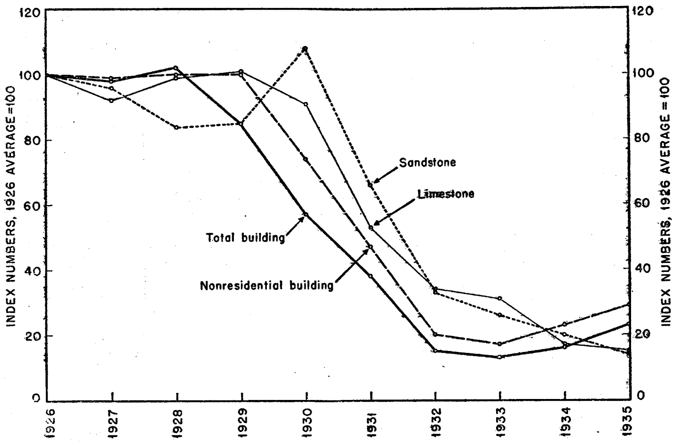

FIGURE 118.—Sales of limestone and sandstone compared with total building and nonresidential building, 1926–35. To facilitate comparison unlike units have been reduced to percentages of the 1926 value. Stone figures are from the Bureau of Mines and include rough and dressed stone; contracts are from F. W. Dodge Corporation.

The Porete Manufacturing Co. of North Arlington, N. J., manufactures a product known as "Poretherm." Portland cement, water, and a foaming agent "porete" are mixed in an ordinary concrete mixer.

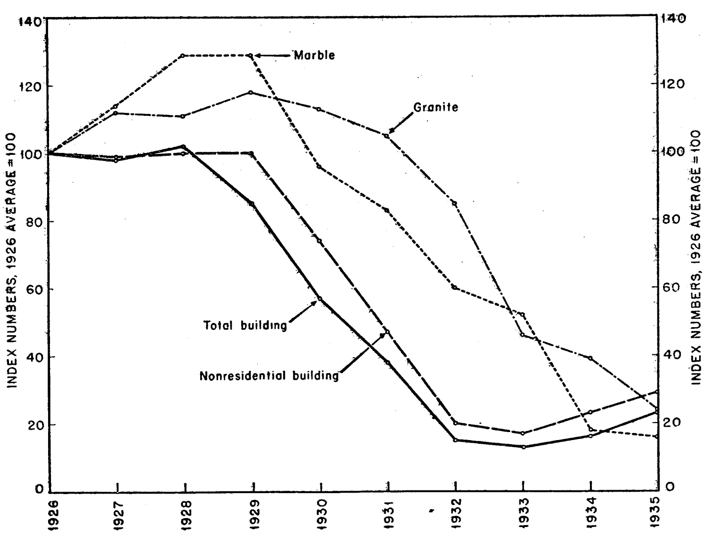

FIGURE 119.—Sales of building marble and granite compared with total building and nonresidential building, 1926–35. To facilitate comparison unlike units have been reduced to percentages of the 1926 value. Stone figures are from the Bureau of Mines and include both rough and dressed stone; contracts are from F. W. Dodge Corporation.

Without chemical action air is whipped into the mixture to form a concrete containing numerous small bubbles. It may be poured in place or made into precast units. It is usually made in one of two weights, 19 or 32 pounds per cubic foot. The light-weight material is used for high temperatures and for insulating refrigerated spaces and the heavier product for ordinary insulating and fireproofing.

The Basalt Rock Co. of Napa, Calif., manufactures a new, light-weight, hollow, webbed concrete building unit with the trade name "basalite." It is fireproof and is said to have high heat-insulating qualities. It may be cut with a saw and will hold nails.

Slag pumice is manufactured in Germany by treating molten slag with less water that that required for granulation. Basic slags are inclined to be less porous than the more acid ones. The product is employed as a heat-insulating material, as artificial pumice, and as aggregate for light-weight concrete. It is nonabsorptive as the pores are not connected with one another.

The Voltuff Products Co. of New Plymouth, Idaho, is engaged in quarrying light-weight building units from a deposit of volcanic tuff in Payette County, Idaho.

A new, light-weight product known as "microporite" is used in Sweden, Denmark, and Germany. It consists largely of calcium hydrosilicate. Finely ground silica and lime are intimately mixed in a water suspension, then made into bricks and blocks which are hardened by steam treatment. The pore space is 75 to 80 percent of the blocks, and the pores are submicroscopic. The blocks are said to have superior heat- and sound-insulating properties but are not recommended for use where exposed to the weather.

A new, light-weight building block known as "foamed slag" is manufactured at Scunthorpe, Lincolnshire, England. No details of the process of manufacture are available, but the claim is made that walls made of foamed-slag blocks have four and a half times the heat-insulating quality of clay bricks. The erection of several more plants for the manufacture of this product is contemplated.[3]

Translucent marble.—The Vermont Marble Co., in cooperation with the Mellon Institute of Industrial Research, has developed a method of scientific selection and processing of natural marble by which remarkable translucency and artistic color effects are possible without waxing, oiling, or other artificial treatment. The colors, markings, and light diffusion are emphasized when the marble object is illuminated from within. The new development opens up a wide field for marble in lighting and decoration.[4]

Argentine onyx marble.—The C. A. Fritz Corporation, 55 West Forty-second Street, New York, N. Y., imports onyx marble from the Province of San Luis, Argentina. The material is said to be darker green than Mexican onyx and commands a much higher price—more than $35 a cubic foot. It is sold to manufacturers of novelties such as ash trays, lamp bases, clock cases, candlesticks, and book ends. The material is sold as "Brazilian onyx", a name given to it some years ago to hide the location of the deposit.

Tests of stone for floors.—A modification of the Dorry abrasion testing machine has been developed for measuring the abrasive resistance of flooring materials. The results are expressed in terms of the depth of wear in specimens after 333 revolutions of the apparatus using standard Ottawa sand passing a no. 20 sieve and retained on a no. 30. The technique of testing and results of tests on many samples of sandstones, marbles, granites, limestones, and slates are given by Shank.[5]

[3] Quarry Managers' Journal, vol. 18, no. 11, Feb. 5, 1936, p. 368.
[4] Stone, vol. 57, no. 3, March 1936, pp. 101–102.
[5] Shank, J. R., A Wear Test for Flooring Materials: Proc. Am. Soc. Testing Materials, 1935, Reprint 56, 9 pp.

Core drilling of Belgian limestone.—At Soignies, Belgium, where wire saws have been used for many years to cut a dense limestone, the holes for the standards are cut with very simple equipment. The core holes are 35 centimeters (less than 14 inches) in diameter, and the sheave that carries the wire down in the hole is 33 centimeters (13 inches) across. A rotating drum cutter about 6 feet long, with teeth on the lower edge, is fed with steel shot and sinks 8 to 10 inches an hour. Unlike American core drills it has no motor and is gear-driven from a sheave rotated by a wire belt. The same type of wire that is employed as a cutting tool in the quarry is used as a power-transmission belt which is driven by the same motor that operates the wire saw.

Wire-saw developments.—A large slate-producing company in Pennsylvania claims that the cost of cutting slate with wire saws is only 10 percent of what it formerly was with channeling machines. The wire saw also has reduced waste about 50 percent, and the electric energy now needed to operate the quarry is only one-fourth of the former requirement.

A wire saw was used to cut the massive marble columns for the Supreme Court Building in Washington, D. C., prior to smoothing and polishing. The wire ran lengthwise of the huge block, which was mounted on cars, and the necessary curvature was attained by moving the block slowly in a lateral direction while the wire descended.

A wire saw is now used for scabbling marble blocks at a Tennessee quarry. The average cutting rate is about 6 square feet an hour.

Building-stone sample room.—The Procurement Division building of the Treasury Department, Washington, D. C., is now furnished with sample rooms, the entire walls of which are faced with hundreds of large samples of the chief commercial building and ornamental stones. All samples are numbered, and an index enables the observer to identify them. The floors are made of numerous samples of stone tile.

FOREIGN TRADE [6]

Imports.—Foreign trade in stone relates almost exclusively to dimension stone. Imports of stone in 1935 increased 30 percent in value over 1934. The following tables show the value of imports for a 5-year period and the quantities and values by kinds for 1935.

Value of stone imported for consumption in the United States, 1931–35

1931	$1,497,696	1934	$413,301
1932	766,706	1935	556,584
1933	536,643		

Stone imported for consumption in the United States in 1935, by classes

Class	Quantity	Value
Marble, breccia, and onyx:		
In blocks, rough, etc. cubic feet	52,393	$227,405
Sawed do	180	773
Slabs or paving tiles superficial feet	85,092	29,846
All manufactures		40,055
Mosaic cubes of marble or onyx:		
Loose pounds	72,908	1,697
		299,776
Granite:		
Dressed cubic feet	14,565	62,496
Rough do	45,217	57,885
	59,782	120,381
Quartzite short tons	49,025	$99,732
Travertine stone (unmanufactured) cubic feet	17,763	21,498
Stone (other):		
Dressed		1,664
Rough (monumental or building stone) cubic feet	6,262	7,699
Rough (other)		5,834
		15,197
Grand total		556,584

[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.

From the following table of imports by countries of origin in 1935 it is apparent that Italy is still the most important source of foreign marble. However, imports from Argentina (presumably almost all onyx) were valued almost as high as imports from Italy. Substantial quantities were imported from France, Belgium, and the United Kingdom.

Finland supplies about 60 percent of foreign granites and Sweden 27 percent.

Stone imported for consumption in the United States in 1935, 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			$98	9,929	$7,151	$409	$514	43,008	$87,174			$95,346
Cuba			592			15						607
Mexico	4,158	$20,622	121			12						20,755
Total North America	4,158	20,622	811	9,929	7,151	436	514	43,008	87,174			116,708
South America:												
Argentina	3,800	94,378										94,378
Brazil	175	4,252										4,252
Total South America	3,975	98,630										98,630
Europe:												
Austria			1,985			9						1,994
Belgium	6,016	18,402	7,746									26,148
Czechoslovakia			42	221	1,150							1,192
Finland				30,090	71,414							71,414
France	10,220	26,241	7,816			1,153						35,210
Germany			2,563	1,211	4,813	289	24	(1)	33			7,722
Greece	666	1,948										1,948
Italy	22,674	49,824	45,187			5,544				17,763	$21,498	122,053
Netherlands								6,000	12,000			12,000
Norway				1,089	1,607		101					1,708
Portugal	409	830				119						949
Rumania			1,001									1,001
Spain	1,998	4,161	230									4,391
Sweden				16,908	32,306	10	1,155	17	525			33,996
Switzerland			8									8
U. S. S. R.			379			9						388
United Kingdom	2,277	6,747	3,219	282	1,808	530	3,862					16,166
Total Europe	44,260	108,153	70,176	49,801	113,098	7,663	5,142	6,017	12,558	17,763	21,498	338,288
British India			312									312
China			871	1	3	40						914
Japan			201	51	129	360	178					868
South Africa (Union of)						864						864
Grand total	52,393	227,405	72,371	59,782	120,381	9,363	5,834	49,025	99,732	17,763	21,498	556,584

[1] Less than 1 ton.

Exports.—Exports of stone, with which are included cement blocks and other cement manufactures, increased about 24 percent in value in 1935 compared with 1934. Canada, the United Kingdom, and Mexico are the principal foreign markets for stone.

Stone [1] exported from the United States, 1931–35, by classes

Year	Marble in blocks, rough or dressed		Other building or monumental stone (including cement building blocks)		Value of other manufactures of stone (including other cement manufactures)	Total value
	Cubic feet	Value	Cubic feet	Value		
1931	32,443	$141,216	284,050	$209,353	$627,771	$978,340
1932	30,691	99,943	73,098	75,558	273,755	449,256
1933	11,585	46,031	29,933	35,588	244,875	326,494
1934	11,475	44,979	43,176	40,311	354,509	439,799
1935	13,466	55,334	86,761	62,185	428,481	546,000

[1] Figures not separately recorded for stone and for cement building blocks and for stone and for cement manufactures.

Stone [1] exported from the United States in 1935, by classes and countries

Country	Marble in blocks, rough or dressed		Other building or monumental stone (including cement building blocks)		Value of other manufactures of stone (including other cement manufactures)	Total value
	Cubic feet	Value	Cubic feet	Value		
North America:						
Bermuda	27	$1,011	-----	-----	$1,059	$2,070
Canada	7,316	29,929	76,962	$52,758	244,970	327,657
Central America:						
British Honduras	-----	-----	30	140	257	397
Costa Rica	-----	-----	-----	-----	267	267
Guatemala	-----	-----	-----	-----	321	321
Honduras	-----	-----	-----	-----	788	788
Nicaragua	-----	-----	-----	-----	202	202
Panama	192	1,557	86	152	6,621	8,330
Salvador	-----	-----	-----	-----	492	492
Mexico	15	110	7,500	4,954	22,949	28,013
Newfoundland and Labrador	1,175	6,618	-----	-----	412	7,030
West Indies:						
British:						
Barbados	21	35	-----	-----	60	95
Jamaica	13	455	-----	-----	5,241	5,696
Trinidad and Tobago	-----	-----	-----	-----	243	243
Other West Indies	296	1,050	16	77	995	2,122
Cuba	384	1,181	69	98	8,472	9,751
Dominican Republic	5	22	-----	-----	2,053	2,075
Haiti	3	35	-----	-----	443	478
Netherland	38	200	-----	-----	4,095	4,295
South America:						
Argentina	-----	-----	-----	-----	4,084	4,084
Bolivia	-----	-----	-----	-----	387	387
Brazil	-----	-----	-----	-----	436	436
Chile	-----	-----	-----	-----	3,398	3,398
Colombia	8	145	-----	-----	9,029	9,174
Ecuador	41	661	-----	-----	73	734
Guiana (British)	-----	-----	-----	-----	13	13
Peru	-----	-----	-----	-----	605	605
Venezuela	-----	-----	-----	-----	414	414
Europe:						
Austria	-----	-----	-----	-----	80	80
Belgium	-----	-----	-----	-----	2,819	2,819
Denmark	-----	-----	-----	-----	1,640	1,640
Finland	-----	-----	-----	-----	740	740
France	-----	-----	-----	-----	8,529	8,529
Germany	-----	-----	-----	-----	9,367	9,367
Italy	-----	-----	-----	-----	13	13
Netherlands	-----	-----	-----	-----	2,249	2,249
Norway	-----	-----	-----	-----	326	326
Portugal	-----	-----	-----	-----	315	315
Spain	-----	-----	-----	-----	1,018	1,018
Sweden	-----	-----	-----	-----	1,630	1,630
Switzerland	-----	-----	-----	-----	20	20
U. S. S. R. (Russia)	-----	-----	-----	-----	49	49
United Kingdom	3,929	12,275	2,093	3,971	40,296	56,542

[1] Figures not separately recorded for stone and for cement building blocks and for stone and for cement manufactures.

Stone exported from the United States in 1935, by classes and countries—Continued

Country	Marble in blocks, rough or dressed		Other building or monumental stone (including cement building blocks)		Value of other manufactures of stone (including other cement manufactures)	Total value
	Cubic feet	Value	Cubic feet	Value		
Asia:						
British Malaya					$437	$437
Ceylon					26	26
China					2, 499	2, 499
India (British)					6, 931	6, 931
Hong Kong					289	289
Japan					14, 824	14, 824
Netherland India					4, 729	4, 729
Philippine Islands					1, 848	1, 848
Siam					126	126
Other Asia					831	831
Africa:						
Egypt					37	37
Morocco					66	66
Nigeria			5	$35		35
Union of South Africa					4, 255	4, 255
Oceania:						
Australia					2, 904	2, 904
British Oceania					17	17
French Oceania					41	41
New Zealand	3	$50			1, 151	1, 201
	13, 466	55, 334	86, 761	62, 185	428, 481	546, 000

CRUSHED AND BROKEN STONE

Sales of crushed and broken stone in 1935 failed to maintain the upward trend begun in 1934. Commercial stone dropped 15 percent in tonnage and 18 percent in value, whereas industry in general, according to the Federal Reserve Board index of industrial production, increased 14 percent. Preliminary reports from producers indicate that sales of crushed or broken stone were 77,521,000 tons valued at $69,483,000. Comparable figures for 1934 were 91,283,233 tons valued at $85,031,523. If stone for cement and lime manufacture, for which no value is available because nearly all of it is produced by manufacturers for their own use, is included the total production in 1935 was 103,110,987 tons, 11 percent less than the 115,813,243 tons produced in 1934.

From 1926 to 1935, inclusive, production of crushed and broken stone ranged from a peak of 189,793,150 tons in 1929 to a low of 89,952,950 tons in 1933. If the 1923–25 average is taken as 100, the index of output in 1929 was 126; 1933, 60; 1934, 77; and 1935, 69.

The following table of salient statistics shows the quantity and value of crushed and broken stone sold during 1934 and 1935, by uses. Detailed data on asphaltic stone and slate granules and flour are given in the chapters on asphalt and slate.

Crushed and broken stone sold or used by producers in the United States, 1934–35, by principal uses

Use	1934			1935 [1]			Percent of change in—	
	Short tons	Value		Short tons	Value		Tonnage	Average value
		Total	Average		Total	Average		
Concrete and road metal	55,244,470	$52,471,430	$0.95	46,285,000	$42,160,000	$0.91	−16.2	−19.7
Railroad ballast	5,323,450	3,995,177	.75	4,791,000	3,598,000	.75	−10.0	−9.9
Metallurgical (fluxing)	9,230,880	6,297,579	.68	11,110,000	7,364,000	.66	+20.4	+16.9
Alkali works	3,814,060	2,015,506	.53	2,812,000	1,410,000	.50	−26.3	−30.0
Riprap	6,052,970	5,894,259	.97	5,324,000	5,007,000	.94	−12.0	−15.0
Agricultural	1,612,380	1,788,142	1.11	2,250,000	2,773,000	1.23	+39.5	+55.1
Refractory (ganister, mica schist, dolomite, soapstone)	677,410	863,078	1.27	780,000	1,043,000	1.34	+15.1	+20.8
Asphalt filler	172,170	361,404	2.10	(2)	(2)			
Calcium carbide works	305,600	177,458	.58	(2)	(2)			
Sugar factories	479,900	658,502	1.37	408,000	593,000	1.45	−15.0	−9.9
Glass factories	161,220	260,410	1.62	241,000	396,000	1.64	+49.5	+52.1
Paper mills	262,160	408,022	1.56	194,000	281,000	1.45	−26.0	−31.1
Asphaltic stone	410,453	1,762,376	4.29	339,000	1,367,000	4.00	−17.4	−6.8
Slate granules and flour	166,160	1,066,100	6.42	219,000	1,312,000	5.99	+31.8	+23.1
Other uses	7,369,950	7,012,080	.95	2,768,000	2,179,000	.79		
Total	91,283,233	85,031,523	.93	77,521,000	69,483,000	.90	−15.1	−3.2
Portland cement (including "cement rock") [3]; Natural cement ("cement rock") [3]	19,730,000	(4)		19,690,000	(4)		−0.2	
Lime [5]	4,800,000	(4)		5,900,000	(4)		+22.9	
Total stone	115,813,233	(4)		103,111,000	(4)		−11.0	

[1] Subject to revision.
[2] Included under "Other uses."
[3] Value reported as cement in the chapter on Cement.
[4] No value available for stone used in manufacture of cement and lime.
[5] Value reported as lime in the chapter on Lime.

Production by kinds.—The following table shows the quantity of stone employed as aggregate, road stone, or ballast in 1935. Of the total, about 62 percent is limestone, 15 percent trap rock, 9 percent granite, 3 percent sandstone, and 11 percent miscellaneous varieties that do not fall in any major group. The average values per ton at the quarry also are shown in the table.

Crushed stone sold or used by producers in the United States in 1935 [1] for concrete, roads, and railroad ballast, by kinds

Kind	Concrete and road metal		Railroad ballast		Total		
	Short tons	Value	Short tons	Value	Short tons	Value	
						Total	Average
Granite	4,100,000	$4,720,000	700,000	$580,000	4,800,000	$5,300,000	$1.10
Basalt and related rocks (trap rock)	7,200,000	6,850,000	450,000	360,000	7,650,000	7,210,000	.94
Limestone	28,235,000	24,700,000	3,290,000	2,420,000	31,525,000	27,120,000	.86
Sandstone	1,510,000	1,680,000	200,000	145,000	1,710,000	1,825,000	1.07
Miscellaneous	5,240,000	4,210,000	151,000	93,000	5,391,000	4,303,000	.80
	46,285,000	42,160,000	4,791,000	3,598,000	51,076,000	45,758,000	
Average value per ton		$0.91		$0.75		$0.90	

[1] Subject to revision.

The following table shows the amount of stone used in concrete and roads and as railroad ballast for a series of years.

Crushed stone sold or used by producers in the United States, 1931–35, by uses

Year	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1931	65,811,520	$64,908,509	6,812,890	$5,496,455	72,624,410	$70,404,964
1932	48,020,560	43,651,774	3,974,540	3,239,991	51,995,100	46,891,765
1933	40,857,120	35,843,318	4,633,490	3,175,418	45,490,610	39,018,736
1934	55,244,470	52,471,430	5,323,450	3,995,177	60,567,920	56,466,607
1935 [1]	46,285,000	42,160,000	4,791,000	3,598,000	51,076,000	45,758,000

[1] Subject to revision.

Markets.—A decline of 8,959,470 tons in sales of stone for concrete and road metal, influenced by curtailed expenditures for highway construction, was largely responsible for the 11-percent drop in total

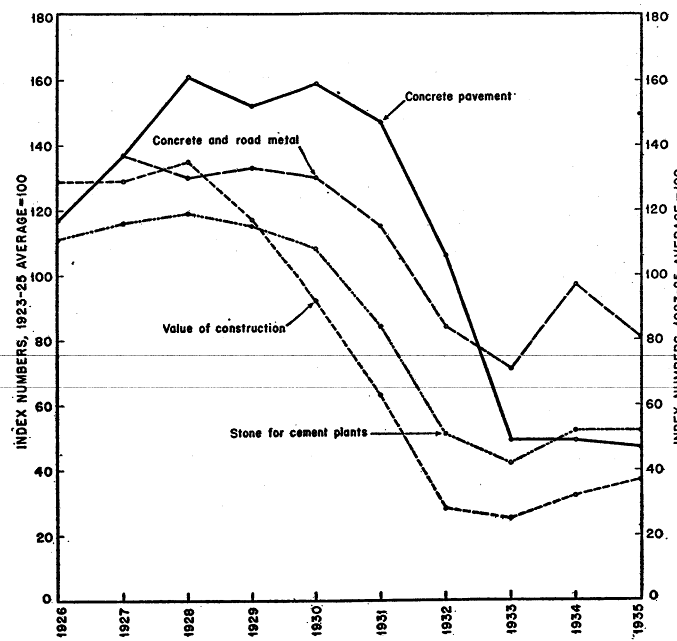

FIGURE 120.—Quantity of crushed stone for concrete and road metal and for cement manufacture compared with square yards of concrete paving and value of construction contract awards, 1926–35. All data are plotted as index numbers, with the 1923–25 average as 100. Figures for 1935 are subject to revision. Statistics of concrete paving were compiled by the Portland Cement Association, and data for construction contract awards were reported by the F. W. Dodge Corporation.

production. The decline in sales of asphaltic stone and stone for cement manufacture also is attributed to curtailed road construction. Figure 120 shows this relationship. The rise in the index of construction from 32 in 1934 to 37 in 1935 prevented what would otherwise have been a drastic reduction in sales of crushed stone and cement and was responsible, at least in part, for increases in output of stone for lime manufacture and refractory and fluxing uses and of slate granules and flour for roofing. Sales of railroad ballast were 10 percent less in 1935 than in 1934, although the volume of railroad construction was about the same in both years. Sales of fluxing stone, which accounted for more than 10 percent of the total production of crushed stone, increased 20 percent in quantity and 17 percent in value in 1935 over 1934. This increase and that in sales of refractory stone, which amounted to 15 percent in quantity and 21 percent in value,

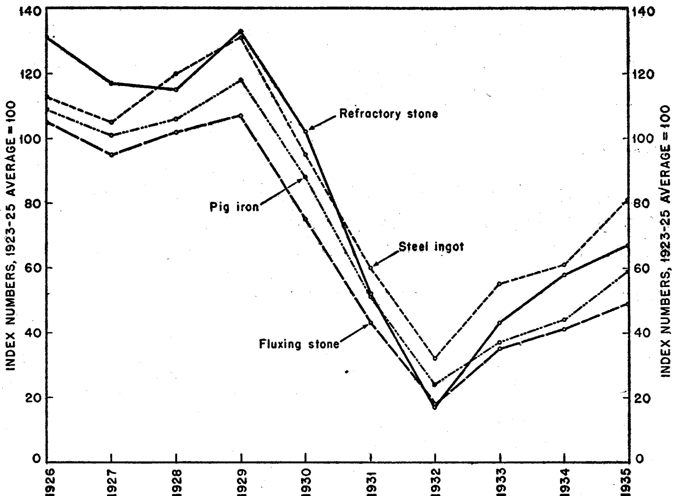

FIGURE 121.—Sales of fluxing stone and refractory stone compared with production of steel ingot and pig iron, 1926–35. All data are plotted as index numbers, with the 1923–25 average as 100, and figures for 1935 are subject to revision. Statistics of steel-ingot and pig-iron production compiled by American Iron and Steel Institute.

were influenced by greater activity in the iron and steel industry. Figure 121 shows the relationship of sales of refractory stone to steel-ingot production and sales of fluxing stone to pig-iron production.

Smaller use of riprap in 1935 than in 1934 indicates fewer improvements to water fronts and a decline in construction of dams. A 40-percent increase in sales of agricultural limestone reflects the greater purchasing power of the farmer in 1935. Sales of stone to alkali works dropped for the second consecutive year. "Other uses" in 1934 included more than 4.5 million tons of uncrushed field stone used in Pennsylvania for road base, but as none of this material was reported from the State in 1935 the total of that classification is reduced considerably.

SLATE

By Oliver Bowles and A. T. Coons

SUMMARY OUTLINE

Sales of slate that had fallen steadily for 5 consecutive years recovered moderately in value during 1934 but continued to decline in quantity. An appreciable gain in 1935 of 39 percent in quantity and 34 percent in value compared with 1934 indicates an encouraging trend toward predepression conditions, although much lost ground is still to be regained.

Roofing slate sold in 1935 totaled 219,000 squares valued at $1,438,700, a gain of 60 percent in quantity and 39 percent in value over the figures for 1934. The average value per square in 1935 was $6.57; in 1934 it was $7.54. The output of the New York-Vermont district was 56,500 squares valued at $399,900 compared with 34,980 squares valued at $302,001 in 1934. In the Pennsylvania district 143,600 squares valued at $870,900 were sold compared with 84,690 squares valued at $585,973 in 1934. Maine showed a small decrease and Virginia a small increase.

Sales of millstock in 1935 totaled 2,939,000 square feet valued at $847,300, an increase of 39 percent in quantity and 46 percent in value compared with 1934. Millstock includes all slate for structural and sanitary purposes, electrical products, blackboards, bulletin boards, school slates, billiard-table tops, and similar products. A moderate recovery in building activity led to gains of 21 percent in quantity and 24 percent in value of sales of structural slate. The unusually high level of electrical output in 1935 no doubt accounted for the remarkable gain of 77 percent in quantity and 70 percent in value of sales of electrical slate. School slates, most of which are exported, gained 48 percent in quantity and 46 percent in value compared with 1934. Blackboards and vaults and covers registered corresponding gains. Slate for flagging, cross-walks, and stepping stones, which is becoming increasingly popular, gained 53 percent in quantity and 24 percent in value.

The following table, arranged to permit ready comparison of the chief products, gives the principal statistical data for the slate industry in 1934 and 1935. Granules and flour, which have little connection with the industry, appear in the table because they are manufactured from slate; they are, however, properly a part of the crushed-stone industry and therefore are included also with other kinds of granules in the chapter of this volume on Stone.

Salient statistics of the slate industry in the United States, 1934–35

	1934			1935				
	Quantity			Quantity			Percent of change in—	
	Unit of measurement	Approximate equivalent short tons	Value	Unit of measurement	Approximate equivalent short tons	Value	Quantity (unit as reported)	Value
Domestic production (sales by producers):								
Roofing slate	*Squares* 137,010	51,640	$1,033,164	*Squares* 219,000	82,500	$1,438,700	+60	+39
Millstock:	*Sq. ft.*			*Sq. ft.*				
Electrical slate	201,710	1,800	147,280	356,000	3,200	250,000	+77	+70
Structural and sanitary slate	671,790	5,600	218,005	810,000	6,700	270,000	+21	+24
Grave vaults and covers	216,520	2,130	46,398	307,000	3,000	68,500	+42	+48
Blackboards and bulletin boards	698,780	1,680	163,983	985,000	2,400	249,000	+41	+52
Billiard-table tops	1,860	20	794	4,700	50	1,800	+153	+127
School slates	[1] 322,960	350	5,499	[1] 476,300	520	8,000	+48	+46
Total millstock	2,113,620	11,580	581,959	2,939,000	15,870	847,300	+39	+46
Flagstones, etc.[2]	399,430	3,350	26,705	612,000	5,130	33,000	+53	+24
Total slate as dimension stone	--------	66,570	1,641,828	--------	103,500	2,319,000	+56	+41
Granules and flour	--------	166,160	1,066,100	--------	219,000	1,312,000	+32	+23
Grand total domestic production	--------	232,730	2,707,928	--------	322,500	3,631,000	+39	+34
Foreign trade:								
Imports for consumption	--------	--------	12,639	--------	--------	5,497	--------	−57
Exports:								
Roofing	*Squares* 1,128	--------	9,851	*Squares* 1,390	--------	11,175	+23	+13
Other dimension slate	--------	--------	[3] 37,113	--------	--------	[3] 26,098	--------	−30
Granules and flour	--------	[3] 6,399	[3] 43,414	--------	[3] 5,816	[3] 41,083	−9	−5

[1] Reported as pieces: 1934, 603,668; 1935, 890,000; square feet approximate.
[2] Includes walkways, stepping stones, and miscellaneous slate.
[3] Collected by the Bureau of Mines from shippers.

Trends in production.—The following table shows sales of dimension slate by producers in recent years.

Slate (other than granules and flour) sold by producers in the United States, 1921–35

Year	Roofing			Millstock		Other [1]		Total	
	Squares	Approximate equivalent short tons	Value	Approximate short tons	Value	Approximate short tons	Value	Approximate short tons	Value
1921–30 (average)	439,769	154,722	$4,336,142	50,349	$3,360,072	7,261	$75,018	212,332	$7,771,232
1931	277,700	103,210	2,364,861	29,440	1,754,054	5,790	66,904	138,440	4,185,819
1932	144,410	56,140	1,072,255	16,170	810,443	2,180	23,786	74,490	1,906,484
1933	153,170	57,920	967,834	12,060	519,078	3,260	28,951	73,240	1,515,863
1934	137,010	51,640	1,033,164	11,580	581,959	3,350	26,705	66,570	1,641,828
1935	219,000	82,500	1,438,700	15,870	847,300	5,130	33,000	103,500	2,319,000

[1] Includes flagstones, walkways, stepping stones, and miscellaneous slate.

Figure 122 compares sales of slate, except granules and flour, from 1926 to 1935, with contracts awarded for residential building and total building during the same period. It illustrates the close relation between activity in the slate and construction industries, particularly for the years since 1929. Slate recovered almost as well as residential building in 1935.

The following table shows granules and flour sold by producers from 1931 to 1935.

Crushed slate (granules and flour) sold by producers in the United States, 1931–35

Year	Granules		Flour		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1931	198,450	$1,182,684	31,530	$129,833	229,980	$1,312,517
1932	174,140	1,058,713	35,610	139,103	209,750	1,197,816
1933	146,880	1,024,917	39,500	155,405	186,380	1,180,322
1934	123,290	902,078	42,870	164,022	166,160	1,066,100
1935	165,000	1,126,000	54,000	186,000	219,000	1,312,000

Trends in sales of roofing slate.—Slate producers are always interested in the success with which slate is meeting competition with other roofing materials. Positive data are unavailable because there

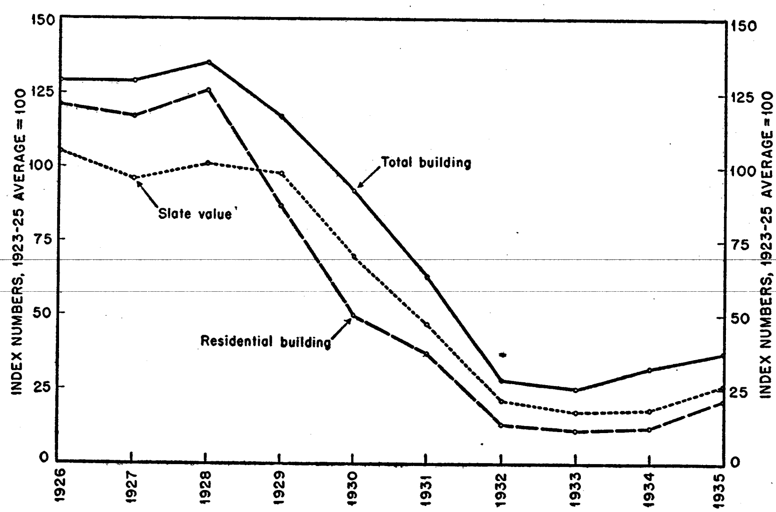

FIGURE 122.—Sales of slate compared with residential building and total building, 1926–35. Statistics of slate compiled by the Bureau of Mines and those for building by the F. W. Dodge Corporation.

are no statistics on roofs, classified by the various materials of which they are made. Roofing slate is used principally in residential building; and although there are no figures for roof areas, the F. W. Dodge Corporation publishes regularly the floor space represented by contracts awarded. Although roof area could not be calculated definitely from floor area, there is nevertheless a close enough correspondence to enable floor space to be used as a rough index of roof space.

Figure 123 plots sales of roofing slate in squares against residential floor space of new construction from 1926 to 1935. Before the slump in building construction that began in 1929 slate evidently was covering a smaller proportion of new houses than during the depression years. This conclusion is not positive, however, because there is no means of knowing how much slate was used for reroofing in either period. Apparently, however, roofing slate did not suffer as serious a decline as residential construction during the depression. The figure shows that sales of roofing slate have followed closely trends in residential building since 1929.

Prices.—Although the volume of sales of roofing slate increased 60 percent in 1935 over that of 1934, prices declined greatly, particularly in the Vermont-New York area, where the average selling

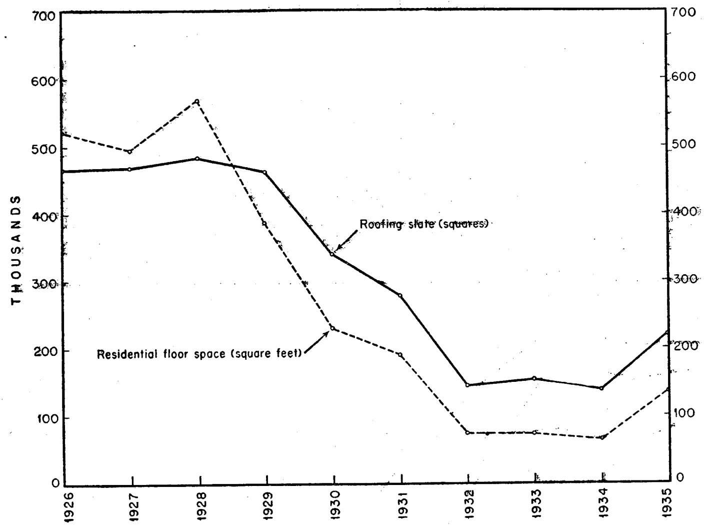

FIGURE 123.—Sales of roofing slate in squares compared with residential floor space in thousands of square feet, 1926–35. Statistics for slate compiled by the Bureau of Mines and those for floor space by the F. W. Dodge Corporation.

price was $1.55 a square lower than in 1934. In the Pennsylvania district the decline averaged 86 cents a square. The average price at the quarry for all roofing slate sold was $6.57 a square, which was 97 cents lower than in 1934.

On the other hand, millstock prices were well maintained. The average selling price per square foot in 1935 was 29 cents compared with 28 cents in 1934. Structural slate increased from 32 to 33 cents a square foot and blackboards from 23 to 25, while electrical slate decreased from 73 to 70 cents.

REVIEW BY DISTRICTS

The active slate-producing districts of the United States are: The Monson (Maine) district; the New York-Vermont district, including Washington County, N. Y., and Rutland County, Vt.; the Lehigh district, including Lehigh and Northampton Counties, Pa.; the Peach Bottom district, including York County, Pa., and Harford County, Md.; Berks County, Pa.; and the Buckingham County (Arvonia) and Albemarle County districts of Virginia. All these districts produce roofing slate and millstock, and some also produce roofing granules and slate flour. In addition, slate was produced during 1934 in Arkansas, California, Georgia, and Tennessee.

Occurrences of slate in the United States and in foreign countries and methods of quarrying and milling are described in a recent book.[1]

The following table shows sales of slate in 1935, by States and uses.

Slate sold by producers in the United States in 1935, 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	5					$38,000	$38,000
Georgia	2					(2)	(2)
Maine	3	3,400	$28,100	244,000	$184,000		212,100
Maryland	1					(2)	(2)
New York	14	3,000	27,000			239,000	266,000
Pennsylvania [3]	32	143,600	870,900	2,541,000	577,800	333,000	1,781,700
Vermont	54	53,500	372,900	154,000	85,500	353,000	811,400
Virginia	5	15,500	139,800			(2)	(2)
Undistributed [4]						382,000	521,800
Total, 1935	117	219,000	1,438,700	2,939,000	847,300	1,345,000	3,631,000
Total, 1934	120	137,010	1,033,164	2,113,620	581,959	1,092,805	2,707,928

[1] Flagging and similar products, granules, and flour.
[2] Included under "Undistributed."
[3] For detailed table for Pennsylvania, see p. 838.
[4] Includes output of States entered as (2) above.

Maine.—Electrical slate is the chief product of the Maine quarries. Sales of roofing slate, which is of minor importance, were somewhat smaller in 1935 than in 1934. Electrical slate sales, however, gained over 90 percent in quantity and over 80 percent in value.

New York-Vermont.—The slate deposits of New York are continuous with those of Vermont, and this district provides all the colored roofing slate now used in the United States.

The New York quarries furnish red, sea-green, unfading-green, purple, and variegated slate. The chief products are granules and flour (red), with a minor output of roofing slate and millstock. Contrary to the general trend in the industry, sales of slate products in New York declined about 13 percent in value in 1935 from the figure attained in 1934.

In addition to the black and gray types common in other slate districts, the Vermont quarries provide a great variety of green, purple, and mottled slates that are well-adapted for ornamental roofing and command relatively high prices. They also produce millstock for structural, sanitary, and electrical uses; flagging; granules, chiefly from the green slate; and slate flour. Many heavy, variegated, colored roofing slabs are sold under the name "architectural." In Vermont and New York much of the roofing slate is quarried and shaped by owners of small quarries worked at irregular intervals and sold either through dealers or to operators of the larger quarries.

[1] Bowles, Oliver, The Stone Industries: McGraw-Hill Book Co., Inc., 1934, 519 pp.

The Vermont slate industry made substantial gains in 1935. Sales of roofing slate increased 77 percent in quantity and 43 percent in value and millstock 12 percent in quantity and 16 percent in value, while total value of sales gained 40 percent compared with 1934.

Peach Bottom district.—The Peach Bottom district situated near Delta, Pa., and Cardiff, Md., furnishes high-grade blue-black roofing slate, but in recent years production has been very small. The chief output of this district is granules and flour.

Lehigh district.—The Lehigh district of Pennsylvania is the most productive slate area in the United States. The products include roofing, structural, sanitary, and electrical slate, blackboards, school slates, flagging, granules, and slate flour.

The following table shows sales of dimension slate in this district in 1935 by counties and uses; it includes also the output of granules and flour in the Lehigh district and in Berks and York Counties.

Slate sold by producers in Pennsylvania in 1935, 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	12	16,400	$95,500	45,000	$22,000	63,000	$13,500
Berks, Northampton, and York [3]	20	127,200	775,400	5,000	2,000	855,000	265,300
Total, 1935	32	143,600	870,900	50,000	24,000	918,000	278,800
Total, 1934	34	84,690	585,973	36,580	19,022	778,130	216,086

County	Millstock				Other (value) [4]	Total value
	Blackboards and bulletin boards		School slates			
	Square feet	Value	Square feet	Value		
Lehigh	328,000	$83,000	533,000	$9,000	$600	$223,600
Berks, Northampton, and York [3]	712,000	183,000			332,400	1,558,100
Total, 1935	1,040,000	266,000	533,000	9,000	333,000	1,781,700
Total, 1934	698,730	163,969	322,960	5,499	246,928	1,237,477

[1] Exclusive of billiard-table material, value for which is included under "Other."
[2] Includes slate for grave covers and vaults.
[3] Berks and York Counties produced roofing granules and flour only.
[4] Includes billiard-table material, as follows: 1934, 1,860 square feet, valued at $794; 1935, 5,000 square feet valued at $1,900.

The quarries of the Lehigh district are chiefly in the vicinity of Bangor, Pen Argyl, Windgap, Chapman Quarries, Berlinsville, Slatington, and Slatedale. Both hard and soft slate is produced. The hard vein is used almost exclusively for roofing; a small output of flagstones is reported at times. The soft vein is used for both roofing and millstock; it is particularly well adapted for blackboards. This small territory is the most important source of slate blackboards in the world.

All branches of the industry in this district showed decisive gains in 1935 compared with 1934. Roofing-slate sales increased nearly 70 percent in quantity and nearly 50 percent in value, electrical slate 37 percent in quantity and 26 percent in value, structural and sanitary slate 18 percent in quantity and 29 percent in value, blackboards 49 percent in quantity and 62 percent in value, and school slates 65 percent in quantity and 64 percent in value. Value of total sales, including granules and flour from Berks and York Counties, increased about 44 percent.

Virginia.—The principal slate-producing district of Virginia is near Arvonia and Ore Bank, Buckingham County. The slate is used almost exclusively for roofing. Sales in 1935 increased 13 percent in quantity and nearly 24 percent in value compared with 1934. Unit prices have advanced substantially both in 1934 and 1935. Roofing slate is produced at times near Dutch Gap, Buckingham County, and Esmont and Monticello, Ablemarle County. There are granule mills at Esmont and Dutch Gap.

Other districts.—A small output of granules was reported from near Mena, Polk County, Ark. Sales in California show a gain of about 7 percent in 1935 compared with 1934. Green slate for granules and flour was produced near Fair Mount, Bartow County, Ga.

NEW DEVELOPMENTS

The newer types of traveling cranes are great timesavers in slate mills. Some have speeds up and down the mill of 300 feet or more a minute, a cross speed of 125 feet, and a lifting speed of 35 feet a minute. These speeds are 50 percent faster than the rate at which many of the older cranes operate.

Inserted-tooth saws equipped with borium- or carboloy-tipped teeth are used successfully in some slate mills. The claim is made that a 44-inch saw having 44 carboloy-tipped teeth rotating at 11 revolutions per minute will cut a slab of slate 12 inches thick at a rate of 20 inches a minute and requires only a 5-horsepower motor drive. The high price of such saws discourages wider use, but the price has been reduced considerably, and further reduction is probable.

A great saving in power is accomplished by equipping derricks, inclined cableways, and quarry cars with roller bearings.

Wire saws introduced into the slate district of Pennsylvania in 1926 by the Bureau of Mines have proved of great advantage in conserving slate, saving time, and reducing production costs. One of the largest companies in the Lehigh district claims that substitution of wire saws for channeling machines has increased quarry production 40 percent, reduced waste to about one-fourth of that resulting from the use of the older methods and equipment, and cut the demand for electric power in the quarry to one-fourth of the former requirement.

FOREIGN TRADE [2]

Imports.—The value of slate imported for consumption in the United States was the smallest in 1935 of any year since 1922; it was less than 6 percent of the value of imports in 1929. The following table shows value of imports from 1930 to 1935.

Value of slate imported for consumption in the United States, 1930–35

1930	$48,065	1933	$9,688
1931	46,581	1934	12,639
1932	17,317	1935	5,497

The following table shows the value of imports in 1934 and 1935 by countries of origin. Canada and Czechoslovakia were the chief sources of supply.

[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.

Value of slate (manufactured) [1] *imported into the United States, 1934–35, by countries*

Country	1934	1935	Country	1934	1935
Canada	$1,867	$2,033	Japan	$36	$360
China		6	Netherlands	6,139	
Czechoslovakia	2,345	2,317	United Kingdom	84	31
Germany	1,604			12,639	5,497
Hong Kong	24	83			
Italy	540	667			

[1] No imports of roofing slate reported since 1932.

Exports.—The following table shows exports of roofing slate from 1930 to 1935. Exports increased more than 23 percent in quantity in 1935 compared with 1934, but the value per square dropped from $8.75 in 1934 to $8.04 in 1935.

Roofing slate exported from the United States, 1930–35

Year	Number of squares	Value	Year	Number of squares	Value
1930	5,278	$64,343	1933	1,155	$7,244
1931	4,174	45,020	1934	1,128	9,851
1932	1,792	12,215	1935	1,390	11,175

The following table shows exports of roofing slate from 1933 to 1935 by countries. The principal markets are in Canada.

Roofing slate exported from the United States, 1933–35, by countries

Country	1933		1934		1935	
	Number of squares	Value	Number of squares	Value	Number of squares	Value
British India					75	$312
Canada	906	$5,498	1,108	$9,672	1,198	9,739
Irish Free State					65	546
Jamaica					1	14
Mexico	7	35	15	140	8	33
New Zealand					43	531
West Indies:						
Trinidad and Tobago	242	1,711				
Other British			5	39		
	1,155	7,244	1,128	9,851	1,390	11,175

The following table shows exports of slate other than roofing from 1933 to 1935. All commodities show a decline in 1935 compared with 1934, except billiard tables, which showed a five-fold increase in quantity and more than a two-fold increase in value. This item, however, is relatively small. The total value of this group of exports declined nearly 17 percent.

Slate other than roofing exported from the United States, 1933–35, by uses [1]

Use	1933		1934		1935	
	Quantity	Value	Quantity	Value	Quantity	Value
School slates, cases [2]	1,302	$10,167	3,686	$25,028	2,773	$18,140
Electrical slate, square feet	1,800	2,000	114	205	10	10
Blackboards, do	28,187	5,791	37,342	10,425	25,578	7,160
Billiard tables, do	500	229	489	230	1,146	518
Structural, do	1,462	611	2,985	1,225	614	270
Slate granules and flour, short tons	5,873	41,076	6,399	43,414	5,816	41,083
		59,874		80,527		67,181

[1] Collected by Bureau of Mines from shippers of products named.
[2] Cases weigh 130 to 165 pounds each; average is 135 pounds.

SAND AND GRAVEL [1]

By H. H. Hughes and M. A. Cornthwaite

SUMMARY OUTLINE

The continued increase in construction activity in 1935 was reflected in an advance of about 14 percent in the output of commercial sand and gravel operations compared with 1934. Activity in road-

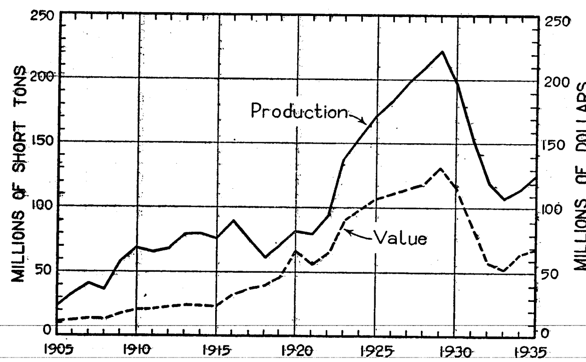

FIGURE 124.—Principal trends in the sand and gravel industry, 1905–35.

building projects, however, apparently was about the same in 1935 as in 1934, for indicators of road and highway construction showed little or no gain. Available data on markets providing outlets for sand and gravel and partial returns from producers indicate that the total output in 1935 was about 125,690,000 short tons valued at approximately $66,000,000. The increase in both production and value that began in 1934 following the sharp decline since 1929 was continued in 1935. (See fig. 124.)

Sales of sand and gravel for virtually all uses increased in 1935 compared with 1934. Glass sand as well as grinding and polishing sand production reflected activity in plate-glass manufacture. Molding sand and fire and furnace sand followed the upward trend of the steel industry. Outlets for building sand and gravel were definitely better in 1935, although paving sand and gravel showed little change from the previous year.

[1] Figures for 1935 are preliminary; detailed data with final revisions will be released later.

The average value of sand and gravel sold for most uses declined slightly in 1935 compared with 1934, although the average for the output of all commercial operations dropped only from $0.64 a ton in 1934 to $0.63 in 1935. Salient statistics of the sand and gravel industry in 1934 and preliminary figures for 1935 are summarized in the following table:

Sand and gravel sold or used by producers in the United States, 1934–35, by commercial and noncommercial operations, and by uses

	1934		1935 [1]			
	Short tons	Value per ton	Short tons	Value per ton	Percent of change: Tonnage	Percent of change: Value per ton
COMMERCIAL OPERATIONS						
Sand:						
Glass	1,923,614	$1.73	2,180,000	$1.70	+13	−2
Molding	2,167,731	1.00	2,900,000	.90	+34	−10
Building	14,534,565	.56	17,500,000	.58	+20	+4
Paving	12,476,833	.57	12,000,000	.56	−4	−2
Grinding and polishing	571,191	1.82	900,000	1.40	+58	−23
Fire or furnace	137,000	1.24	160,000	1.38	+17	+11
Engine	1,211,033	.66	1,700,000	.66	+40	-------
Filter	35,750	2.39	50,000	1.90	+40	−21
Railroad ballast [2]	607,380	.27	1,000,000	.27	+65	-------
Other	959,217	.65	900,000	.65	−6	-------
Total sand	34,624,314	.68	39,290,000	.68	+13	-------
Gravel:						
Building	14,244,016	.69	18,000,000	.65	+26	−6
Paving	19,276,791	.66	20,000,000	.63	+4	−5
Railroad ballast [2]	6,422,166	.29	7,700,000	.37	+20	+28
Other [3]	755,622	.53	700,000	.50	−7	−6
Total gravel	40,698,595	.61	46,400,000	.59	+14	−3
Total sand and gravel	75,322,909	.64	85,690,000	.63	+14	−2
NONCOMMERCIAL OPERATIONS [4]						
Total sand and gravel	41,288,780	.31	40,000,000	.30	−3	−3
COMMERCIAL AND NONCOMMERCIAL OPERATIONS						
Grand total	116,611,689	.53	125,690,000	.53	+8	-------

[1] Figures subject to revision.
[2] Includes some sand used for fills and similar purposes.
[3] May include some gravel used by railroads for fills and miscellaneous purposes.
[4] By States, counties, municipalities, and other Government agencies, directly or under lease.

During the past 10 years gravel has become increasingly important in total sand and gravel output. (See fig. 125.) In 1926 gravel and sand each comprised 50 percent of the total. In 1934, however, sales of gravel were 67 percent of the total output and sales of sand only 33 percent. Preliminary figures for 1935 indicate that gravel comprised 34 and sand 66 percent. This trend over the 10-year period apparently reflects increased use of gravel for purposes previously supplied by other materials.

Noncommercial production.—Beginning in 1932 statistics of the sand and gravel industry have been broken down to show production by commercial and by noncommercial operations—States, counties, municipalities, and other Government agencies. Noncommercial producers in 1934 reported a total output of 41,288,780 short tons of sand and gravel with an average value of $0.31 a ton. New England and States west of the Mississippi commonly contribute more than three-fourths of the total of this material. More than half of it is reported by State highway officials. Only 9,411,195 short tons—

less than one-fourth—of the sand and gravel produced by noncommercial operations in 1934 was washed or screened. By far the larger part reported was pit-run material having a relatively low unit value.

Complete statistics from noncommercial producers are not yet available for 1935, but partial returns indicate that the output was

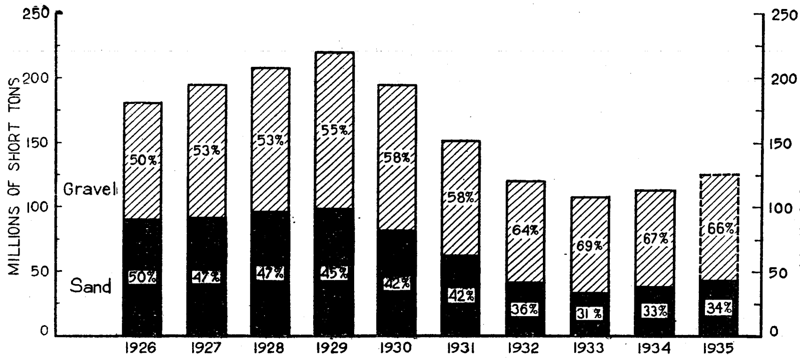

FIGURE 125.—Sand and gravel sold or used by producers in the United States, 1926–35, showing relative importance of each. Figures for 1935 are subject to revision.

probably about the same as in 1934. The average value per ton of the material produced was also about the same.

The relative increase in output of sand and gravel by noncommercial producers from 1928 to 1935 is indicated in figure 126. In 1934, sand and gravel reported by noncommercial operations accounted for 35 percent of all material included in the Bureau of Mines canvass; and in 1935 the output of noncommercial plants probably comprised about 32 percent of the total.

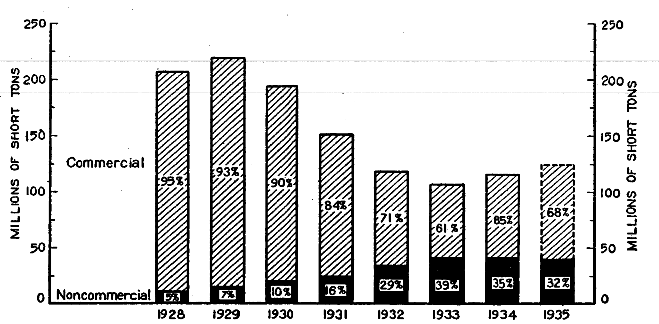

FIGURE 126.—Sand and gravel sold or used in the United States by commercial and noncommercial producers, 1928–35. Figures for 1935 are subject to revision.

Employment and output per man.—In 1934, sand and gravel producers who accounted for 78.4 percent of commercial production also reported data on employment. This information included the average number of men employed during the year, the number of days the plant was operated, and the length of the working day.

The accompanying table summarizes data covering those plants for which actual returns were received; no estimates for companies not reporting have been included. The table is set up by regions to show the average number of men employed, total man-shifts, and total man-hours as calculated from data reported on the schedules.

From these totals, the average number of days in operation, and the average number of hours worked per man per day have been computed for each region and for the United States. The quantity of sand and gravel produced at plants included in the study is also shown in the table, as well as the percentage of total commercial production reported. Finally, computations have been made to show the average output of sand and gravel per man-shift and per man-hour.

Employment in the commercial sand and gravel industry, sand and gravel produced at plants included in the study, and average output per man in the United States, 1934, by regions [1]

Region	Employment					Production			Percent of commercial industry represented
	Average number of men	Time employed				Commercial sand and gravel, short tons	Average per man, short tons		
		Average number of days	Total man-shifts	Man-hours			Per shift	Per hour	
				Average per man per day	Total				
1. Maine, New Hampshire, Vermont, Rhode Island, Massachusetts, and Connecticut	457	143	65,242	8.2	533,885	1,651,150	25.3	3.1	74.5
2. New York	818	151	123,677	8.0	993,910	3,773,058	30.5	3.8	53.4
3. Pennsylvania, New Jersey, and Delaware	2,135	176	376,723	8.2	3,082,725	6,818,635	18.1	2.2	94.2
4. West Virginia, Virginia, Maryland, and District of Columbia	934	257	239,847	8.3	1,987,890	3,720,733	15.5	1.9	76.0
5. South Carolina, Georgia, Alabama, Florida, and Mississippi	414	157	64,797	8.3	540,903	1,378,395	21.3	2.5	64.5
6. North Carolina, Kentucky, and Tennessee	673	177	119,103	8.3	987,834	2,117,790	17.8	2.1	85.3
7. Arkansas, Louisiana, and Texas	1,374	181	248,198	8.3	2,049,934	4,374,084	17.6	2.1	81.6
8. Ohio	1,261	174	219,932	8.2	1,804,046	4,092,787	18.6	2.3	83.2
9. Illinois and Indiana	1,671	168	280,439	8.2	2,313,523	8,024,545	28.6	3.5	89.9
10. Michigan and Wisconsin	1,042	129	134,628	8.6	1,158,209	4,829,404	35.9	4.2	77.8
11. North Dakota, South Dakota, and Minnesota	447	113	50,326	8.2	413,276	1,590,387	31.6	3.8	60.2
12. Nebraska and Iowa	785	112	87,600	8.4	731,843	2,655,985	30.3	3.6	85.6
13. Kansas, Missouri, and Oklahoma	713	168	120,098	7.7	924,266	2,987,338	24.9	3.2	80.9
14. Wyoming, Colorado, New Mexico, Utah, and Arizona	256	174	44,628	7.9	352,712	4,368,253	97.9	12.4	90.7
15. California and Nevada	824	192	157,986	7.7	1,213,798	4,349,785	27.5	3.6	78.9
16. Montana, Washington, Oregon, and Idaho	807	148	119,611	6.8	808,879	2,285,909	19.1	2.8	55.7
Total United States, 1934	14,611	168	2,452,835	8.1	19,897,633	59,018,238	24.1	3.0	78.4
Total United States, 1933	12,536	155	1,947,225	8.7	16,937,862	47,215,123	24.2	2.8	71.4

[1] Does not include plants operated by or directly for States, counties, municipalities, and other Government agencies.

Altogether 14,611 men were reported as receiving employment in the sand and gravel plants of the producers included in the study. This group covered 78.4 percent of the total commercial production. If it is assumed that production at the rest of the commercial plants required about the same relative number of men, approximately 18,500 men were employed by the sand and gravel industry during 1934, an increase of about 1,000 men from 1933. The average number of days employed in 1934 was 168 compared with 155 in 1933, but the average shift dropped from 8.7 hours in 1933 to 8.1 in 1934.

The output of sand and gravel per man-hour ranged from 1.9 tons in region 4, which comprises West Virginia, Virginia, Maryland, and

District of Columbia, to 4.2 tons in Michigan and Wisconsin. The output of 12.4 tons per man-hour in region 14 is not comparable to that of other regions, because it reflects the highly mechanized sand and gravel operation supplying aggregates to Boulder Dam.

Productivity of labor at sand and gravel operations showed a general improvement in 1934 for the average output per man-hour

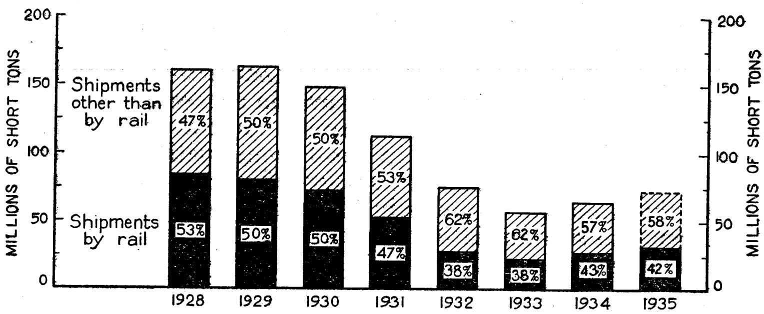

FIGURE 127.—Shipments of sand and gravel, by modes of transportation, 1928–35. Data on rail shipments are from reports of the Interstate Commerce Commission; to insure comparability, glass and molding sand, railroad ballast, and noncommercial production have been excluded from the figures used in the comparisons. Figures for 1935 are subject to revision.

increased from 2.8 tons in 1933 to 3 tons in 1934. Productivity varies widely with type and size of operation, and the Bureau of Mines is making a detailed study of the problem, the results of which will be released later.

Prices.—Final data on the average value of sand and gravel produced in 1935 are not yet available, but preliminary figures based on partial returns from producers indicate a moderate price recession. The average value of all sand accounted for remained at about $0.68 a ton in 1935, the same as in 1934, but the average value of all gravel produced apparently dropped from $0.61 a ton in 1934 to $0.59 in 1935. Wholesale price statistics compiled by the Bureau of Labor Statistics substantiate the decline in price indicated by partial returns from producers. The wholesale price index of building sand dropped from 99.4 in 1934 to 98.7 in 1935, and gravel declined from 91.2 to 89.6.

Only meager data are available to indicate the average value of noncommercial production in 1935, but it probably was approximately $0.30 a ton, 1 cent less than in 1934.

Rail and water shipments.—Shipments of sand and gravel on class I railroads in 1935 totaled 30,451,218 short tons, an increase of 10 percent over 27,683,407 short tons in 1934. This advance continued the upturn started in 1934, which had terminated an uninterrupted sharp decline beginning in 1928. This increase in rail shipments checks closely the indicated advance of 14 percent in commercial production. In 1934, 43 percent of commercial production exclusive of glass and molding sand and nonrevenue railroad ballast was shipped by rail. In 1935, preliminary figures indicate that 42 percent was transported on class I roads.

The quantity of sand and gravel shipped by barge on the Ohio and Monongahela Rivers in the Pittsburgh district increased 12 percent—from 1,581,410 short tons in 1934 to 1,766,427 short tons in 1935. This increase also checks closely the advance indicated by the preliminary figures of commercial production in 1935.

MARKETS

About four-fifths of all sand and gravel produced at commercial operations commonly enters some form of building or highway construction. More than half is used with cement in concrete. Consumption of portland cement therefore provides a good indicator of the demand for sand and gravel, although from 1934 to 1935 cement shipments dropped 1 percent, whereas sand and gravel output increased about 14 percent. This apparent discrepancy reflected the continued slump in concrete highway construction as well as an indicated trend toward wider use of gravel in concrete.

Most of the output of noncommercial operations is unprepared pit-run material used locally in road construction. Preliminary returns for 1935 indicate that production of such material was maintained at about the same rate as in 1934, and a slight drop in sales of road oil tends to substantiate the returns.

Data relating to the production and consumption of sand and gravel are summarized in the following table. Detailed statistics of the construction industry are included in the chapter on Stone.

Summary of data relating to production and consumption of sand and gravel [1]

	1934	1935 [2]	Percent of change in 1935 from 1934
Sand and gravel shipments:			
Rail shipments, class I roads [3] ... short tons	27,683,407	30,451,218	+10
Water shipments: Pittsburgh district [4] ... do	1,581,410	1,766,427	+12
Correlative industries:			
Portland-cement shipments ... barrels	75,901,279	74,934,000	−1
Paving-asphalt shipments ... short tons	924,135	877,466	−5
Cut-back asphalt shipments ... do	624,183	707,953	+13
Road-oil sales ... barrels	7,702,753	7,164,732	−7
Construction: [5]			
Concrete-pavement contract awards [6] ... square yards	45,108,000	43,427,000	−4
Construction contract awards [7]	$1,543,842,000	$1,844,546,000	+19
Railway expenditures, class I roads: For ballast [8]	$9,894,952	$11,438,000	+16
Glass production, monthly average:			
Glass containers (shipments) [9] ... gross	2,920,000	3,136,000	+7
Illuminating glassware [10] ... turns	1,517	2,005	+32
Polished plate glass [11] ... square feet	7,651,000	14,985,000	+96
Foundry activity:			
Foundry and malleable pig-iron production ... gross tons	2,154,349	2,824,822	+31
Malleable castings [12] ... short tons	369,458	466,395	+26
Freight-car loadings, all commodities: Total, monthly average [13] ... cars	2,566,000	2,627,000	+2

[1] Many of the data available in this table are published currently in "Survey of Current Business"; comparable data for 1928 are given in Minerals Yearbook, 1934, p. 839.
[2] Figures for 1935 are subject to revision.
[3] Interstate Commerce Commission.
[4] Chief statistician, Board of Engineers for Rivers and Harbors.
[5] Detailed statistics of construction are contained in the Stone chapter in this volume.
[6] Portland Cement Association.
[7] F. W. Dodge Corporation.
[8] Interstate Commerce Commission and Bureau of Railway Economics.
[9] Glass Container Association.
[10] Illuminating Glassware Guild.
[11] Plate Glass Manufacturers of America.
[12] U. S. Bureau of the Census.
[13] American Railway Association.

Highway construction.—Concrete-highway construction in 1935 slumped even lower than in 1934. According to statistics of the Portland Cement Association total concrete-pavement contract awards were only 43,427,000 square yards, a drop of 4 percent from 45,108,000 square yards in 1934. This volume was far below the 1928 peak of 148,078,000 square yards.

Statistics of asphalt shipments and road-oil sales provide a general indicator of trends in construction of bituminous roads. Shipments of paving asphalt dropped slightly—from 75,901,279 short tons in 1934 to 74,934,000 in 1935. Shipments of cut-back asphalts continued upward with an increase of 13 percent—from 624,183 short tons in 1934 to 707,953 in 1935. Road-oil sales slumped about 7 percent in 1935, but, as explained in the Asphalt discussion in this volume, the drop in part may reflect changes in specifications rather than actual lessened demand.

Partial returns from sand and gravel producers confirm the trends indicated by data on highway construction. Paving-sand output in 1935 apparently was about 12,000,000 tons, slightly lower than in 1934. Paving-gravel production amounted to about 20,000,000 tons—an increase of 4 percent from 1934.

Most of the sand and gravel reported by noncommercial producers also is used for paving, and this material should be included in total figures for aggregates consumed in highway and road construction. Preliminary returns indicate that the output of noncommercial operations in 1935 may have been about 40,000,000 short tons—approximately the same as in 1934.

Building construction.—The F. W. Dodge Corporation reported a total of $1,844,546,000 in construction-contract awards in 37 States east of the Rocky Mountains in 1935. Although this was an increase of 19 percent from 1934 it was less than one-third of the 1928 peak. Supplementary records of construction activity also show advances in 1935. The total value of all building permits issued in 811 cities throughout the United States increased 70 percent over 1934, and permits for new residential buildings increased 172 percent. Engineering-construction contract awards advanced 17 percent.

Returns from nearly half the commercial sand and gravel producers also indicate better demand for building sand and gravel in 1935. Production of building sand was about 17,500,000 short tons, an increase of 20 percent from 1934. The output of building gravel increased about 26 percent—from 14,244,016 short tons in 1934 to approximately 18,000,000 in 1935.

Railroad ballast.—The upturn in demand for ballast that began in 1934 continued even stronger in 1935. Estimates of the Bureau of Railway Economics indicate that total ballast expenditures by class I railroads in the United States in 1935 were about $11,438,000, an increase of 16 percent over $9,894,952 in 1934. Although expenditures include all kinds of material used as ballast, as well as transportation and unloading costs, about 60 percent of the amount reported represents actual cost of the material.

Preliminary returns from producers also show an increase in ballast production, and available data indicate an output of ballast gravel in 1935 amounting to 7,700,000 short tons, an advance of 20 percent over 1934. Railroad ballast sand may have amounted to as much as 1,000,000 tons in 1935 compared with 607,380 in 1934.

Other outlets.—Production of glass sand in 1935 was about 2,180,000 short tons, 13 percent more than in 1934, according to returns from companies accounting for over 80 percent of the total output in 1934. This increase was expected, for plate-glass production nearly doubled in 1935 compared with 1934, and the output of glass containers increased 7 percent. Production of illuminating glassware also was higher.

Continued recovery in the iron and steel industry was reflected in an increase of 34 percent in the output of molding sand in 1935 compared with 1934, and of 17 percent in the output of fire or furnace sand.

The sharp rise in plate-glass production and foundry activity explained the advance of 58 percent in output of grinding and polishing sand, for the dimension-stone industry, the other large outlet, showed little recovery in 1935.

Although freight-car loadings advanced only 2 percent in 1935 compared with 1934, returns from producers indicated an increase of 40 percent in the output of engine sand.

Filter-sand production apparently increased about 40 percent in 1935, but sales of sand for miscellaneous purposes may have been slightly below 1934.

ECONOMIC DEVELOPMENTS

Probably the most significant development in the sand and gravel industry during 1935 was the invalidation of the National Industrial Recovery Act by unanimous decision of the Supreme Court of the United States. Opinion in the industry concerning the merits of the code apparently was divided, but at the time of the decision of the Supreme Court the code authority was approaching a settlement of the most vital problem with which it was involved—namely, agreement upon a suitable definition of the sand and gravel industry. It is unquestionably true that a definite decision on the matter of definitions would have resulted in a more harmonious condition in the industry.

When the code became inoperative the industry found itself confronted with the question as to the most effective means for joint cooperation with the crushed-stone and slag industries in the interest of stabilization. During the latter part of June there were joint meetings of the three national associations to determine to what degree there should be formal cooperation among the industries through their respective organizations. Many proposals were offered, ranging from complete consolidation to a return to the strictly independent status of the associations prior to the enactment of the Recovery Act. It was decided to form a Mineral Aggregates Institute, through which the associations could work in the handling of common problems. The institute functioned for the rest of the year, and during the joint conventions of the associations in St. Louis in the early part of 1936, one day was devoted to a program arranged by the institute. However, shortly thereafter it was decided to abandon the institute, although this decision apparently was not influenced by disharmony or by a failure to recognize the mutuality of interest on certain questions.

Producers attending the convention apparently were opposed to any effort to reenact a recovery act providing for compulsory codes, and they seemed to feel that voluntary codes would not offer any reasonable hope for effective elimination of unfair trade practices. They also adopted a resolution protesting against unfair competition of plants operated by States, counties, or other local Government agencies.

Most of the producers at the meeting reported that non-Government demand was much stronger in 1935, particularly with reference to housing and railroad ballast, and that the industry expected increased business from highways in 1936.

GYPSUM[1]

By OLIVER BOWLES and R. W. METCALF

SUMMARY OUTLINE

According to preliminary figures based on returns of the quarterly canvasses of the Bureau of Mines, crude gypsum and gypsite mined in the United States totaled 1,937,500 short tons in 1935, the highest figure reached since 1931 and a 30-percent gain over the output of 1,491,396 tons in 1934. Imports of crude gypsum, chiefly from Canada, increased from 360,186 tons in 1934 to 450,250 in 1935, a gain of 25 percent.

Sales of calcined gypsum and gypsum products manufactured from domestic and imported material show substantial gains in all classifications in 1935 compared with 1934. To reflect more accurately the gains in 1935, the following percentages are based on a comparison with the quarterly returns of 1934 rather than on the final figures for that year. The heaviest increase occurred in sales of plaster board and lath, which were 94 percent higher than in 1934. Sales of Keene's cement advanced 45 percent, and sales of calcined gypsum for manufacturing purposes and for neat, wood fiber, and other plasters gained about 33 percent. Sales of partition tile increased 18 percent and sales of wallboard 17 percent. Imports of crude gypsum gained 25 percent; and exports, which are relatively small, gained 73 percent. Exports of plaster and other gypsum products increased about 41 percent.

Salient statistics for the gypsum industry for recent years are summarized in the following table:

Salient statistics on gypsum and gypsum products in the United States, 1931–35

	1931	1932	1933	1934	1935[1]
Crude gypsum:					
Mined .... short tons	2,559,017	1,416,274	1,335,192	1,536,170	1,937,500
Imported .... do	713,880	374,072	359,490	361,186	450,250
Apparent supply .... do	3,272,897	1,790,346	1,694,682	1,897,356	2,387,750
Sales by domestic plants:[2]					
Raw gypsum:					
Short tons	851,443	516,136	491,273	578,947	625,000
Value	$1,882,557	$1,216,388	$1,089,100	$1,266,945	(3)
Gypsum products					
For building purposes:					
Short tons	[4] 2,077,214	[4] 1,149,872	[4] 1,011,506	[4] 1,074,017	1,418,000
Value	[4] $26,359,518	[4] $16,122,200	[4] $14,085,071	$15,510,835	(3)

[1] Subject to revision.
[2] Gypsum and gypsum products produced from rock of both domestic and foreign origin.
[3] Not available.
[4] Includes calcined gypsum sold to other manufacturers and for miscellaneous uses.

[1] Figures for 1935 are preliminary; detailed data with final revisions will be released later.

Salient statistics on gypsum and gypsum products in the United States, 1931–35—Continued

	1931	1932	1933	1934	1935
Sales by domestic plants—Contd.					
Gypsum products—Continued.					
For manufacturing uses:					
Short tons	55, 172	43, 889	48, 965	66, 573	100, 000
Value	$478, 589	$454, 718	$470, 041	$673, 624	(3)
Total gypsum products sold:					
Short tons	2, 132, 386	1, 193, 761	1, 060, 471	1, 140, 590	1, 518, 000
Value	$26, 838, 107	$16, 576, 918	$14, 555, 112	$16, 184, 459	(3)
Grand total sales:					
Short tons	2, 983, 829	1, 709, 897	1, 551, 744	1, 719, 537	2, 143, 000
Value	$28, 720, 664	$17, 793, 306	$15, 644, 212	$17, 451, 404	(3)
Gypsum products imported:[5]					
Short tons	7, 364	3, 302	3, 108	1, 646	1, 904
Value	$76, 373	$29, 365	$33, 413	$26, 436	$28, 094
Exports:					
Plaster board, etc.[6]					
Square feet	6, 386, 649	1, 981, 685	1, 646, 733	1, 895, 700	1, 929, 348
Value	$157, 897	$46, 175	$36, 057	$43, 041	$42, 465
All other:[6]					
Short tons	11, 275	4, 919	5, 333	4, 853	9, 245
Value	$234, 540	$91, 025	$83, 155	$90, 451	$143, 731

[5] Includes ground and calcined gypsum and Keene's cement, but not "manufactures of which plaster of paris is the component material of chief value n. s. p. f." (principally statues, art goods, and novelties).
[6] Includes raw and calcined gypsum and gypsum products.

DOMESTIC PRODUCTION AND SALES

The following table shows domestic gypsum sold or used during recent years:

Gypsum mined and uncalcined and calcined gypsum sold or used by producers in the United States, 1931–35

Year	Number of active establishments[1]	Total quantity mined (short tons)	Sold or used by producers				
			Without calcining		Calcined		Total value
			Short tons	Value	Short tons	Value	
1931	60	2, 559, 017	773, 185	$1, 565, 367	1, 593, 753	$19, 235, 990	$20, 801, 357
1932	57	1, 416, 274	444, 816	929, 567	890, 495	11, 976, 719	12, 906, 286
1933	61	1, 335, 192	420, 935	806, 325	821, 738	11, 121, 153	11, 927, 478
1934	64	1, 536, 170	512, 317	970, 828	902, 539	12, 791, 149	13, 761, 977
1935[2]	(3)	1, 937, 500	550, 000	(3)	1, 200, 000	(3)	(3)

[1] Each mine, plant, or combination mine and plant is considered as 1 establishment.
[2] Subject to revision.
[3] Not available.

PRICES

Price quotations for gypsum have little significance; as given in Metal and Mineral Markets they exhibit no variations during the past 5 years. Prices vary considerably with locality, but general trends are shown by comparing average prices for the entire country calculated from quantities and values of actual sales as reported to the Bureau of Mines. The following table shows the average sales values f. o. b. mill for the more important products during recent years. Data for 1935 are not yet available.

Average values per short ton of gypsum and gypsum products (made from domestic crude gypsum) sold or used by producers in the United States, 1931–34

Use	Average price per ton			
	1931	1932	1933	1934
Sold without calcining:				
To portland cement mills	$1.91	$1.95	$1.78	$1.75
For agriculture	4.89	5.69	5.57	4.96
For other purposes	1.99	2.07	2.25	1.98
Average raw sales	2.02	2.10	1.92	1.89
Calcined gypsum or gypsum products:				
Base-coat plasters	7.99	8.46	8.79	9.57
Sanded and finished plasters	7.62	9.39	9.07	9.37
Molding plasters	9.22	13.29	13.28	13.38
Keene's cement	14.04	14.89	14.35	15.34
Plaster board and lath	18.09	18.90	19.26	18.79
Wall board	30.70	36.39	34.14	35.35
Partition tile	7.01	7.18	6.41	7.54

DISTRIBUTION OF SALES

The chief sales of raw gypsum are to cement plants. About 3 percent by weight of gypsum is added to cement clinker before grinding. During the grinding process it becomes thoroughly mixed with

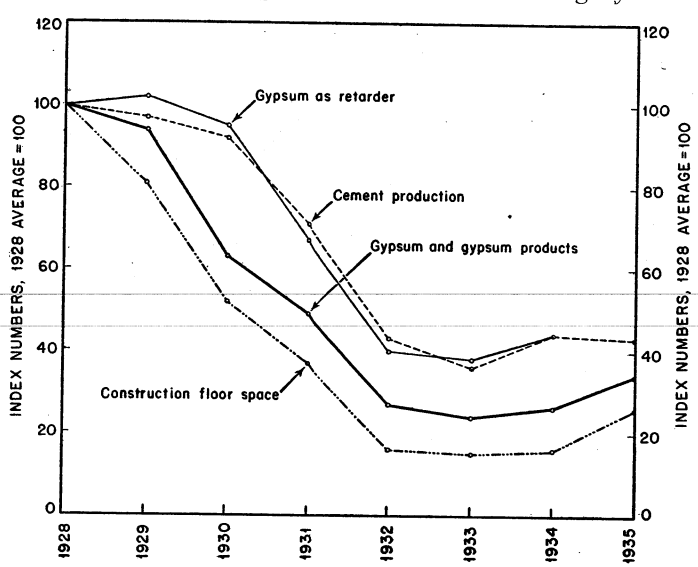

FIGURE 128.—Raw gypsum from foreign and domestic sources sold to cement plants compared with cement production, and calcined gypsum and gypsum products from foreign and domestic sources used for building purposes compared with floor space of building construction, 1928–35. To facilitate comparison unlike units have been reduced to percentages of 1928. Statistics on floor space are from F. W. Dodge Corporation.

the cement, and when a cement or concrete mixture is made the gypsum retards the setting time enough to permit placing, compacting, and finishing of the surface.

This branch of the gypsum industry naturally follows closely activity in cement production. Figure 128 shows trends in gypsum sold as retarder compared with cement production during recent years. Figures for sales of raw gypsum to cement plants during 1935 are not yet available, but from figure 128 it may be inferred that they were about the same or slightly less than in 1934.

Calcined gypsum is used extensively in the building industries. The companies that calcine the raw gypsum sell only part of it simply as calcined plaster (stucco); they manufacture most of it into various plasters, wallboards, partition tile, and insulating materials. Figure 128 shows the close relationship between sales of gypsum building materials and the floor space of building construction. Figures for sales of calcined gypsum and gypsum products in 1935 are not yet available, but the gain of over 60 percent in the floor space of construction implies a corresponding gain in sales of gypsum products.

These two curves are so closely parallel that trends in floor space of construction can be used as a reliable indicator of probable markets for gypsum products used in the building trades. Data for floor space are available monthly within 60 days of the end of the month covered. Thus one may plot trends in floor space monthly and estimate therefrom, long before actual figures are available, the probable extent of the market demands for gypsum products. The general upward or downward trend of the curve for floor space enables one to forecast with reasonable accuracy a future increase or decrease in the market demands for gypsum products.

Crude gypsum and gypsum products made from domestic crude gypsum sold or used by producers in the United States, 1934–35, by uses

Use	1934		1935 [1]	
	Short tons	Value	Short tons	Value
Without calcining:				
To portland cement mills	441,014	$773,977	(2)	(2)
For agriculture	18,595	92,287	(2)	(2)
For other purposes	52,708	104,564	(2)	(2)
Total without calcining	512,317	970,828	550,000	(2)
Calcined:				
For building purposes:				
Base-coat plasters	469,188	4,492,271	} 755,000	(2)
Sanded plasters	47,877	330,652		
Finished plasters	39,052	483,758		
Molding plasters	23,197	310,444		
Keene's cement	13,613	208,794	19,000	(2)
Plasterboard and lath	[3] 73,804	1,386,480	[3] 140,000	(2)
Wallboard	[4] 127,665	4,512,721	[4] 150,000	(2)
Partition tile	[5] 26,265	198,113	[5] 32,900	(2)
Insulating materials	1,616	19,449	(2)	(2)
Other building purposes	7,842	125,709	(2)	(2)
Total for building purposes	830,119	12,068,391	1,106,000	(2)
For manufacturing uses:				
To plate-glass works	15,831	92,883	(2)	(2)
To terra-cotta works	1,243	10,218	(2)	(2)
To pottery works	26,221	264,013	(2)	(2)
For other manufacturing uses	19,151	258,786	(2)	(2)
Total for manufacturing uses	62,446	625,900	} 94,000	(2)
For other purposes [6]	9,974	96,858		
Total calcined	902,539	12,791,149	1,200,000	(2)
Grand total value		13,761,977		(2)

[1] Subject to revision.
[2] Not available.
[3] 1934: 96,194,226 square feet; 1935 (subject to revision): 190,000,000 square feet.
[4] 1934: 169,934,547 square feet; 1935 (subject to revision): 207,905,000 square feet.
[5] 1934: 4,687,736 square feet; 1935 (subject to revision): 5,519,000 square feet.
[6] Includes calcined gypsum sold to other manufacturers and for miscellaneous uses.

Considerable quantities of calcined gypsum are sold to manufacturing companies, who use it for setting plates of glass or blocks of granite for polishing, as terra cotta and pottery molds, as dental plaster, and in many other ways. Sales for such uses are governed principally by industrial activity.

Calcined gypsum is made into various products used chiefly for building purposes. The weights of gypsum products, as reported in the following tables, include the weight of added material, such as filler, fiber, paper, and reinforcing. Due to the preponderance of neat plaster sold and the relatively small amounts of materials added to many other products, the aggregate tonnage figures do not greatly exceed the amount of calcined gypsum used. The preceding table shows, insofar as data are available, the amount of crude gypsum and gypsum products made from domestic crude, sold or used by producers during the past 2 years.

Imported gypsum enters the same market channels as that of domestic origin. The following table shows the distribution of sales of imported gypsum in 1934 and 1935 as reported to the Bureau of Mines by the importing companies:

Imported crude gypsum and gypsum products made from imported crude sold or used in the United States, 1934–35, by uses, as reported to the Bureau of Mines by the importers

Use	1934		1935 [1]	
	Short tons	Value	Short tons	Value
Without calcining:				
To portland cement mills	19,832	$42,401	(2)	(2)
For agriculture	41,808	210,594	(2)	(2)
For other purposes	4,990	43,122	(2)	(2)
Total without calcining	66,630	296,117	75,000	(2)
Calcined:				
For building purposes:				
Base-coat plasters	111,110	1,055,052	220,000 (Base-coat, sanded, finished, and molding plasters combined)	(2)
Sanded plasters	11,004	87,084		
Finished plasters	37,281	548,908		
Molding plasters	6,025	85,145		
For other building purposes [3]	68,504	1,569,397	92,000	(2)
Total for building purposes	233,924	3,345,586	312,000	(2)
For manufacturing uses [4]	4,127	47,724	6,000	(2)
Total calcined	238,051	3,393,310	318,000	(2)
Grand total value		3,689,427		(2)

[1] Subject to revision.
[2] Not available.
[3] Includes calcined gypsum used for Keene's cement, plasterboard, lath, wallboard, partition tile, roofing tile, insulating materials, and other building purposes, and calcined gypsum sold to other gypsum manufacturers and for miscellaneous uses.
[4] Includes gypsum sold to potteries and for other manufacturing uses.

NEW DEVELOPMENTS

A new type of heat-insulating building material for which exceptional merit is claimed consists of ordinary ⅜-inch gypsum board, one surface of which is covered with a thin sheet of aluminum. Considerable publicity has been given during the past 3 years to the virtues of aluminum foil as a nonconductor of heat.

According to tests made in Germany a paste made of potato starch and caustic soda may be used instead of gypsum as a cement retarder.

Reconditioning or plant extensions have either been made or are contemplated by the National Gypsum Co. at National City, Mich.; Akron, Ohio; Clarence Center, N. Y.; York, Pa.; Rotan, Tex.; and Fort Dodge, Iowa. The mill of the Cardiff Gypsum Co. at Fort Dodge, Iowa, has been reconditioned and has resumed operation. The Dolomite Products Co. has modernized its gypsum mine near Wheatland, N. Y., and has increased its output to about five times the tonnage produced in 1932. The National Gypsum Co. of Buffalo, N. Y., has acquired the properties of the Universal Gypsum & Lime Co. of Chicago, Ill.

FOREIGN TRADE [2]

Imports.—Nearly all the imports of crude gypsum enter along the Atlantic seaboard from Canada and on the Pacific coast from Mexico. The following tables show imports during recent years and imports from 1933 to 1935 by countries. The total value of imports gained nearly 24 percent.

Gypsum imported for consumption in the United States, 1931–35

Year	Crude		Ground		Calcined		Manufactured plaster of paris (value)	Keene's cement		Total value
	Short tons	Value	Short tons	Value	Short tons	Value		Short tons	Value	
1931	713,880	$713,313	4,806	$40,809	2,430	$32,552	$36,825	128	$3,012	$826,511
1932	374,072	346,766	2,076	14,762	1,174	13,561	17,948	52	1,042	394,079
1933	359,490	373,919	1,907	18,032	1,177	14,781	13,305	24	600	420,637
1934	360,186	371,082	1,085	14,880	534	10,890	16,859	27	666	414,377
1935	450,250	463,050	1,240	15,440	601	11,364	20,958	63	1,290	512,102

Crude gypsum imported into the United States, 1933–35, by countries

Country	1933		1934		1935	
	Short tons	Value	Short tons	Value	Short tons	Value
Canada	338,189	$354,473	329,835	$341,283	408,908	$424,752
Germany	17	75				
Italy					394	1,679
Mexico	21,277	19,131	31,351	29,799	40,948	36,619
United Kingdom	7	240				
	359,490	373,919	361,186	371,082	450,250	463,050

The foregoing figures somewhat exceed the quantities reported to the Bureau of Mines by 15 firms who were the major importers in 1935. The following table is a preliminary summation of the data furnished by these firms.

[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.

Crude gypsum imported and uncalcined and calcined gypsum, from imported rock, sold or used in the United States, 1931–35, as reported to the Bureau of Mines by the importers

Year	Number of importers	Crude imported (short tons)	Sold or used by importer				
			Without calcining		Calcined		Total value
			Short tons	Value	Short tons	Value	
1931	8	630,892	78,258	$317,190	538,633	$7,602,117	$7,919,307
1932	14	351,723	71,320	286,821	303,266	4,600,199	4,887,020
1933	13	340,337	70,338	282,775	238,733	3,433,959	3,716,734
1934	14	345,094	66,630	296,117	238,051	3,393,310	3,689,427
1935 [1]	15	420,579	75,000	(2)	318,000	(2)	(2)

[1] Subject to revision.
[2] Not available.

Exports.—The maximum value of exports of gypsum and gypsum products in any one year was $955,169 in 1929. Thereafter export trade declined to a mere fraction of this amount, reaching a low of $72,094 in 1932. Recovery was slow in 1933 and 1934, but a gain of 64 percent in value of exports for 1935 over that of the previous year points to a more substantial revival.

Gypsum and gypsum products exported from the United States, 1931–35

Year	Crude, crushed, or ground		Plaster board and wall board		Plaster, calcined, and manufactures, n. e. s.	
	Short tons	Value	Square feet	Value	Short tons	Value
1931	4,502	$37,816	6,386,649	$157,897	6,773	$196,724
1932	3,580	18,931	1,981,685	46,175	1,339	72,094
1933	3,774	11,049	1,646,733	36,057	1,559	72,106
1934	2,614	12,165	1,895,700	43,041	2,239	78,286
1935	4,528	15,473	1,929,348	42,465	4,717	128,258

WORLD PRODUCTION

The following table shows world production for a 5-year period:

World production of gypsum, 1931–35, by countries, in metric tons

[Compiled by M. T. Latus]

Country [1]	1931	1932	1933	1934	1935
Algeria	91, 120	90, 550	86, 220	83, 920	(2)
Argentina [3]	39, 473	33, 543	34, 805	44, 142	(2)
Australia:					
New South Wales	1, 766	2, 481	2, 307	2, 753	(2)
South Australia	24, 596	45, 684	51, 373	76, 449	(2)
Victoria	1, 590	2, 951	5, 214	6, 499	(2)
Western Australia	226	3, 706	2, 653	5, 392	(2)
Austria [4]	48, 000	36, 000	45, 000	45, 000	(2)
Canada	800, 931	398, 883	336, 283	457, 511	(5)
Chile	13, 173	11, 989	13, 682	16, 200	(2)
China	71, 500	53, 000	65, 000	(6)	(2)
Cyprus [7]	9, 934	10, 995	12, 881	9, 217	(2)
Egypt [8]	130, 000	130, 000	130, 000	130, 000	(2)
Estonia	7, 851	8, 299	5, 670	4, 905	6, 238
France	2, 832, 280	2, 081, 010	(6)	(6)	(2)
Germany [9]	490, 000	398, 500	485, 000	810, 000	(2)
Greece	3, 200	2, 167	3, 535	(6)	(2)
India, British	54, 493	52, 246	33, 674	49, 540	(2)
Italy	587, 845	529, 821	534, 026	458, 978	443, 518
Latvia [10]	31, 431	36, 812	48, 251	82, 800	83, 202
Luxemburg	9, 263	9, 403	12, 864	10, 689	(2)
Morocco, French	70, 400	39, 080	(6)	(6)	(2)
New Caledonia	11, 550	11, 900	11, 565	13, 585	(2)
Palestine	491	1, 481	2, 602	3, 431	(2)
Peru	8, 603	6, 553	7, 000	10, 105	(2)
Poland	24, 000	(6)	(6)	(6)	(2)
Rumania	53, 003	40, 018	57, 094	47, 176	(2)
Spain	827, 282	697, 230	709, 246	741, 245	(2)
Sweden	50	115	49	121	(2)
Tunisia	17, 450	26, 000	17, 580	15, 550	(2)
Union of South Africa	14, 847	7, 113	11, 809	23, 296	(2)
United Kingdom:					
Great Britain	767, 011	1, 011, 399	1, 000, 865	977, 014	(2)
Northern Ireland	(6)	41	----------	----------	(2)
United States	2, 321, 489	1, 284, 815	1, 211, 259	1, 393, 583	[8] 1, 706, 522
Yugoslavia [11]	836	(6)	842	(6)	(2)
	9, 400, 000	7, 100, 000	7, 100, 000	7, 800, 000	(2)

[1] In addition to the countries listed, gypsum is produced in Cuba, Japan, Switzerland and the U. S. S. R. (Russia), but production data are not available.
[2] Data not available.
[3] Rail and river shipments.
[4] Estimate furnished by Bundesministerium für Handel und Verkehr.
[5] Data for crude gypsum mined not available. Shipments of crude (lump, crushed, and ground) and calcined gypsum amounted to 491,568 tons.
[6] Data not available; estimate included in world total.
[7] Exports of crude and calcined gypsum.
[8] Approximate production.
[9] 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.
[10] Exports.
[11] Serbia only.

LIME [1]

By Oliver Bowles and A. T. Coons

SUMMARY OUTLINE

The lime industry made a substantial gain in 1935 compared with 1934. According to preliminary figures, sales by producers totaled 2,955,000 short tons valued at $21,438,000 in 1935, an increase of 23 percent in quantity and 26 percent in value over 1934. The average value per ton was $7.25 in 1935 compared with $7.16 in 1934. Sales of hydrated lime in 1935, which are included in the total given above, were 990,000 tons valued at $7,763,000, an increase of 19 percent in quantity and 23 percent in value compared with 1934. The average value per ton of hydrated lime was $7.84 in 1935 and $7.63 in 1934.

Sales by uses are shown in the table of salient statistics that follows. An increase of 46 percent in the value of building contracts—exclusive of public works and public utilities—awarded in 1935 compared with 1934 is reflected in an increase in sales of building lime of 32 percent in quantity and 34 percent in value. The chemical industries suffered less than the building trades during the depression, therefore their recovery, although substantial, was less pronounced. Thus sales of chemical lime increased only about 17 percent in quantity and value compared with 1934. Steel plants were operating at nearly 50 percent of capacity throughout most of 1935, whereas they averaged about 36 percent during 1934. This gain in furnace operation led to an increase of 32 percent in quantity and 33 percent in value of refractory lime (dead-burned dolomite) sold in 1935. A gain of 25 percent in quantity and 26 percent in value of agricultural lime sold in 1935 reflects the increased buying power of farmers during the year. Thus lime, which supplies a broad and diversified market, shared in the growing activity of the building, chemical, and metallurgical industries and of agriculture.

The following table summarizes the principal statistics of the lime industry in 1935 compared with 1934.

[1] Figures for 1935 are preliminary; detailed data with final revisions will be released later.

Salient statistics of the lime industry in the United States, 1934–35

	1934	1935 [1]	Percent of change in 1935
Sales by producers:			
Total lime:			
Short tons	2,397,087	2,955,000	+23.3
Value	$17,164,024	$21,438,000	+25.9
Per ton	$7.16	$7.25	+1.3
Hydrated lime (included in total):			
Short tons	829,430	990,000	+19.4
Value	$6,324,623	$7,763,000	+22.7
Per ton	$7.63	$7.84	+2.8
By uses:			
For building:			
Short tons	511,419	677,000	+32.4
Value	$4,260,865	$5,716,000	+34.2
Per ton	$8.33	$8.44	+1.3
For agriculture:			
Short tons	222,077	278,000	+25.2
Value	$1,478,128	$1,867,000	+26.3
Per ton	$6.66	$6.72	+.9
For chemical uses (exclusive of dead-burned dolomite):			
Short tons	1,338,723	1,570,000	+17.3
Value	$8,726,617	$10,255,000	+17.5
Per ton	$6.52	$6.53	+0.2
Dead-burned dolomite:			
Short tons	324,868	430,000	+32.4
Value	$2,698,414	$3,600,000	+33.4
Per ton	$8.31	$8.37	+0.7
Imports:			
Quicklime and hydrated lime:			
Short tons	9,232	4,443	−51.9
Value	$83,319	$46,603	−44.1
Per ton	$9.03	$10.49	+16.2
Dead-burned dolomite:			
Short tons	6,473	7,519	+16.2
Value	$166,912	$189,714	+13.7
Per ton	$25.79	$25.23	−2.2
Exports (lime):			
Short tons	3,752	3,927	+4.7
Value	$60,167	$63,672	+5.8
Per ton	$16.04	$16.21	+1.1

[1] Subject to revision.

PRODUCTION

The accompanying table shows total lime sold or used by producers in recent years.

Lime sold or used by producers in the United States, 1931–35

Year	Number of plants in operation	Short tons	Value [1]	
			Total	Average
1931	345	2,707,614	$18,674,913	$6.90
1932	343	1,959,990	12,302,231	6.28
1933	332	2,269,280	14,253,659	6.28
1934	324	[2] 2,397,087	[2] 17,164,024	7.16
1935 [3]	320	2,955,000	21,438,000	7.25

[1] Value given represents value of bulk lime f. o. b. at point of shipment and does not include cost of barrel or package.
[2] Includes 129,290 tons, valued at $671,864, used by producers (captive tonnage). Comparable separate figures for earlier years not recorded.
[3] Subject to revision.

Production by States.—Ohio leads all the States as a producer of lime. Sales in that State totaled 717,000 tons valued at $5,629,000 in 1935, an increase of 28 percent in quantity and 31 percent in value over 1934. Ohio is the leading producer of hydrated lime, of which more than 30 percent is commonly used in construction. An output of 307,000 tons valued at $2,492,000 in 1935 represents increases of 35 percent in quantity and 41 percent in value over 1934 (227,922 tons valued at $1,761,871). Ohio is also the ranking State in production of building lime; the output in 1935 was 269,000 tons valued at

$2,254,000, an increase of 45 percent in quantity and 51 percent in value compared with 1934.

Ohio ranks as the third largest producer of agricultural lime, with an output of 32,000 tons valued at $196,000 in 1935, or about the same as in 1934. The State is the largest producer of dead-burned (refractory) dolomite with an output of 227,000 tons valued at $2,008,000 in 1935, an increase of 30 percent in quantity and value over 1934, when 174,939 tons valued at $1,547,828 were produced. Lime sold to the chemical industries in Ohio totaled 189,000 tons valued at $1,171,000 in 1935, an increase of 12 percent in quantity and value over 1934. Sales of chemical lime in Ohio in 1934 were 169,323 tons valued at $1,046,306.

Pennsylvania, with an output of 502,000 tons valued at $3,587,000, ranked next to Ohio in total production. The 1935 output was an increase of 16 percent in quantity and 13 percent in value over 1934 (434,519 tons valued at $3,165,539). Pennsylvania ranked second also in production of hydrated lime—151,000 tons valued at $1,195,000 in 1935, an increase of 10 percent in quantity and value over 1934. The State was the leading producer of agricultural lime in 1935—136,000 tons valued at $931,000, an increase of 23 percent in quantity and value over 1934. It ranked second in output of building lime—47,000 tons valued at $378,000, an increase of 18 percent in quantity and 16 percent in value. Nearly 60 percent of the lime (including dead-burned dolomite) produced in Pennsylvania is used in metallurgical and chemical plants. Sales for such uses were 319,000 tons valued at $2,278,000 in 1935, an increase of 8 percent in quantity and 9 percent in value over 1934.

Ohio and Pennsylvania accounted for over 40 percent of the total production of lime in 1935. Other States producing more than 100,000 tons, in order of output, were Missouri, West Virginia, Tennessee, Virginia, Alabama, and Illinois. Production increased in virtually all the lime-producing States. In 1935, 320 plants were in operation and in 1934, 324. The following table gives production by States in 1935.

Lime sold or used by producers in the United States in 1935, by States [1]

State	Number of plants in operation	Short tons	Value	State	Number of plants in operation	Short tons	Value
Alabama		127,000	$777,000	New Jersey		3,000	$23,000
Arizona		20,000	201,000	New Mexico		(2)	(2)
Arkansas		(2)	(2)	New York		56,000	432,000
California		50,000	498,000	North Carolina		(2)	(2)
Colorado		(2)	(2)	Ohio		717,000	5,629,000
Connecticut		(2)	(2)	Oregon		(2)	(2)
Florida		13,000	112,000	Pennsylvania		502,000	3,587,000
Georgia		5,000	43,000	Puerto Rico		7,000	66,000
Hawaii		7,000	73,000	Rhode Island		2,000	24,000
Idaho		(2)	(2)	South Dakota		(2)	(2)
Illinois		116,000	910,000	Tennessee		143,000	810,000
Indiana		72,000	442,000	Texas		38,000	343,000
Kentucky		(2)	(2)	Utah		14,000	129,000
Louisiana		(2)	(2)	Vermont		37,000	270,000
Maine		(2)	(2)	Virginia		134,000	862,000
Maryland		39,000	292,000	Washington		34,000	339,000
Massachusetts		69,000	619,000	West Virginia		211,000	1,412,000
Michigan		36,000	273,000	Wisconsin		41,000	358,000
Minnesota		(2)	(2)	Undistributed		154,000	1,205,000
Missouri		308,000	1,704,000				
Montana		(2)	(2)		320	2,955,000	21,438,000
Nevada		(2)	(2)				

[1] Subject to revision.
[2] Included under "Undistributed."

CONSUMPTION BY USES

Lime is an important raw material in many industries. Details of its uses and many other features of the lime industry are contained in a recent Bureau report.[2]

The following table shows consumption by principal uses in 1935.

Lime sold or used by producers in the United States in 1935, by uses [1]

Use	Quantity		Value	
	Percent of total	Short tons	Total	Average
Agricultural	9.4	278,000	$1,867,000	$6.72
Building	22.9	677,000	5,716,000	8.44
Chemical	53.1	1,570,000	10,255,000	6.53
Refractory lime (dead-burned dolomite)	14.6	430,000	3,600,000	8.37
	100.0	2,955,000	21,438,000	7.25
Hydrated lime (included in the above totals)	33.5	990,000	7,763,000	7.84

[1] Subject to revision.

TRENDS IN PRINCIPAL USES

Figure 129 shows trends in the principal uses of lime from 1915 to 1935. The chief increases since the bottom of the depression in 1932 have been in chemical uses. Sales for agriculture have remained fairly constant. Building lime has been slow to recover because building activity still remains far below normal levels; however, some improvement is to be noted in 1935. Trends in the average value per ton and in the number of plants in operation are also shown in the figure.

The lime industry depends for its market largely upon the building trades and the steel furnaces. Nearly half of all lime sold in 1934 entered these market channels.

The degree of activity in the building trades is reflected in market demands for building lime. This relationship is shown in figure 130, which gives trends in construction contracts awarded from 1926 to 1935 and consumption of building lime during the same period.

Similarly, figure 131 shows the relation of sales of fluxing and refractory lime (dead-burned dolomite) to output of steel ingots from 1926 to 1935.

AGRICULTURAL LIME AND OTHER LIMING MATERIALS

Both lime and various forms of unburned calcium carbonate are used for soil improvement. Lime acts more quickly than unburned carbonate and gives a more speedy return in increased crop yield than ground limestone. As 2 tons of limestone give the same amount of calcium oxide as 1 ton of lime, the higher cost of the lime is compensated somewhat by a saving in freight. The accompanying table shows the quantities, effective lime content, and values of the various liming materials used on farms in 1935.

[2] Bowles, Oliver, and Banks, D. M., Lime: Inf. Circ. 6884, Bureau of Mines, 1936, 37 pp.

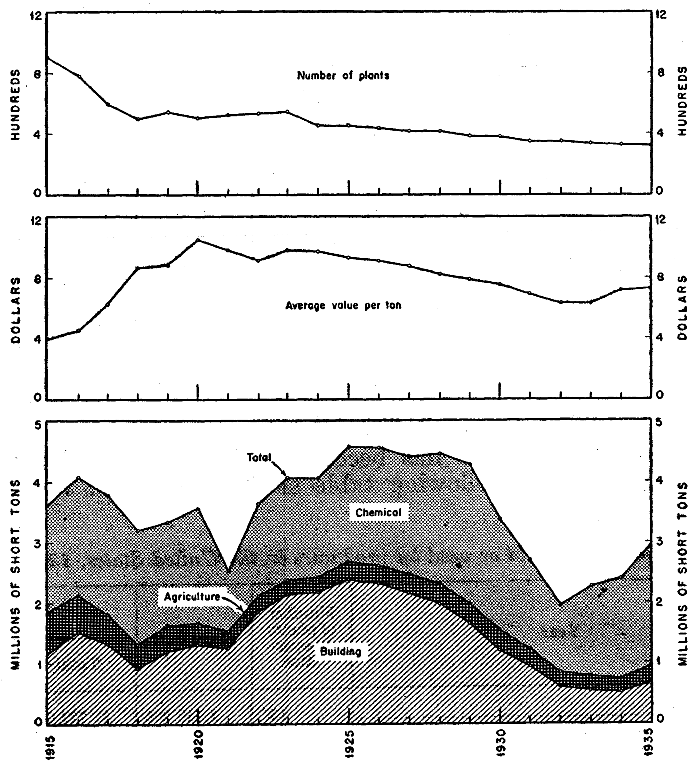

FIGURE 129.—Principal trends of the lime industry, 1915–35.

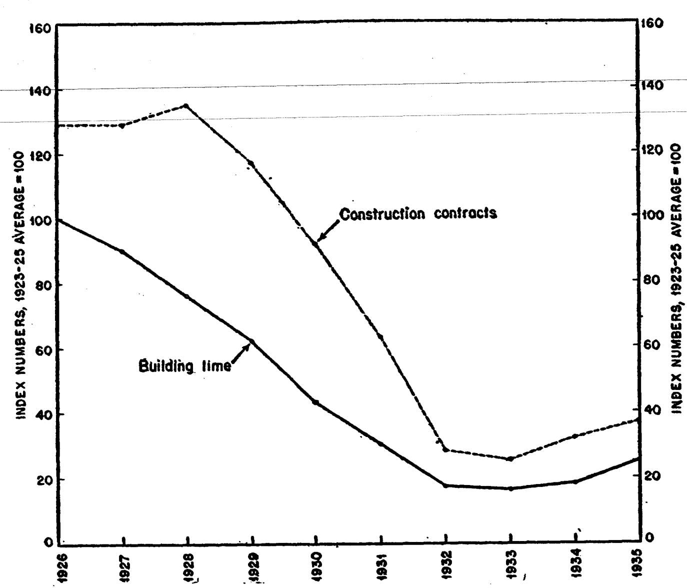

FIGURE 130.—Value of sales of building lime compared with value of construction contracts awarded, 1926–35. To facilitate comparison unlike units have been reduced to percentages of the 1923–25 average. Statistics for lime are from the Bureau of Mines; those for construction compiled by the Federal Reserve Board from data of the F. W. Dodge Corporation.

Agricultural lime and other liming materials sold or used by producers in the United States in 1935, by kinds [1]

Kind	Short tons		Value	
	Gross	Effective lime content [2]	Total	Average
Lime from limestone:				
Quicklime	92,000	77,500	$514,000	$5.59
Hydrated	183,000	120,800	1,343,000	7.34
Lime from oyster shells [3]	16,258	13,700	102,593	6.31
Oyster shells (crushed) [3]	44,145	21,300	106,609	2.41
Limestone	2,250,000	968,400	2,773,000	1.23
Calcareous marl	88,062	38,860	96,658	1.09

[1] Subject to revision. [2] Estimated. [3] Bureau of Fisheries.

HYDRATED LIME

Production of hydrate has become an important activity of the lime industry. The following table shows production for the past 5 years:

Hydrated lime sold or used by producers in the United States, 1931–35

Year	Number of plants in operation	Short tons	Value	
			Total	Average
1931	157	1,119,266	$7,729,047	$6.91
1932	158	852,251	5,370,273	6.30
1933	157	840,007	5,622,026	6.69
1934	165	829,430	6,324,623	7.63
1935 [1]	160	990,000	7,763,000	7.84

[1] Subject to revision.

The following table shows production by States in 1935:

Hydrated lime sold or used by producers in the United States in 1935, by States [1]

State	Short tons	Value	State	Short tons	Value
Alabama	23,000	$169,000	Pennsylvania	151,000	$1,195,000
Arizona	5,500	74,000	Rhode Island	1,600	13,000
California	12,000	121,000	Tennessee	37,000	292,000
Florida	8,000	66,000	Texas	20,000	195,000
Georgia	5,000	43,000	Utah	3,000	42,000
Hawaii	6,500	73,000	Vermont	9,500	70,000
Illinois	25,000	217,000	Virginia	55,000	387,000
Indiana	31,000	214,000	Washington	4,500	44,000
Maryland	23,000	184,000	West Virginia	43,000	287,000
Massachusetts	23,000	186,000	Wisconsin	11,000	84,000
Missouri	107,000	702,000	Undistributed [2]	62,400	486,000
New York	16,000	127,000			
Ohio	307,000	2,492,000		990,000	7,763,000

[1] Subject to revision.
[2] Arkansas, Connecticut, Idaho, Kentucky, Louisiana, Maine, Michigan, Minnesota, Montana, Nevada, Oregon, and South Dakota.

NEW DEVELOPMENTS

A new use for lime includes employment of quicklime as an agent for removing snow and ice, particularly around frogs, switches, and crossings of railroad tracks. Another novel use for the heat generated by lime hydration is for heating canned food. The food container may be encased in a larger can provided with two compartments, one containing quicklime and the other water. When heat is desired the partition is perforated and the water allowed to mix with the lime.

Recent research on lime has shown that lime putty made directly from quicklime has distinct advantages. This has stimulated interest in lime-putty plants, many of which were established in 1935 by lime manufacturers and independent concerns as well. Lime-putty units for both mortar and plaster work are equipped to obtain close control of putty consistency, thus providing a product that insures maximum service and requires minimum attention at the job.

The Building Science Research Laboratories at Watford, England, have found that the plasticity and workability of lime may be con-

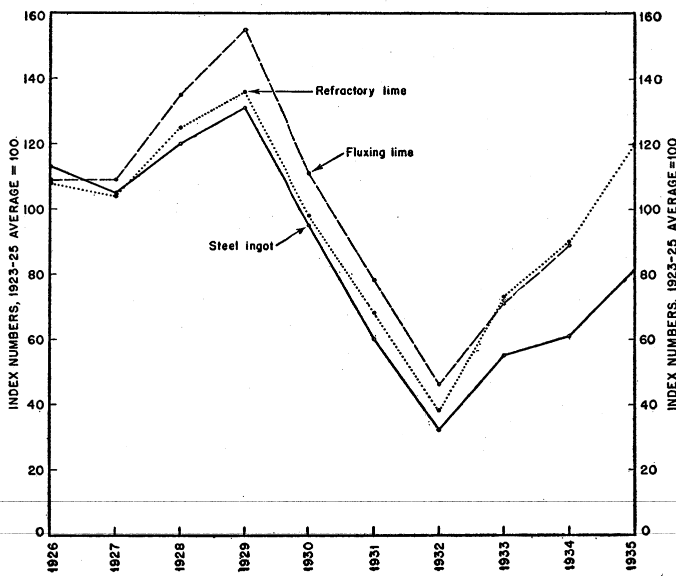

FIGURE 131.—Sales of fluxing and refractory lime compared with steel-ingot production, 1926–35. To facilitate comparison unlike units have been reduced to percentages of the 1923–25 average. Data on production of steel ingots compiled by American Iron and Steel Institute.

trolled to some extent by manufacturing processes. Thus hydration with an excess of water gives greater plasticity than addition of merely enough water to satisfy the chemical reaction. When excess water is used the lime particles are very small and are surrounded by a lubricating envelope of water. When the lime is hydrated with water vapor results are similar to those obtained when the lime is hydrated with a slight excess of water. It was also found that additions of small amounts of aluminum sulphate during hydration cause an increase in plasticity because gelatinous aluminum hydroxide is formed.

Studies of particle size of hydrated limes made by the Bureau of Standards led to the conclusion that if there was a relation between particle size and plasticity the determining factor was in the material finer than 1 micron.

PRICES

Trends in lime prices were steadily downward from 1923 to 1932, when lime sold at an average of $6.28 a ton f. o. b. plant. The price remained unchanged in 1933, advanced to $7.16 a ton in 1934, and rose to $7.25 a ton in 1935. The greatest gain in 1935, 11 cents a ton, was in building lime ($8.33 a ton in 1934 to $8.44 in 1935). Agricultural lime and dead-burned dolomite each gained 6 cents a ton and chemical lime, 1 cent.

The average price of lime is still far below the level of 1926. The price index of lime (1926=100) was 78.6 in 1934 and 79.6 in 1935. The price index of all commodities in 1935 was 80.0 and that of all building materials 85.3, therefore the recovery in prices of lime has not kept pace with that of other commodities.

FOREIGN TRADE [3]

Imports.—Imports of lime for consumption in the United States in 1935 declined nearly 24 percent in quantity and nearly 6 percent in value compared with 1934. Imports of hydrated lime and dead-burned dolomite increased, but imports of lime of other kinds decreased greatly. The following table shows imports for a series of years. As indicated in the table of imports by countries of origin, nearly all of the foreign lime is obtained from Canada for use in the State of Washington and in San Francisco.

Lime imported for consumption in the United States, 1931–35

Year	Hydrated lime		Other lime		Dead-burned dolomite		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1931	2,268	$26,622	12,190	$155,245	6,051	$152,795	20,509	$334,662
1932	1,677	18,756	7,100	77,279	5,120	115,808	13,897	211,843
1933	1,200	11,865	9,305	93,399	6,763	163,081	17,268	268,345
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

Lime (exclusive of dead-burned dolomite) imported for consumption in the United States, 1934–35, by countries and districts

Country	District	1934		1935	
		Short tons	Value	Short tons	Value
Austria	New York			2	$81
Canada	Buffalo	61	$426		
	Maine and New Hampshire	89	1,292	87	1,231
	San Francisco	1,138	11,717	1,678	19,180
	Vermont	8	61	9	88
	Washington	7,850	67,374	2,458	22,443
Cuba	Los Angeles			62	659
	Florida			87	770
Germany	New York	10	1,268	20	1,343
Japan	Washington			(1)	3
Mexico	El Paso	2	17	1	5
United Kingdom	New York	40	701	35	767
	Philadelphia	34	460	4	33
	Wisconsin	(1)	3		
		9,232	83,319	4,443	46,603

1 Less than 1 ton.

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.

Exports.—Lime exported from the United States in 1935 increased 4.7 percent in quantity and 5.8 percent in value compared with 1934. The following tables show exports for a series of years and for countries of destination in 1935:

Lime exported from the United States, 1931–35

Year	Short tons	Value	Year	Short tons	Value
1931	11,924	$129,943	1934	3,752	$60,167
1932	3,579	56,479	1935	3,927	63,672
1933	3,710	58,095			

Lime exported from the United States in 1935, by countries

Country	Short tons	Value	Country	Short tons	Value
North America:			South America:		
Canada	1,706	$21,258	Argentina	29	$1,035
Central America:			Chile	15	264
British Honduras	6	87	Colombia	33	788
Honduras	4	59	Ecuador	45	1,039
Nicaragua	72	2,361	Peru	721	9,462
Panama	88	1,102	Venezuela	5	74
Salvador	43	516	Europe:		
Mexico	134	2,750	France	15	657
Newfoundland and Labrador	15	246	Italy	4	186
West Indies:			Sweden	48	1,764
British:			United Kingdom	18	598
Jamaica	76	1,096	Asia:		
Other British	221	3,911	China	(1)	11
Cuba	60	1,138	Japan	397	11,067
Dominican Republic	98	818	Other Asia	7	277
Netherland	52	876	Oceania (New Zealand)	14	193
			Africa (Liberia)	1	39
				3,927	63,672

[1] Less than 1 ton.

CLAY[1]

By L. E. Geyer and R. W. Metcalf

SUMMARY OUTLINE

The figures of the Bureau of Mines on the production of clay cover chiefly material that is mined and sold and do not include the clays used at plants immediately connected with the mines or pits. As virtually all brick and heavy-clay-products plants produce their own clay, the Bureau figures fall far short of the annual production of clays used for the manufacture of all ceramic wares; however, they include the tonnage of clay used by the whiteware industry and as fillers in the paper and other trades. It would be difficult to obtain figures on clay output in the heavy-clay-products industries as such plants usually work on a finished-product basis.

Various kinds and types of clays occur in every State, but high-quality clays suitable for use in the better grades of ceramic wares or as fillers are found in only a few States. Most of the ordinary clays found throughout the country can be used for brickmaking and for other heavy-clay products unless they contain high percentages of impurities.

Large deposits of high-grade clays occur in many sections, notably in the Eastern States,[2] the Mississippi Valley, and the Pacific Northwest. Part of these resources have not been developed as rapidly as their quality might warrant, owing to inadequate transportation facilities or lack of power and water for mining and purification.

The desirable high-grade clays used in making fine ceramic wares are of two types: Ball clays found mainly in the Mississippi Valley, particularly in Kentucky, Tennessee, and Missouri, and kaolins (china clays) mined in Georgia, Florida, and the Carolinas. Kaolin and china clay are essentially the same, but in trade usage the English or foreign clays of this type are invariably called china clays and the American clays kaolins.

Use of domestic kaolins has been rather slow in developing, owing to several factors. The early potteries in this country were generally started by Englishmen whose formulas called for English clays, and as these clays were carefully mined, of fine quality, and priced about the same or little higher than domestic clays the tendency has been

[1] Figures for 1935 are preliminary where stated; final figures will be released later.
[2] National Bureau of Standards, Ceramic Properties of Some White Burning Clays of the Eastern United States: Circ. 325, May 4, 1927.

to continue importations. Moreover, American producers have been slow in adopting careful mining and purification methods and in persuading manufacturers to make the formula adjustments necessary for the use of American clays. American kaolins or china clays are actually purer mineralogically, particularly in that they contain less mica than English clays, therefore they cannot be substituted pound for pound in many body formulas. However, American producers are constantly improving production technique and doing more research to enable the manufacturers to make proper substitution for English clays.

The former predominance of imported china clays may also have been due partly to the general idea that anything imported was of far superior quality. There was some foundation for this belief, for when the World War shut off imports it was difficult for the paper

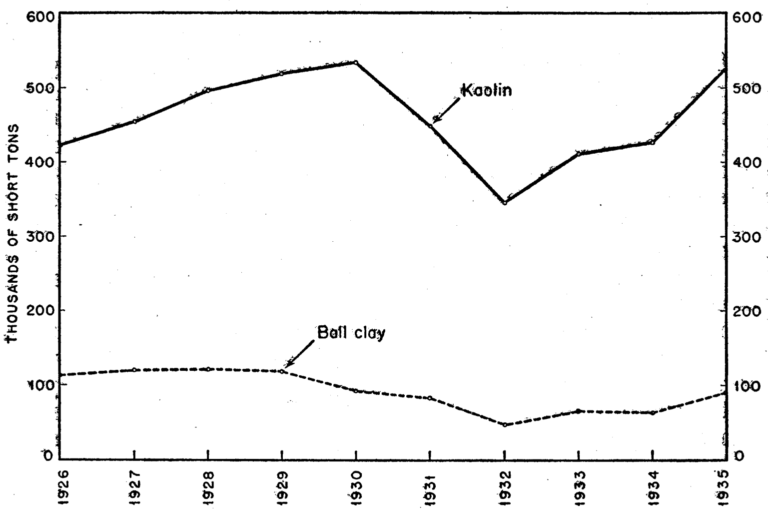

FIGURE 132.—Kaolin and ball clay sold by producers in the United States, 1926–35.

trade to obtain domestic clays that were free from grit and did not wear out spreading knives too rapidly.

The history of ball clays has been very similar, although domestic ball clays have been accepted in the trade somewhat more generally than domestic kaolins.

Sales of kaolin or china clay by producers in the United States increased gradually from 1925 until 1930 when, owing to the depression and general retrenchment of business, they decreased decidedly. The decline continued through 1931 and 1932, but since 1932 the trend in production has been upward with general improvement in business conditions, so that in 1935 sales were only slightly below those in 1930, the peak year.

Sales of ball clay by domestic producers in the United States declined steadily from 1925 until 1932 when they recovered slightly. Production in 1935 almost equaled that in 1930 but was considerably below the average for 1925–29.

Salient statistics of the clay industry in the United States, 1931–35

	1931	1932	1933	1934	1935 [1]
Domestic clay sold:					
Kaolin, china clay..........short tons..	443,300	344,994	411,233	426,335	523,585
Ball clay..........do....	83,007	47,573	64,551	62,877	90,489
Slip clay..........do....	1,916	525	1,562	5,117	4,316
Fire clay..........do....	1,473,161	725,993	1,133,693	1,288,909	1,783,321
Stoneware clay..........do....	57,466	49,736	28,188	56,678	35,460
Bentonite..........do....	78,815	71,613	117,428	215,339	189,840
Miscellaneous..........do....	381,830	151,382	83,518	132,008	168,913
Total sold:					
Quantity..........do....	2,519,495	1,391,816	1,840,173	2,187,263	2,795,924
Value..........	$8,352,185	$5,201,609	$6,840,617	$8,197,253	$10,290,425
Imports:					
Kaolin, china clay..........short tons..	151,426	99,807	116,180	100,775	125,963
Common blue, Gross Almerode..........do....	15,183	5,880	7,099	9,467	15,552
Other clays:					
Crude..........do....	15,615	13,290	17,623	11,678	24,488
Washed, treated [2]..........do....	8,376	8,133	9,756	9,226	7,453
Total imports:					
Quantity..........do....	190,600	127,110	150,658	131,146	173,456
Value..........	$1,536,024	$877,180	$1,180,503	$1,341,524	$1,635,591
Exports:					
Fire clay..........short tons..	45,314	22,086	32,432	36,053	49,949
Other clay..........do....	61,389	59,273	66,093	84,264	101,524
Total exports:					
Quantity..........do....	106,703	81,359	98,525	120,317	151,473
Value..........	$1,244,855	$1,054,623	$1,234,888	$1,455,979	$1,865,069

[1] Subject to revision.
[2] Includes "acid-treated earths."

DOMESTIC PRODUCTION

The table on clay sold by producers in the United States in 1935, by States and kinds, shows that Georgia is by far the largest producer of kaolin or paper clay, followed by South Carolina and Pennsylvania. The fine-grained Georgia kaolins are used extensively in the paper and filler trades. The kaolins of North Carolina, Virginia, California, and Delaware, although of good quality for fillers and ceramic wares, have not been exploited as extensively as those of Georgia and South Carolina. Kentucky and Tennessee are the only important producers of ball clay. Illinois, Maryland, Missouri, and New Jersey produce clays of this type but in almost negligible quantities. Public Works Administration funds were allocated recently for a study of clays in western Kentucky and Tennessee to determine their commercial importance for bleaching.

Deposits of fire clay occur in about three-fourths of the States, but annual production amounts to over 100,000 short tons only in Pennsylvania, Missouri, Ohio, and Kentucky. A recent investigation [3] on the geologic distribution of fire clays shows the extent of resources available in the United States.

Most stoneware clays are produced in Pennsylvania and Ohio; New Jersey and Washington contribute a few thousand tons annually.

The largest tonnage of bentonite comes from California; Arizona, Oklahoma, South Dakota, Texas, Utah, and Wyoming also produce substantial quantities.

[3] Chelikowsky, J. R., Geologic Distribution of Fire Clays in the United States: Jour. Am. Ceram. Soc., vol. 18, no. 12, December 1935, p. 367.

Clay sold by producers in the United States, 1925–29 and 1931–35, by kinds

Year	Kaolin or china clay and paper clay		Ball clay		Slip clay		Fire clay	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1925–29 (average)	453, 618	$3,834,285	116, 127	$890, 457	6, 839	$37, 000	2, 810, 001	$7, 747, 918
1931	443, 300	2, 946, 953	83, 007	639, 798	1, 916	13, 613	1, 473, 161	3, 741, 038
1932	344, 994	2, 011, 208	47, 573	312, 751	525	5, 105	725, 993	2, 057, 060
1933	411, 233	2, 366, 339	64, 551	400, 564	1, 562	11, 365	1, 133, 693	3, 141, 545
1934	426, 335	2, 699, 016	62, 877	423, 421	5, 117	35, 832	1, 288, 909	3, 733, 033
1935 [1]	523, 585	3, 766, 109	90, 489	607, 730	4, 316	25, 839	1, 783, 321	4, 532, 565

Year	Stoneware clay		Bentonite		Miscellaneous clay		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1925–29 (average)	88, 575	$188, 055	(2)	(2)	568, 869	$1, 220, 458	4, 044, 029	$13, 918, 173
1931	57, 466	131, 915	78, 815	$472, 045	381, 830	406, 823	2, 519, 495	8, 352, 185
1932	49, 736	82, 521	71, 613	503, 673	151, 382	229, 291	1, 391, 816	5, 201, 609
1933	28, 188	59, 581	117, 428	760, 174	83, 518	101, 049	1, 840, 173	6, 840, 617
1934	56, 678	100, 279	215, 339	1, 050, 578	132, 008	155, 094	2, 187, 263	8, 197, 253
1935 [1]	35, 460	70, 280	189, 840	1, 071, 412	168, 913	216, 490	2, 795, 924	10, 290, 425

[1] Subject to revision.
[2] Sales of bentonite included under "Miscellaneous clay" before 1930 when separate figures first became available.

Clay sold by producers in the United States in 1935, by States and kinds [1]

State	Number of active establishments reporting sales	Kaolin or china clay and paper clay		Ball clay		Fire clay		Stoneware clay		Miscellaneous clay [2]		Total	
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	10					34,594	$50,605			10,560	$5,764	45,154	$56,369
Arizona	2									([3])	([3])	([3])	([3])
Arkansas	3					([3])	([3])			([3])	([3])	([3])	([3])
California	50	3,560	$35,789			107,832	250,157	1,950	$5,870	87,166	237,715	200,508	529,531
Colorado	14					33,027	49,028			23,342	19,867	56,369	68,895
Connecticut	3					178	2,225			113	564	291	2,789
Delaware	1	([3])	([3])									([3])	([3])
Florida	2	([3])	([3])									([3])	([3])
Georgia	19	[4] 339,777	[4] 2,349,718					([3])	([3])	([3])	([3])	353,752	2,366,470
Idaho	2					([3])	([3])					([3])	([3])
Illinois	12			442	$4,184	89,965	255,839	8,336	18,635			98,743	278,658
Indiana	16					30,829	49,181	4,000	3,000	29,657	27,646	64,486	79,827
Iowa	9					2,143	20,726			1,132	12,821	3,275	33,547
Kentucky	18			44,971	305,687	147,342	371,557					192,313	677,244
Maine	1									([3])	([3])	([3])	([3])
Maryland	7			9,032	55,673	8,016	38,952					17,048	94,625
Massachusetts	5					([3])	([3])			([3])	([3])	753	8,868
Michigan	1									([3])	([3])	([3])	([3])
Minnesota	4					77	751	3,020	6,570	123	273	3,220	7,594
Missouri	46	([3])	([3])	([3])	([3])	260,262	983,007					261,097	989,916
Montana	4					368	2,327			10,976	8,964	11,344	11,291
Nebraska	4									10,303	21,762	10,303	21,762
Nevada	1									650	3,896	650	3,896
New Jersey	24			([3])	([3])	68,859	319,796	4,582	18,462	([3])	([3])	80,082	373,277
New Mexico	4					([3])	([3])			([3])	([3])	1,760	5,677
New York	4					([3])	([3])			([3])	([3])	([3])	([3])
North Carolina	7	8,162	118,972					150	300			8,312	119,272
North Dakota	2					([3])	([3])			([3])	([3])	([3])	([3])
Ohio	55					304,670	612,809	9,702	12,246	639	2,307	315,011	627,362
Oklahoma	3									6,735	70,327	6,735	70,327
Oregon	1					([3])	([3])					([3])	([3])
Pennsylvania	91	30,478	97,322			623,344	1,333,104	([3])	([3])	21,401	21,767	676,548	1,455,658
South Carolina	13	113,586	859,510			205	1,794					113,791	861,304
South Dakota	3									([3])	([3])	([3])	([3])
Tennessee	11			34,498	230,741	16,766	59,755			9,430	9,430	60,694	299,926
Texas	10					7,146	24,486			39,392	237,137	46,538	261,623
Utah	5					([3])	([3])			([3])	([3])	15,817	121,778
Virginia	3	([3])	([3])			([3])	([3])			([3])	([3])	8,185	59,160
Washington	10					1,302	4,152	2,305	1,642	4,950	4,397	8,557	10,191

See footnotes at end of table.

Clay sold by producers in the United States in 1935, by States and kinds [1]—Continued

State	Number of active establishments reporting sales	Kaolin or china clay and paper clay		Ball clay		Fire clay		Stoneware clay		Miscellaneous clay [2]		Total	
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
West Virginia	5					38,670	$70,654					38,670	$70,654
Wyoming	5									37,087	$351,789	37,087	351,789
Undistributed		28,022	$304,798	1,546	$11,445	7,726	31,660	1,415	$3,555	69,413	277,315	58,831	371,145
1935 Total	490	523,585	3,766,109	90,489	607,730	[5] 1,783,321	[5] 4,532,565	35,460	70,280	[6] 363,069	[6] 1,313,741	2,795,924	10,290,425
1935 Average value per ton			7.19		6.72		2.54		1.98				3.68
1934 Total	482	426,335	2,699,016	62,877	423,421	[5] 1,288,909	[5] 3,733,033	56,678	100,279	[7] 352,464	[7] 1,241,504	2,187,263	8,197,253
1934 Average value per ton			6.33		6.73		2.90		1.77				3.75

[1] Subject to revision.
[2] Includes adobe, shale, etc. Slip clay and bentonite are also included in this column as a matter of statistical convenience.
[3] Included under "Undistributed."
[4] Includes kaolin sold for refractory uses: 41,502 tons valued at $97,933.
[5] Fire clay totals include diaspore and burley clay from Missouri, as follows: 1935, 27,972 tons valued at $115,343; 1934, 20,294 tons, $104,692.
[6] Includes 4,316 tons of slip clay valued at $25,839 from New York and Pennsylvania and 189,840 tons of bentonite valued at $1,071,412 from Arizona, California, Oklahoma, South Dakota, Texas, Utah, and Wyoming. Of the total bentonite, California reported 63,184 tons valued at $215,315; Oklahoma, 4,805 tons, $58,508; Texas, 39,391 tons, $237,123; and Wyoming, 37,076 tons, $351,690.
[7] Includes 5,117 tons of slip clay valued at $35,832 and 215,339 tons of bentonite valued at $760,174.

Georgia kaolin sold or used, 1931–35, 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
1931	245, 304	$1,602,248	$6. 53	32, 498	$54, 185	$1. 67	277, 802	$1, 656, 433	$5. 96
1932	207, 519	1, 148, 000	5. 53	26, 725	48, 988	1. 83	234, 244	1, 196, 988	5. 11
1933	239, 271	1, 342, 512	5. 61	40, 767	75, 108	1. 84	280, 038	1, 417, 620	5. 06
1934	236, 606	1, 535, 046	6. 49	47, 950	86, 177	1. 80	284, 556	1, 621, 223	5. 70
1935 [1]	298, 275	2, 251, 785	7. 55	41, 502	97, 933	2. 36	339, 777	2, 349, 718	6. 92

[1] Subject to revision.

IMPORTS AND EXPORTS [4]

Imports of clay increased from 131,146 short tons in 1934 to 173,456 short tons in 1935. They declined rapidly and steadily from 1925 to 1932, but increased moderately in 1933 and 1935. Of the clays imported, kaolin or china clay constitutes the greatest tonnage.

Exports of domestic clays of all kinds have been climbing steadily since 1932. In 1935 exports were second only to the peak year of 1929 when they amounted to 153,350 short tons. (See fig. 133.)

Clay imported for consumption in the United States, 1925–29 and 1931–35

Year	Kaolin or china clay		Common blue and Gross-Almerode glass-pot clay		All other clays				Total	
					Unwrought		Wrought			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1925–29 (average)	339, 014	$3, 055, 885	12, 130	$113, 307	57, 001	$493, 983	4, 047	$52, 550	412, 192	$3, 715, 725
1931	151, 426	1, 056, 393	15, 183	116, 446	15, 615	125, 326	[1] 8, 376	[1] 237, 859	[1] 190, 600	[1] 1, 536, 024
1932	99, 807	461, 191	5, 880	45, 445	13, 290	90, 140	[1] 8, 133	[1] 280, 404	[1] 127, 110	[1] 877, 180
1933	116, 180	632, 437	7, 099	69, 639	17, 623	141, 992	[1] 9, 756	[1] 336, 435	[1] 150, 658	[1] 1, 180, 503
1934	100, 775	752, 993	9, 467	111, 828	11, 678	120, 738	[1] 9, 226	[1] 355, 965	[1] 131, 146	[1] 1, 341, 524
1935	125, 963	959, 821	15, 552	165, 560	24, 488	220, 382	[1] 7, 453	[1] 289, 828	[1] 173, 456	[1] 1, 635, 591

[1] Includes "clays or earths, artificially activated with acid or other material", as follows: 1931, 4,912 short tons, valued at $184,381; 1932, 7,328 tons, $267,560; 1933, 5,640 tons, $258,291; 1934, 3,867 tons, $232,664; 1935, 3,589 tons, $212,036; not separately classified prior to change in tariff.

Domestic clay exported from the United States, 1925–29 and 1931–35

Year	Fire clay		All other		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1925–29 (average)	55, 316	$434, 842	54, 028	$782, 927	109, 344	$1, 217, 769
1931	45, 314	329, 112	61, 389	915, 743	106, 703	1, 244, 855
1932	22, 086	228, 073	59, 273	826, 550	81, 359	1, 054, 623
1933	32, 432	264, 595	66, 093	970, 293	98, 525	1, 234, 888
1934	36, 053	308, 424	84, 264	1, 147, 555	120, 317	1, 455, 979
1935	49, 949	380, 604	101, 524	1, 484, 465	151, 473	1, 865, 069

[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.

PRICES

Prices of kaolin or china clay and bentonite fluctuated slightly throughout 1935. Domestic dry-ground china clay, air-floated, 99.75 percent through 300-mesh, ranged from $7 to $8 per ton in bulk in car lots, while the less-car-lot price ranged from $9 to $15 per ton. Imported, white, lump china clay in bulk ranged from $22 to $25 per ton; the same variety, powdered, in bags, commanded a price of $37.50 per ton. Domestic-grade water-ground and silk-bolted china clay, 99.9 percent through 325-mesh, f. o. b. works in car lots, was

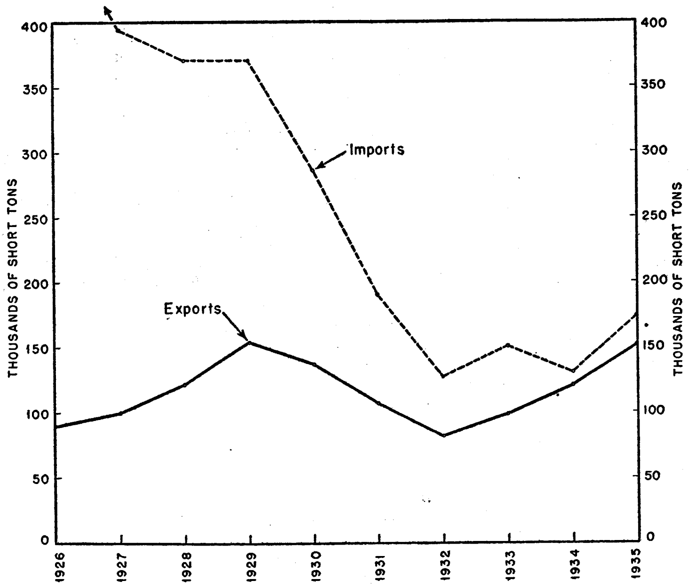

FIGURE 133.—Imports and exports of all clays, 1926–35.

quoted at $8 to $9 per ton. The same grade in 50-pound paper bags ranged from $9.75 to $11.25 per ton.

Bentonite, 96 percent through 300-mesh, f. o. b. points in Wyoming, was constant throughout the year at $17.50 per ton. Bentonite, 92 percent through 200-mesh, was quoted at $12.50 per ton.

The average value of several kinds of clay as reported by producers is shown in the following table:

Average values per short ton of various kinds of clay sold by producers in the United States, 1925–29 and 1931–35

Year	Kaolin and paper clay		Ball clay	Slip clay	Fire clay	Stoneware clay	All kinds of clay
	United States	South Carolina					
1925–29 (average)	$8.45	$8.93	$7.67	$5.41	$2.76	$2.12	$3.44
1931	6.65	6.84	7.71	7.10	2.54	2.30	3.32
1932	5.83	6.40	6.57	9.72	2.83	1.66	3.74
1933	5.75	5.99	6.21	7.28	2.77	2.11	3.72
1934	6.33	7.26	6.73	7.00	2.90	1.77	3.75
1935 [1]	7.19	7.57	6.72	5.99	2.54	1.98	3.68

[1] Subject to revision.

TECHNOLOGIC DEVELOPMENTS

Recent developments of different type faces and engraving in the printing industry necessitate papers having different working surfaces. Clay and talc have formed the basis of fillers for paper stock in the past, but other so-called fillers, such as zinc and titanium pigments, have recently been introduced into paper making.[5] Only small additions of these materials are needed to produce the desirable opacity and high whiteness; and while they may not be formidable contenders for the clay-filler trade at present, further developments may be forthcoming.

Glass building blocks may offer serious competition to brick and heavy-clay products. At least two or three glass manufacturers have made building blocks, and several buildings of such blocks were completed during the year.

Probably the greatest development in the clay-working industries, or at least the one that has received the most publicity, during the past year is the deairing process.

Equipment for deairing clays is being perfected as the technical problems incident to any new development are being worked out. Such equipment has been generally used during the past 2 years in plants manufacturing hotel china, semiporcelain, and electrical porcelain. More than 100 installations of machinery for deairing clays [6] are being used in the manufacture of heavy-clay products such as brick and tile.

The process permits intricate molding, twisting, turning, and shaping of the ware so that it can be used where clay bodies are desired that otherwise could be obtained only by the slow process of hand labor.

Another development in the heavy-clay-products industry is the manufacture of light-weight masonry materials of clay aggregates. Briefly, one process comprises mixing a clay slurry containing dolomite and plaster of paris with an acid, which causes it to foam. After a few minutes setting the mixture becomes hard enough to be cut into any desired shape by hand, after which it is fired like other ceramic products.[7]

Sagger clays have long been the subject of research, as they are of major importance in the pottery industry of the United States. An investigation[8] was recently completed on 51 American clays used for sagger making, and it was found that talc, because of its magnesia content, when added to the mix tended to increase the life of the sagger.

Recent research on the problem of substituting American for imported clays [9] indicates that it is possible to mix one or more American clays with certain fluxes and obtain a clay having properties sufficiently like those of the English china clays to make substitution seem practicable. In the Pacific Northwest, where the white clays range from the highly plastic to the weakly plastic residual kaolins, it was found [10] that by proper mixing of these two types the use of imported clays may be eliminated.

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5 Johnsen, Bjarne., The Pulp and Paper Industry: Ind. and Eng. Chem., vol. 27, no. 5, May 1935, pp. 514–18.

6 Ceramic Industry, February 1935, p. 114.

7 Bole, George A., Cellulated Clay Units: Ind. and Eng. Chem., vol. 27, no. 8, p. 886.

8 Heindl, R. A., A Study of Sagger Clays and Sagger Bodies: Nat. Bur. of Stand. Jour. of Res., vol. 15, no. 3, September 1935, p. 255.

9 Klinefelter, T. A., and Meyers, W. W. Properties of Some American Kaolins and a Comparison with English China Clays: Jour. Am. Ceram. Soc., vol. 18, no. 6, June 1935, p. 163.

10 Wilson, Hewitt, Kaolin and China Clay in the Pacific Northwest: Univ. of Wash. Exp. Sta. Bull. 76. 1934.

ABRASIVE MATERIALS

By Bertrand L. Johnson and A. E. Davis

SUMMARY OUTLINE

The value of abrasive materials sold in 1935 increased 10 percent compared with 1934, indicating continued recovery in general in the abrasives industries.

Abrasive processes—cutting, sawing, grinding, and polishing—are essential steps in many diverse manufacturing industries. The quantities of abrasive materials used in these processes are directly related to the production of various commodities; hence they are to a considerable extent indicators of industrial activity. The following table of salient statistics therefore not only presents the trend in activity of each commodity but portrays to some degree that of the industries in which the abrasives are employed.

Some commodities included in this chapter also have important nonabrasive uses. For instance, only relatively small quantities of diatomite and tripoli are now used as abrasives compared with the quantities formerly so used. It seems desirable, however, to continue to include such commodities in the annual chapters of this series for purposes of comparison until the minerals in this diverse group are reclassified.

On the other hand, it should be noted that the quantities of sundry materials mentioned later under the caption "Miscellaneous Abrasive Materials" used for abrasive purposes are not included in this chapter.

Salient statistics of abrasives industries in the United States, 1934–35

	1934	1935	Percent of change in 1935
Domestic production:			
Natural silica abrasives:			
Diatomite	[1] $1,206,143	[1] $1,206,143	
Tripoli (value as sold—crude and finished)[2]	329,356	383,416	+16.4
Quartz	129,965	111,784	−14.0
Ground sand and sandstone	1,392,173	1,783,439	+28.1
Special silica stone products:			
Grindstones and pulpstones	463,234	505,378	+9.1
Oilstones and related products	94,419	105,589	+11.8
Millstones	10,101	9,530	−5.7
Natural silicate abrasives:			
Pumice and pumicite	207,058	236,727	+14.3
Garnet	214,815	(3)	(+)
Natural alumina abrasives:			
Emery	1,800	1,606	−10.8
Total natural abrasives	4,049,064	[4] 4,343,612	+7.3
Total artificial abrasives	5,972,697	6,691,087	+12.0
Grand total	10,021,761	[4] 11,034,699	+10.1
Foreign trade:			
Imports	3,405,881	5,125,106	+50.5
Exports	[5] 511,259	515,547	+.8

[1] Average for 1933–35; Bureau of Mines not at liberty to publish annual figures.
[2] No sales of crude reported in 1934.
[3] Bureau of Mines not at liberty to publish figures.
[4] Exclusive of value of garnet.
[5] Revised.

NATURAL SILICA ABRASIVES

Diatomite.—Diatomite (known also as diatomaceous earth, infusorial earth, tripolite, and kieselguhr)—included in this group of abrasive materials because of its use as an abrasive, although only relatively small quantities are now used that way—is composed chiefly of the minute silica skeletons of marine or fresh-water plants known as diatoms and is a light, earthy material, loose and powdery in some occurrences, more or less firmly coherent in others, generally white or gray with a fine, uniform grain.

The principal uses are now nonabrasive in character and include utilization as heat and sound insulation, filler, filtering agent, absorption agent, and concrete admixture, in bleaching, as support for catalysts, and in paints. It is a mild abrasive and is used in paste and liquid metal polishes, in scouring and cleansing soaps, in dentifrices, and in nail-polishing powders.

The principal production centers, formerly in the eastern United States, are now in the Western States, notably near Lompoc,[1] Calif., where large deposits of high-grade material have been worked for many years. In 1935, as usual, California was the chief source of production; sales were also reported from Nevada, New York, New Jersey, Oregon, and Washington.

The Bureau of Mines has not been at liberty to publish annual production figures for diatomite since 1926, but consolidated returns by 3-year periods are available. The totals for the period 1933–35, as shown below, represent a decline of 1.6 percent of the total quantity and 7.3 percent of the total value reported for the period 1930–32. About one-half of the producers reported increased sales in 1935 over those in 1934.

[1] Mulryan, Henry, Geology, Mining and Processing of Diatomite at Lompoc, Santa Barbara County, Calif. Am. Inst. Min. and Met. Eng. Tech. Pub. 687, 1936, 30 pp.

Diatomite sold or used by producers in the United States, 1930–35 [1]

Year	Short tons	Value	Year	Short tons	Value
1930 1931 1932	248, 273	$3, 902, 126	1933 1934 1935	244, 342	$3, 618, 428

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

The trend of diatomite production, shown graphically in figure 134, emphasizes the growing demand for this material in the predepression years.

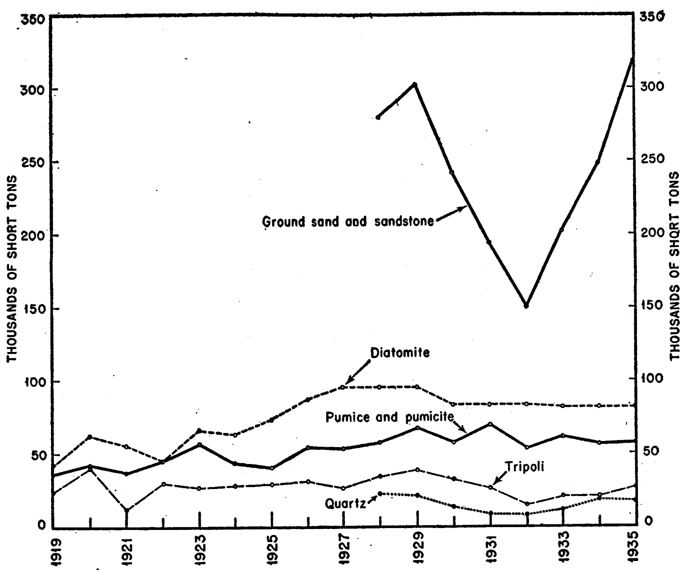

FIGURE 134.—Trends in production of diatomite, tripoli, pumice and pumicite, quartz, and ground sand and sandstone in the United States, 1919–35.

The companies reporting production and sales of diatomite in the United States in 1935, with locations of the deposits from which it was obtained, were as follows:

Adirondack Diatomaceous Earth Co., Keene, N. H. Deposit near Poland, Herkimer County, N. Y.

Atomite Products Co., 803 American Bank Building, Portland, Oreg. Deposit at Terrebonne, Deschutes County, Oreg.

The Dicalite Co., 756 South Broadway, Los Angeles, Calif. Deposit at Walteria, Los Angeles County, Calif.

The Electro-Silicon Co., 130 Cedar Street, New York, N. Y. Deposit at Virginia City, Storey County, Nev.

Johns-Manville Products Corporation, 22 East Fortieth Street, New York, N. Y. Deposit at Lompoc, Santa Barbara County, Calif.

Marcrum, J. G., Netcong, N. J. Deposit near Stanhope, Sussex County, N. J.

Mineral Products Manufacturing Co., 1735 Ventura Avenue, Fresno, Calif. Deposit at Mendota, Fresno County, Calif.

National Diato Co. Deposit and office at Harper, Malheur County, Oreg. (Successor to Pacific Coast Diatom Co.)

National Silica Products Co., 1201 Bryant Street, Palo Alto, Calif. Deposit at Lompoc, Santa Barbara County, Calif.

Pacatome, Ltd., Bradley, Calif. Deposit near Bradley, Monterey County, Calif.

The Paraffine Companies, Inc., 475 Brannan Street, San Francisco, Calif. Deposit near Lompoc, Santa Barbara County, Calif.

Raylite Aggregates, Inc., 1302 Park Central Building, Los Angeles, Calif. Deposit at Palos Verdes, Los Angeles County, Calif.

Tri-O-Lite Products Co. Deposit and office at Carlin, Elko County, Nev.

Webley, E. J. Deposit and office at Quincy, Grant County, Wash.

Tripoli.—The materials grouped under this heading include certain naturally extremely finely divided forms of silica, such as tripoli and rottenstone. Deposits of tripoli occur in southeastern, central, and western United States, but the tripoli industry has centered largely in the Missouri-Oklahoma and Illinois fields.[2] The Tennessee deposits have been recently described.[3] Rottenstone is produced only in Pennsylvania.

The tripoli industry of the United States is small, the tonnage produced annually ranging from 12,000 to 40,000 short tons in recent years. In 1935, tripoli and related products were produced in Arkansas, California, Georgia, Illinois, Missouri, Oklahoma, and Pennsylvania, with a total output of 27,375 short tons valued at $383,416, an increase of 33.3 percent in quantity and 16.4 percent in value compared with 1934. The Missouri-Oklahoma and Illinois fields were the principal producing areas. The following table gives production data for tripoli from 1931–35. Tonnage figures for 1919–35 are shown in figure 1.

Tripoli (including Pennsylvania rottenstone) sold or used by producers in the United States, 1931–35

Year	Illinois			Other States [1]			Total		
	Short tons	Value		Short tons	Value		Short Tons	Value	
		Crude (partly estimated)	As sold (crude and finished)		Crude (partly estimated)	As sold (crude and finished)		Crude (partly estimated)	As sold (crude and finished)
1931	12,651	$27,170	$87,481	14,031	$29,078	$222,650	26,682	$56,248	$310,131
1932	6,097	10,895	84,795	8,678	20,527	147,905	14,775	31,422	232,700
1933	8,757	18,103	149,979	12,121	27,582	200,404	20,878	45,685	350,383
1934 [2]	7,417	17,241	119,418	13,112	27,622	209,938	20,529	44,863	329,356
1935	10,001	19,149	113,484	17,374	42,640	269,932	27,375	61,789	383,416

[1] 1931–32: Arkansas, Missouri, Oklahoma, Pennsylvania, and Tennessee; 1933–34: Arkansas, California, Georgia, Missouri, Oklahoma, Pennsylvania, and Tennessee; 1935: Arkansas, California, Georgia, Missouri, Oklahoma, and Pennsylvania.

[2] No sales of crude reported in 1934.

According to a memorandum from Oliver C. Ralston, of the Bureau of Mines, covering a recent field trip—

Missouri tripoli, which, due to its porous and irregular shaped grains is claimed to stick better to buffing wheels, has a high reputation in this country and abroad, about 25 percent of the product being exported. It is produced mainly near Seneca, Mo., by the Barnsdall Tripoli Co., and the Independent Gravel Co. Mining is done largely by farmers who have been mining tripoli from their farms as a side line for three generations, and accordingly are far more familiar with the acceptable grades of material than any hired help. They now mine from ground owned by one or other of the two companies, haul the material to the mills on trucks and bargain with the mill superintendents who are also men of long experience. In a few cases farmers who still own their own land are selling

[2] Weigel, W. M., Technology and Uses of Silica and Sand: Bull. 266, Bureau of Mines, 1927, pp. 160–176.

[3] Spain, E. L., Jr., Tripoli Deposits of the Western Tennessee Valley: Am. Inst. Min. and Met. Eng. Tech. Pub. 700, 1936, 17 pp.

direct to cement companies for admixture in making special cements. The Independent Gravel Co. markets a considerable amount of cement admix tripoli, used as a pozzuolanic material. Federal specifications call for minus 200-mesh, but all particles smaller than 10 microns are to be removed on account of silicosis danger; such particles, however, are more desirable for polishing powders. The Independent Gravel Co. also owns an old filterstone plant where white stone of suitable porosity and soundness is machined into desired shapes. Whereas alundum and other synthetic filter plates have totally displaced tripoli filterstones, there is still a considerable export business to places where the natural stones have been in use for generations.

Tripoli is used in a variety of ways but principally for abrasives and polishes, fillers, concrete admixture, foundry facings, filters, and divers ceramic and chemical uses. Rottenstone is used as a filler and also as a mild abrasive in wood and metal finishing. In 1933 the Bureau of Mines presented for the first time statistics on the quantity and value of tripoli and selected materials sold by producers according to uses. Similar data for 1935 are shown in the following table:

Tripoli sold or used by producers in the United States in 1935, by uses

Use	Number of producers reporting	Short tons	Value as sold (crude and finished)	Percent of total accounted for	
				Quantity	Value
Abrasives	6	10,162	$159,134	37.3	42.0
Concrete admixture	3	3,040	42,450	11.2	11.2
Filler	7	4,810	65,445	17.7	17.3
Foundry facing	3	2,590	40,254	9.5	10.6
Miscellaneous	5	6,623	71,633	24.3	18.9
Total accounted for	[1] 8	27,225	378,916	100.0	100.0
Use not specified	1	150	4,500		
Grand total	9	27,375	383,416		

[1] A producer reporting more than 1 use is counted only once in arriving at total.

The companies reporting production and sales of tripoli (including Pennsylvania rottenstone) in the United States in 1935, with locations of the deposits from which the material was obtained, were as follows:

Barnsdall Tripoli Co., Seneca, Mo. Deposits at Seneca, Newton County, Mo., and in Ottawa County, Okla., near Seneca, Mo.
Corona Products, Inc. Deposit and office at Rogers, Benton County, Ark.
Independent Gravel Co., 220½ West Fourth Street, Joplin, Mo. Deposit at Racine, Newton County, Mo.
Geo. S. Mepham Corporation, East St. Louis, Ill. Deposit at Delta, Alexander County, Ill.
Olive Branch Minerals Co., Cairo, Ill. Deposit at Olive Branch, Alexander County, Ill.
Ozark Minerals Co., 807½ Washington Avenue, Cairo, Ill. Deposit at Elco, Alexander County, Ill.
Penn Paint & Filler Co. Deposit and office at Antes Fort, Lycoming County, Pa.
Tennessee Valley Mineral Co., route 3, Summerville, Ga. Deposit near Summerville, Chattooga County, Ga.
Western Talc Co., 1901 East Slauson Street, Los Angeles, Calif. Deposit near Barstow, San Bernardino County, Calif.

Quartz.—Quartz is used in the manufacture of fused-quartz glass, ferrosilicon, whiteware, and enamel; as packing in acid towers and water filters; for refractory purposes; as a filler; and as the abrading agent in some kinds of sandpaper, soaps and scouring compounds, metal polishes, and safety matches. Exceptionally clear crystals of quartz are used in optical instruments and for various purposes in the electrical industry.

The production of quartz in the United States in 1935 from pegmatite dikes or veins or from quartzite amounted to 17,178 short tons valued at $111,784, a decrease of 6 percent in tonnage and 14 percent in value compared with 1934. About 44 percent of the total was sold by the producers as crude or crushed quartz and about 56 percent as ground quartz. Part of the crude also may have reached ultimate consumers as ground quartz.

Production data from 1931 to 1935 are shown in the following tables.

Quartz sold or used by producers in the United States, 1931–35

Year	Crude [1]		Ground [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1931	4,460	$19,208	[3] 3,391	[3] $49,895	[3] 7,851	[3] 69,103
1932	4,383	15,394	[3] 3,104	[3] 43,764	[3] 7,487	[3] 59,158
1933	4,094	14,556	[3] 7,059	[3] 56,492	[3] 11,153	[3] 71,048
1934	4,447	16,168	13,846	113,797	18,293	129,965
1935	7,586	26,807	9,592	84,977	17,178	111,784

[1] Includes some crushed quartz.
[2] 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.
[3] Partly estimated.

Quartz (crude, crushed, and ground) [1] *sold or used by producers in the United States, 1933–35, by States*

State	1933		1934		1935	
	Short tons	Value	Short tons	Value	Short tons	Value
California	(2)	(2)	(2)	(2)	650	$2,600
Maryland	371	$5,565	564	$6,390	405	6,075
Undistributed [3]	[4] 10,782	[4] 65,483	17,729	123,575	16,123	103,109
	[4] 11,153	[4] 71,048	18,293	129,965	17,178	111,784

[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] 1933: Arizona, California, Missouri, New Jersey, New York, North Carolina, Ohio, Tennessee, and Wisconsin; 1934: Arizona, California, Missouri, New Jersey, New York, North Carolina, Ohio, Tennessee, and Virginia; 1935: Arizona, Missouri, New Jersey, New York, North Carolina, Ohio, and Tennessee.
[4] Partly estimated.

The trend in the production of quartz for the past 8 years for which statistics are available is shown in figure 134.

Following is a list of some recent producers and sellers of crude quartz:

Carolina Minerals Co., Inc., Spruce Pine, N. C.
Consolidated Feldspar Corporation, Trenton, N. J.
Harford Talc & Quartz Co., P. O. Box 63, Towson, Md.
Kingman Feldspar Co., Kingman, Ariz.
Ohio Quartz Products Corporation, Jackson, Ohio.
C. F. Wolfradt, 319 South 8th Street, Alhambra, Calif.

Following is a list of producers of crushed quartz:

Consolidated Feldspar Corporation, Trenton, N. J.
Ohio Quartz Products Corporation, Jackson, Ohio.
Harford Talc & Quartz Co., P. O. Box 63, Towson, Md.

Following is a list of manufacturers of ground quartz:

Charlotte Chemical Laboratories Inc., Charlotte, N. C.
Consolidated Feldspar Corporation, Trenton, N. J.
Eureka Flint & Spar Co., Trenton, N. J.
Glading, McBean & Co., Los Angeles, Calif.
Harford Talc & Quartz Co., P. O. Box 63, Towson, Md.
Pioneer Silica Products Co., R. R. 3, Pacific, Mo.
Tennessee Mineral Products Corporation, Spruce Pine, N. C.

Ground sand and sandstone.—Considerable quantities of ground sand and sandstone are sold by companies producing glass sand and other special silica sands. This pulverized silica is used widely in the ceramic trades; as a silica wash for molds in steel foundry works; as a filler in prepared roofing, paint, and other products; in fertilizers; and as an abrasive agent in various cleaning and scouring compounds.

Production of this ground sand and sandstone rose to 318,632 short tons valued at $1,783,439 in 1935, an increase of 28 percent in both quantity and value over 1934.

The following table gives production data from 1931 to 1935. These figures include material known in some localities as "silica flour."

Ground sand and sandstone sold or used by producers in the United States, 1931–35 [1]

Year	Short tons	Value	Year	Short tons	Value
1931	183,880	$1,196,425	1934	248,026	$1,392,173
1932	150,109	875,749	1935	318,632	1,783,439
1933	202,099	1,106,410			

[1] Includes only finely ground material. Figures probably incomplete.

Ground sand and sandstone sold or used by producers in the United States, 1934–35, by States [1]

State	1934		1935	
	Short tons	Value	Short tons	Value
Illinois	50,748	$285,849	66,492	$370,488
Massachusetts	514	3,471	995	5,723
New Jersey	64,467	291,733	69,131	338,314
Ohio and Pennsylvania	59,128	368,720	96,663	529,947
Virginia			32,152	246,534
West Virginia	(2)	(2)		
Undistributed [3]	73,169	442,400	53,199	292,433
	248,026	1,392,173	318,632	1,783,439

[1] Includes only finely ground material. Figures probably incomplete.
[2] Included under "Undistributed."
[3] 1934: California, West Virginia, and Wisconsin; 1935: California and Wisconsin.

The trends in the production of ground sand and sandstone since 1919 are shown in figure 134.

The following companies reported production of ground sand and sandstone in 1934 and 1935.

Central Silica Co., Zanesville, Ohio.
Cheshire White Quartz Sand Co., Cheshire, Mass.
Del Monte Properties Co., 401 Crocker Building, San Francisco, Calif.
Michigan Quartz Silica Co., Milwaukee, Wis.
Minnesota Mining & Manufacturing Co., St. Paul, Minn.

National Pulverizing Co., Millville, N. J.
National Silica Co., Oregon, Ill.
National Silica Works, Berkeley Springs, W. Va.
New Jersey Pulverizing Co., 205 West Thirty-fourth Street, New York, N. Y.
Ottawa Silica Co., Box 506, Ottawa, Ill.
Pennsylvania Glass Sand Corporation (grinds in New Jersey, Pennsylvania, and West Virginia), Lewistown, Pa.
Potters Mining & Milling Co., East Liverpool, Ohio.
Shenandoah Silica Co., P. O. Box 266, Trenton, N. J.
Standard Flint & Spar Corporation, Trenton, N. J.
Standard Sanitary Manufacturing Co., Campo, Calif.
Standard Silica Co., Box 407, Ottawa, Ill.
Wedron Silica Co., 38 South Dearborn Street, Chicago, Ill.

Abrasive sand.—Sand is used extensively in sawing and rubbing granite, limestone, marble, slate, and soapstone. It is also used for removing surface inequalities in crude-rolled plate glass before grinding and polishing, and for sand-blasting. The demand for this grinding and polishing sand depends largely upon conditions in the dimension-stone and plate-glass industries.

Figures for the production of abrasive sand are included with those of related materials in the chapter on Sand and Gravel. In 1929, sand sold or used for this purpose reached a tonnage of 1,636,464 short tons, declined to 419,691 tons in 1932, and in 1934, at 571,191 tons, had only recovered 12 percent of its decline from the 1929 levels. Preliminary figures indicate that the output in 1935 was slightly greater than in 1934.

SPECIAL SILICA STONE PRODUCTS

Grindstones and pulpstones.—Domestic production of natural grindstones and pulpstones comes chiefly from northeastern Ohio and western West Virginia; smaller quantities come from Pierce County, Wash. In 1935, there was an increase of 17 percent in quantity and 20 percent in value of natural grindstones produced over 1934. Pulpstones in 1935 increased 9 percent in quantity and decreased 9 percent in value compared with 1934.

The following table shows the sales of these materials during the low years of the depression and the recent recovery stage.

Grindstones and pulpstones sold by producers in the United States, 1931–35

Year	Grindstones		Pulpstones		
	Short tons	Value	Pieces	Short tons	Value
1931	6,994	$221,272	482	1,730	$120,877
1932	6,001	158,566	483	1,667	88,874
1933	11,197	298,174	855	2,979	146,076
1934	9,781	285,603	760	2,849	177,631
1935	11,476	342,864	948	3,111	162,514

The companies reporting production of grindstones and pulpstones for commercial purposes in the United States in 1935, with locations of the quarries from which the stone was obtained, are as follows:

Briar Hill Stone Co. (grindstones). Quarry and office at Glenmont, Holmes County, Ohio.

Cleveland Quarries Co., Cleveland, Ohio (grindstones). Quarries at Amherst, Lorain County, Ohio; at Berea, Cuyahoga County, Ohio; and at Marietta, Washington County, Ohio.

Constitution Stone Co., Constitution, Ohio (grindstones and pulpstones). Quarries at Constitution, Washington County, Ohio; at Ravenswood, Jackson County, W. Va.; and at St. Marys, Pleasants County, W. Va.

General Stone Co., Amherst, Ohio (pulpstones). Quarry at Opekiska, Monongalia County, W. Va.

Hall Grindstone Co. (grindstones). Quarry and office at Marietta, Washington County, Ohio.

Mount Pisbia Stone Co., Elyria, Ohio (grindstones). Quarry at Layland, Coshocton County, Ohio.

Nicholl Stone Co., Lorain, Ohio (grindstones). Quarry at Kipton, Lorain County, Ohio.

Ohio Valley Stone Co. (grindstones). Quarry and office at Marietta, Washington County, Ohio.

H. P. Scheel Co., Rockport, Wash. Quarry and office at Rockport, Skagit County, Wash.

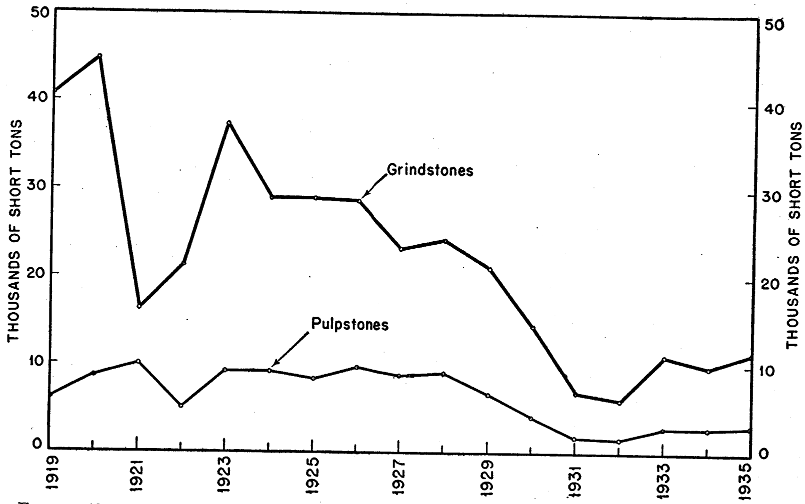

FIGURE 135.—Trends in production of grindstones and pulpstones in the United States, 1919–35.

Smallwood-Low Stone Co., Fairmont, W. Va. (pulpstones). Quarry in Monongalia County near Fairmont, W. Va.

Smallwood Stone Co., Union Trust Building, Cleveland Ohio (pulpstones). Quarry at Opekiska, Monongalia County, W. Va.

Uffington Stone Co. (pulpstones). Quarry and office at Uffington, Monongalia County, W. Va.

Walker Cut Stone Co., Tacoma, Wash. (pulpstones). Quarry at Wilkeson, Pierce County, Wash.

West Virginia Pulpstone Corporation, Builders Exchange Building, Cleveland, Ohio (pulpstones). Quarry at Morgantown, Monongalia County, W. Va.

The general downward post-war trend in grindstones, probably due to the substituting of manufactured abrasive wheels for the natural grindstones, is shown in figure 135. The horizontal trend in pulpstone production prior to the depression is also shown.

Oilstones and related products.—The small natural abrasive stones included in this group have highly diversified uses. Although artificial abrasives compete with them in virtually every application the natural stones have qualities that encourage their continued use. There was an increase of 11 percent in quantity and 12 percent in value in 1935 compared with 1934.

Oilstones are manufactured from novaculite quarried in Arkansas; scythestones and whetstones are made chiefly of sandstone from Ohio and Indiana and of schist from Vermont; and rubbing stones are fine-grained sandstones quarried in Indiana and Ohio.

The following table shows production for the past 5 years:

Oilstones and other whetstones, hones, scythestones, and rubbing stones sold by producers in the United States, 1931–35

Year	Short tons	Value	Year	Short tons	Value
1931	370	$81,951	1934	396	$94,419
1932	331	63,960	1935	439	105,589
1933	587	96,597			

The manufacturers of oilstones and other whetstones, scythestones, and rubbing stones from natural stone in 1935, with the sources of their raw materials, are as follows:

American Rubbing Stone Co., Cincinnati, Ohio (rubbing stones). Quarry at Floyds Knobs, Floyd County, Ind.

West Baden Whetstone Co. Quarries at West Baden, Ind. (Sells this stone to Norton Pike Co. Buys Arkansas and Ohio stone and manufactures it.)

Cleveland Quarries Co., Cleveland, Ohio (scythestones, lathe stones, and holystones). Quarries at Amherst, Lorain County, Ohio, and at Berea, Cuyahoga County, Ohio.

Garland Whetstone & Kaolin Co., John C. Wolf, Hot Springs, Ark. (Produces rough stone, in Garland County, for oilstones, some of which is shipped abroad, and some of which is sold to manufacturers in this country.)

Lewis Whetstone Co., W. E. Lewis, Hot Springs, Ark. (Produces rough stone, in Garland County, for oilstones, most of which is shipped to Germany.)

Norton Pike Co., Littleton, N. H. (oilstones, whetstones, and scythestones). Production from Barton, Orleans County, Vt.; Hot Springs, Garland County, Ark.; McDermott, Scioto County, Ohio; and West Baden, Orange County, Ind. (Quarries owned are in Arkansas and Vermont. Stone from Ohio and Indiana is purchased.)

Millstones.—Although steel rolls, disks, tube mills, and other types of grinding equipment have superseded the ancient buhrstone, natural millstones are still preferred for certain uses, notably for grinding paint. In 1935, quarries yielding these natural millstones were in operation at three localities in eastern United States—Ulster County, N. Y. (yielding the "Esopus" stone from the Shawangunk conglomerate); Brush Mountain, Montgomery County, Va. (furnishing the "Brush Mountain" stone—a fine-grained quartzite); and near Salisbury, Rowan County, N. C. (supplying a granite millstone).

The millstone-manufacturing industry, producing stones to the value of $200,000 annually in the early eighties, has declined in importance; and in the years immediately before the recent depression the value of the production ranged only between $20,853 and $45,937. The 1932 depression cut the output to a value of $4,450. In 1935, sales of millstones and related products of domestic origin were $9,530, a decrease of 5.7 percent compared with 1934 when a value of $10,101, the highest since 1932, was registered.

The following table presents production data for millstones and related products from 1931 to 1935.

Value of millstones, chasers, and dragstones sold by producers in the United States, 1931–35

Year	New York		Other States [1]		Total	
	Producers	Value	Producers	Value	Producers	Value
1931	6	$2,030	2	$3,300	8	$5,330
1932	5	1,850	2	2,600	7	4,450
1933	7	5,187	2	3,200	9	8,387
1934	5	3,381	3	6,720	8	10,101
1935	8	4,645	3	4,885	11	9,530

[1] 1931–35: North Carolina and Virginia.

The following are names and addresses of the producers who reported sales of millstones and chasers of their own manufacture in the United States in 1935; the raw material from which the stones were made was obtained from Ulster County, N. Y.; Rowan County, N. C.; and Montgomery County, Va.

Addis, Wilson C., Stone Co., route 2, Kerhonkson, N. Y.
Coddington, George, Accord, N. Y.
Coddington, Oscar, Accord, N. Y.
Decker, Floyd, Kerhonkson, N. Y.
Esopus Millstone Co., High Falls, N. Y.
Gardner Bros., Salisbury, N. C.
Laurence, Harry, Accord, N. Y.
Olinger, P. L. (successor to R. L. Olinger & Co.), Blacksburg, Va.
Schoonmaker, Cyrus, Kerhonkson, N. Y.
Smith, John, Accord, N. Y.
Snider, R. E., Cambria, Va.

Flint lining and grinding pebbles.—A continued moderate demand for flint linings and grinding pebbles for use in grinding minerals, ores, and other materials exists principally in those industries that require a product with a minimum iron content. Steel balls, however, have displaced flint pebbles extensively in ordinary work.

In 1935, sales of flint beach pebbles from the ocean front in San Diego County, Calif., were reported only by John T. Momand, Pacific Coast Pebble Co., Carlsbad, Calif., and sales of cut cubes and tube-mill liners of quartzite quarried near Jasper, Minn., were reported only by the Jasper Stone Co., Sioux City, Iowa. The marked increase in demand for these materials in 1933 was followed by a decided decrease in consumption in 1934. In 1935, however, the Jasper Stone Co. reported improved business conditions and an increase in output over the preceding year. The Bureau of Mines is not at liberty to publish the production for 1934 and 1935 because there were only two producers, but the production for the 3 previous years is shown in the following table.

Pebbles for grinding and flint lining for tube mills sold or used by producers in the United States, 1931–35

Year	Short tons	Value	Year	Short tons	Value
1931	2,024	$26,211	1934	(1)	(1)
1932	976	13,070	1935	(1)	(1)
1933	3,709	47,011			

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

NATURAL SILICATE ABRASIVES

Pumice and pumicite.—Pumice and pumicite are both volcanic materials—pumice, a cellular glassy lava, and pumicite, finely divided glassy particles ejected during volcanic eruptions. Both are complex silicates of aluminum, sodium, potassium, calcium, magnesium, and iron. Commercial deposits of these materials occur in many parts of the central and western United States. In 1935, pumice was produced in the Pacific Coast States California and Oregon, and pumicite in California and the Midwest States Oklahoma, Kansas, and Nebraska, most of the production coming from Kansas.

Sales of pumice and pumicite in 1935 increased 1.7 percent in quantity and 14.3 percent in value over 1934. The following table shows the quantity and value of pumice and pumicite sold or used by producers for the past 5 years.

Pumice and pumicite sold or used by producers in the United States, 1931–35

Year	Short tons	Value	Year	Short tons	Value
1931	68,819	$338,586	1934	56,169	$207,058
1932	53,214	235,204	1935	57,116	236,727
1933	61,220	241,834			

The trends in the production of these materials during the post-war years is shown in figure 134.

The following table shows sales according to uses. Approximately 89 percent of the material was used for cleansing and scouring compounds and hand soaps. Sales of acoustic plaster, forming 5 percent of the total used, were the second most important use and increased 1,279 tons over the preceding year, attaining nearly the 1931 total.

Pumice and pumicite sold or used by producers in the United States, 1934–35, by uses

Use	1934			1935		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Cleansing and scouring compounds and hand soaps	49,719	$162,832	$3.28	50,640	$176,456	$3.48
Other abrasive uses	299	3,302	11.04	927	9,438	10.18
Concrete admixture and concrete aggregate	601	3,426	5.70	612	4,402	7.19
Acoustic plaster	1,581	19,181	12.13	2,860	37,742	13.20
Miscellaneous uses [1]	3,969	18,317	4.62	2,077	8,689	4.18
	56,169	207,058	3.69	57,116	236,727	4.14

[1] 1934: Includes material used as insecticide, floor sweep, and heat or cold insulation, for filtering, in asphalt, and for grading roads, chicken litter, and some unspecified uses; 1935: Includes material used in asphalt, grading roads, chicken litter, filtering, rock gardens and landscaping, as a floor sweep, and some unspecified uses.

The companies reporting production and sales of pumice and pumicite in the United States in 1935, with locations of the deposits from which the materials were obtained, were as follows:

Basalt Rock Co., Inc. Deposit and office at Napa, Napa County, Calif.

Brown, Charles. Deposit and office at Shoshone, Inyo County, Calif.

California Quarries Corporation, 1300 Quinby Building, Los Angeles, Calif. Deposit in Mono County near Laws, Calif.

Chamberlain Co., Inc., 2550 East Ninth Street, Los Angeles, Calif. Deposit near Calipatria, Imperial County, Calif.

The Cudahy Packing Co., 221 North LaSalle Street, Chicago, Ill. Deposits at Fowler, Meade County, Kans., and at Saltdale, Kern County, Calif.

The Davidson Pumice Co., Norton, Kans. Deposits at Calvert, Norton County, Meade, Meade County, and Natoma, Osborne County, Kans.

Dodson Concrete Board Co., 1463 Barwise Avenue, Wichita, Kans. Deposit at Wilson, Ellsworth County, Kans.

Gray Eagle Placer Mining Claim (M. L. Francis), R. F. D., Creston, Calif. Deposit near Creston, San Luis Obispo County, Calif.

La Ritchie, Claire E. (West Coast Pumice Co.). Deposit and office at Chemult, Klamath County, Oreg.

La Rue Axtell Pumice Co., Eustis, Nebr. Deposits at Eustis, Frontier County, and Ingham, Lincoln County, Nebr.

Little Lake Pumice Co., 4232 South Produce Plaza, Los Angeles, Calif. (successor to Victorville Lime Rock Co., June 10, 1935). Deposit near Little Lake, Inyo County, Calif.

Mid-Co Products Co., 238 Railway Exchange Building, Kansas City, Mo. Deposits at Meade, Meade County, and in Grant County near Satanta (Haskell County), Kans., and near Gate, Beaver County, Okla.

Pearl Pumice Quarries, Box 565, Monticello Way, Napa, Calif. Deposit near Napa, Napa County, Calif.

Pumicite Co., 4025 Clara Avenue, St. Louis, Mo. Deposit at Fowler, Meade County, Kans.

Red Mountain Cinder Quarry (H. P. Thelan). Deposit and office at Little Lake, Inyo County, Calif.

Tonopah & Tidewater Railway, 510 West Sixth Street, Los Angeles, Calif. Deposit at Shoshone, Inyo County, Calif.

The Barnsdall Tripoli Corporation, Seneca, Mo., has begun production of a new American pumice from a deposit near Grant, N. Mex., which is similar to Italian pumice.

Garnet.—Garnet production in the United States declined from an all-time peak of 9,006 short tons in 1923 to 1,950 tons in 1932, the smallest annual production in about 50 years, consequent upon the competition of artificial abrasives and the industrial depression. There has been some recovery from the 1932 low, and sales in 1934 were 2,591 short tons. Sales of garnet in 1935 increased both in quantity and value compared with 1934, but the Bureau of Mines is not at liberty to publish figures, as less than three producers reported. New York, producing a grade of abrasive garnet recognized as the world's standard, was the only producing State. The New Hampshire garnet area, a consistent producer in recent years, was not productive in 1935. A comprehensive description of the New Hampshire garnet deposits was published during the year.[4]

In North Carolina, Celo Mines, Inc. (Burnsville, N. C.), began to recover garnet concentrates as a byproduct of its kyanite operations; a minus-20 plus 48-mesh material for sand-blast carving was placed on the market early in 1936. Other garnet deposits of past or possible future commercial importance occur in the metamorphic rocks of the Atlantic Coast States and in various Rocky Mountain and far West States, but, in view of the marked excess productive capacity of existing plants over trade demands, little interest has been taken lately in their possible commercial development.

The bulk of the garnet produced (85 to 90 percent) is used by the abrasive paper and cloth industry in the manufacture of garnet paper and cloth for use in the woodworking and shoe-manufacturing industries. Small quantities of loose garnet fines are used for surfacing plate glass.

Price quotations on garnet concentrates have changed but little in the past 5 years, according to quotations in the Engineering and Mining Journal. Adirondacks (New York) garnet concentrates, f. o. b. mine, were constant at $85 a ton, while New Hampshire concentrates, f. o. b. mine, decreased from $45 a ton in 1930 to $30 a ton in 1935. Quotations for Spanish garnet, c. i. f. port of entry, remained at $60 a ton throughout this period.

The following table shows the production of abrasive garnet since 1931.

Abrasive garnet sold or used by producers in the United States, 1931–35

Year	Short tons	Value	Year	Short tons	Value
1931	2,946	$193,015	1934	2,591	$214,815
1932	1,950	147,350	1935	(1)	(1)
1933	2,794	224,717			

1 Bureau of Mines not at liberty to publish figures.

4 Conant, L. C., The New Hampshire Garnet Deposits: Econ. Geol., vol. 30, no. 4, June-July 1935, pp. 387-399.

The companies reporting sales of garnet in the United States in 1935, with locations of the deposits from which the garnet was obtained are as follows:

Barton Mines Corporation, North Creek, Warren County, N. Y. Deposit on Gore Mountain, Warren County, N. Y.

Warren County Garnet Mills, Inc., 149 Orange Street, Newark, N. J. Deposit near Riparius, Warren County, N. Y.

The garnet mines near North Wilmot, Merrimack County, N. H., were not operated in 1935. The Garnet Products Co., South Danbury, N. H., the former owner of the property, was succeeded by the Davenport Garnet Co. (same address) August 27, 1935.

In recent years the artificial abrasives have made increasing inroads into the industrial fields formerly occupied by garnet. The trends

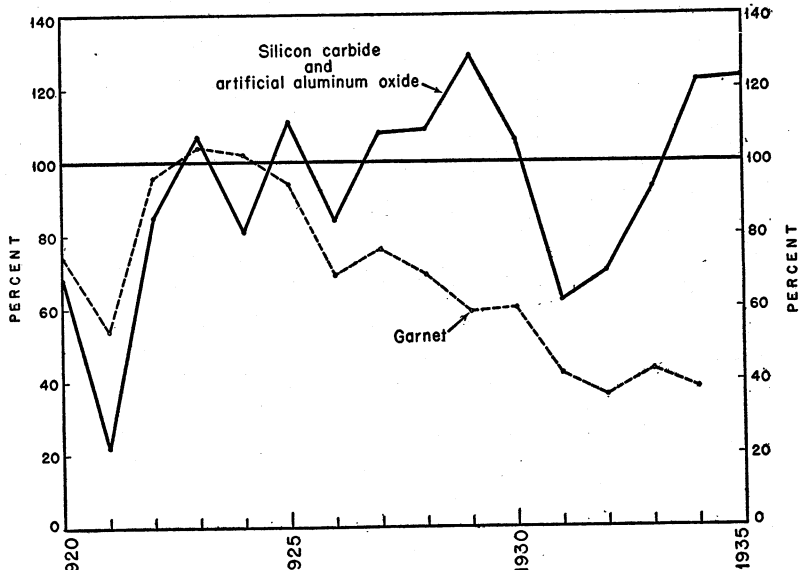

FIGURE 136.—Ratio of indexes of garnet production and production of silicon carbide and artificial aluminum oxide (1923–25 average=100) to the Federal Reserve Board index of industrial production (1923–25 average=100), 1920–35.

in garnet production since 1920 and the production of silicon carbide and artificial aluminum oxide with reference to industrial production as represented by the Federal Reserve Board index of industrial production are shown in figure 136.

NATURAL ALUMINA ABRASIVES

Corundum.—Corundum, a natural aluminum oxide (Al_2O_3), surpassed in hardness among minerals only by the diamond, has not been mined in the United States since 1918, and there has been no regular production since 1906, insofar as Government records show.

The world's supply of corundum now comes almost entirely from deposits in the northern Transvaal, Union of South Africa, where it is obtained largely from the unconsolidated surface deposits resulting from the disintegration of corundum-bearing veins.

The domestic demand for corundum is satisfied by the import of a small tonnage each year, chiefly from the Union of South Africa.

Emery.—Emery is a naturally occurring, granular, intimate intermixture of corundum and magnetite; some varieties contain also important amounts of hematite and spinel. It is used principally as a grinding agent in the metal trades, in which, however, it has been extensively replaced by artificial abrasives.

Commercial deposits of emery occur in but few localities in the United States, and production in recent years has been confined to a locality near Peekskill, Westchester County, N. Y. The general trend of the domestic production has been downward since the World War and in 1935 reached the lowest point in many years. The quantity of emery sold or used by domestic producers for the past 5 years is shown in the following table.

Emery sold or used by producers in the United States, 1931–35

Year	Short tons	Value	Year	Short tons	Value
1931	512	$5, 557	1934	189	$1, 800
1932	250	2, 781	1935	176	1, 606
1933	1, 056	12, 283			

Sales of emery in 1935 were reported by only one company: Smith & Ellis, Peekskill, N. Y.; deposit near Peekskill, Westchester County, N. Y. The emery mine formerly operated by the Keystone Emery Mills near Peekskill, Westchester County, N. Y., was leased to Joseph de Luca, Peekskill, N. Y., in 1935 but was not operated during the year.

NATURAL CARBON ABRASIVES

Abrasive or industrial diamonds.—There are two types of abrasive or industrial diamonds—black diamonds (carbonados) and bort. Black diamonds, which are found chiefly in the State of Bahia (Brazil), are reputed to be harder than the gem varieties and are especially valuable for cutting tools because they have no cleavage. The other variety (bort), obtained principally from South Africa, consists of cull stones from gem diamonds. Industrial diamonds are widely used in drill bits for drilling and boring rock. Diamond-tooth saws are used extensively for sawing marble, limestone, and other varieties of dimension stone.

In the United States diamonds have been produced at only one locality—near Murfreesboro, Pike County, Ark. About 300 carats of gem stones and bort were produced there in 1932, but no production is known to have occurred since. Imports of abrasive diamonds in 1935 were valued at $4,391,529, an increase of 50 percent over 1934.

ARTIFICIAL ABRASIVES

Artificial abrasives may be divided into three main groups: (1) Metallic abrasives, such as crushed steel, steel shot, and steel wool; (2) metallic carbides, chiefly silicon carbide; and (3) synthetic aluminum oxide.

The combined production of silicon carbide and aluminum oxide in 1935 increased 15 percent in quantity and 10 percent in value compared with 1934. As these abrasives are used primarily in the metal trades the larger sales doubtless resulted from increased activity in the iron, steel, and allied industries. The trends since 1920 in the combined production of silicon carbide and artificial aluminum oxide with reference to industrial production as represented by the Federal Reserve Board index of industrial production is shown in figure 136. Metallic abrasives also increased in 1935 (42 percent in quantity and 34 percent in value over 1934).

The table that follows gives the production of silicon carbide, aluminum oxide, and steel shot or crushed-steel grains. These materials compete with the natural abrasives used as grains—for example, emery, corundum, and garnet. The figures represent the total output of crude materials or first products of the manufacturing plants, not all of which are used as abrasive materials. A large but undetermined part of the silicon carbide and aluminum oxide output is used for refractory and other purposes not within the abrasive field. The total output is shown here without separation of the products according to uses, because it is thought that the proportion used as abrasive material has not fluctuated so widely in recent years as to destroy the value of these figures for comparison with the statistics of natural abrasives.

Crude artificial abrasives sold, shipped, or used, from manufacturing plants in the United States and Canada, 1931–35

Year	Silicon carbide [1]		Aluminum oxide [1]		Metallic abrasives		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1931	8,193	$967,840	25,070	$2,336,586	11,105	$613,683	44,368	$3,918,109
1932	11,593	1,066,064	18,835	1,400,420	8,482	410,264	38,910	2,876,748
1933	16,606	1,715,989	30,778	2,436,962	6,844	381,314	54,228	4,534,265
1934	18,038	1,753,019	46,496	3,665,226	10,312	554,452	74,846	5,972,697
1935	24,266	2,164,728	49,990	3,784,726	14,593	741,633	88,849	6,691,087

[1] Includes material used for refractories and other nonabrasive uses.

MISCELLANEOUS ABRASIVE MATERIALS

In addition to the materials already discussed several other commodities are used for abrasive purposes.

An artificial abrasive consisting of tin oxide or a mixture of tin oxide and oxalic acid, termed "putty powder," is used for polishing marble and granite. Rouge and crocus, forms of ferric oxide, are employed to produce a high luster—the former on precious metals and the latter on tin and cutlery. Rouge is used also for final polishing of plate glass. Chromium oxide, manganese dioxide, and magnesia have limited use as abrasives. River silt is employed to a limited extent in cleansing powders and in the manufacture of bath bricks; clay as a mild abrasive in some polishes and cleansing soaps and highly burned clay (sometimes ground to dust) in metal polishes; talc for polishing peanuts and rice; a pure high-grade lime, as well as whiting, for polishing surgical instruments, stainless steels, and cutlery; whiting also as a mild abrasive for polishing plated ware and in a number of window-cleaning compounds; and pulverized feldspar in certain soaps and cleaning compounds.

FOREIGN TRADE [5]

The total value of abrasive materials imported for consumption in the United States in 1935 was $5,125,106, of which 86 percent was industrial diamonds; the value of the imports was 50 percent higher than in 1934. Exports increased less than 1 percent in value in 1935 over 1934, small gains in grindstones and abrasive wheels being nearly counterbalanced by the decrease in imports of other natural abrasives.

The following tables summarize the value of abrasive materials imported for consumption in the United States from 1931 to 1935; the quantity and value of imports from 1933 to 1935, by kinds; and the value of domestic materials exported from the United States from 1931 to 1935.

Value of abrasive materials imported for consumption in the United States, 1931–35

Material	1931	1932	1933	1934	1935
Millstones and burrstones	$2,435	$1,794	$1,123	$2,172	$2,064
Grindstones	39,171	14,196	13,615	14,085	20,895
Hones, oilstones, and whetstones	24,881	15,543	29,968	35,143	53,563
Emery and corundum	151,501	107,199	170,921	256,423	467,171
Garnet	149	356	20		
Tripoli and rottenstone	53,581	39,055	57,029	37,853	24,925
Pumice	77,168	51,062	75,422	83,272	98,232
Diamond:					
Dust and bort	20,292	12,860	47,092	68,982	97,918
Glaziers' and engravers', unset, and miners'	2,400,879	1,061,823	1,263,156	2,862,349	4,293,611
Flint, flints, and flint stones, unground	54,623	27,217	29,485	45,602	66,727

Abrasive materials imported for consumption in the United States, 1933–35, by kinds

Kind	1933		1934		1935	
	Quantity	Value	Quantity	Value	Quantity	Value
Millstones and burrstones:						
Rough or unmanufactured short tons	9	$416	6	$483	1	$137
Bound up into millstones do	17	707	17	1,689	19	1,927
Grindstones, finished or unfinished do	413	13,615	379	14,085	598	20,895
Hones, oilstones, and whetstones do	84	29,968	68	35,143	101	53,563
Emery:						
Ore do	701	6,398	3,428	41,537	4,805	64,909
Grains, ground, pulverized, or refined pounds	(1)	(1)	(1)	(1)	(1)	(1)
Paper and cloth of emery or corundum pounds	(2)	63,181	(2)	26,185	(2)	22,747
Wheels, files, and other manufactures of which emery or corundum is the material of chief value pounds	100,778	48,833	81,131	47,882	108,382	62,506
Corundum (see also "Emery"):						
Ore short tons	1,036	49,442	2,187	134,884	5,056	309,194
Grains, ground, pulverized, or refined pounds	[1] 48,257	[1] 3,067	[1] 91,855	[1] 5,935	[1] 114,801	[1] 7,815
Garnet in grains or ground, pulverized, etc short tons	(3)	20				
Tripoli and rottenstone do	4,119	57,029	1,587	37,853	1,590	24,925
Pumice:						
Crude or unmanufactured do	6,796	55,826	7,091	60,343	8,741	65,696
Manufactures of, or of which pumice is the component material of chief value short tons	(4)	19,596	(4)	22,929	(4)	32,536
Diamond:						
Bort carats	3,059	46,936	1,838	37,820	3,039	43,333
Dust pounds	(4)	156	(4)	31,162	(4)	54,585
Glaziers' and engravers', unset, and miners' carats	263,484	1,263,156	526,007	2,862,349	954,589	4,293,611
Flint, flints, and flint stones, unground short tons	4,640	29,485	5,154	45,602	8,768	66,727
		1,687,831		3,405,881		5,125,106

[1] Emery included with corundum; not separately classified.
[2] 9,394 reams in 1932, 7,053 reams in 1933, 2,956 reams in 1934, 2,507 reams in 1935; weight not recorded.
[3] Less than 1 ton.
[4] Quantity not recorded.

[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.

Value of domestic abrasive materials exported from the United States, 1931–35

Material	1931	1932	1933	1934	1935
Grindstones	$104,602	$85,528	$88,950	$143,626	$148,943
Abrasive wheels, emery and other	115,076	64,069	213,087	113,118	116,376
All other natural abrasives, hones, whetstones, etc.	232,196	147,469	158,812	254,515	250,228

SULPHUR AND PYRITES

By Robert H. Ridgway and A. W. Mitchell

SUMMARY OUTLINE

Increased industrial activity throughout the world in 1935 caused definite improvement in the sulphur industry; and world production of native sulphur, supplemented by the recovery of elemental sulphur from sulphide ores, increased substantially. Although exports from the United States, the principal supplier, decreased materially, shipments from Italy and Japan were at higher rates. Larger output from European countries helped to supply world demand. World stocks at the mines increased due to excess of production over shipments in Italy.

The marketing agreement formed in July 1934 between the Sulphur Export Corporation (American) and the Central Sulphur Sales Bureau (Italian) was suspended in October 1935 due to the application of sanctions against Italy by certain foreign countries. On October 15 an agreement between the two parties was reached by which the past agreement would be maintained after sanctions against Italy had been lifted. Meanwhile, the Sulphur Export Corporation will supply the sanctionist countries, whereas Italy will supply the full requirements to Germany, Austria, and Hungary and will continue to export to Argentina, Brazil, and Switzerland. This restricted market for Italian sulphur during the period of the sanctions will reduce Italy's exports of this commodity materially and cause larger demands on other sources, principally the United States.

The price of sulphur, as quoted by domestic trade journals, remained unchanged throughout the year.

The United States continued to be by far the major factor in the world production of sulphur in 1935. Italy, the second largest producing country, increased its production 8 percent and made the largest output since 1914. Japanese production has been increasing in recent years, and in 1935 output reached a record figure for Japan of 148,000 tons. Norwegian output, which comes from the treatment of cupreous pyrites, was about the same as in 1934, or about equaled the installed capacity of the producing plant. Steps are being taken, however, to double the capacity of this plant in the near future. Spain is augmenting its output of native sulphur with a production of elemental sulphur from pyrites in a plant similar to that operating in Norway. More than half of the Spanish output now comes from pyrites. In 1935, Portugal began production of elemental sulphur from the pyrites produced at the San Domingos mine. It is believed that Sweden also had a sizable output of sulphur from the smelter gases at the Boliden works at Ronskar. The Consolidated Mining & Smelting Co. of Canada, Ltd., is building a plant for the recovery of sulphur from the smelter gases at its smelter at Trail, British Columbia. In Germany the recovery of sulphur from manufactured industrial gases now equals half the indicated domestic consumption. The manufacture of sulphur from native anhydrite has been demonstrated commercially by a pilot plant in England.[1] The process is also deemed applicable to production of sulphur from smelter gases.

As usual, Spain was the most important source of pyrites in the world; increased output has placed Japan in second place, while Norway dropped to third.

Consumption of both sulphur and pyrites in the United States increased in 1935. In the sulphur industry the year was characterized by increased production, slightly increased shipments, decreased exports, and a steady price. The following table outlines the principal features of the domestic situation in recent years.

Salient statistics of the sulphur industry in the United States, 1925–29 and 1932–35

	1925–29 average	1932	1933	1934	1935
Sulphur:					
Production of crude sulphur long tons	1,951,034	890,440	1,406,063	1,421,473	1,632,590
Shipments of crude sulphur:					
For domestic consumption do	1,397,411	756,242	1,114,853	1,106,723	1,232,607
For export do	707,175	352,610	522,515	507,115	402,383
Total shipments do	2,104,586	1,108,852	1,637,368	1,613,838	1,634,990
Imports do	1,896		4,773	5,839	1,763
Exports of treated sulphur do	11,956	7,270	8,763	10,112	10,916
Producers' stocks at end of year do	2,413,000	3,500,000	3,300,000	3,100,000	3,100,000
Price of crude sulphur f. o. b. mines, per long ton	$17.50	$18	$18	$18	$18
Pyrites:					
Production long tons	273,936	189,703	284,311	432,524	506,215
Imports do	373,186	253,248	374,417	366,315	397,113
Price of imported pyrites c. i. f. Atlantic ports, cents per long-ton unit	12–13	12–13	12–13	12–13	12–13
Sulphuric acid: Production of byproduct sulphuric acid at copper and zinc plants 60° B short tons	1,118,453	600,334	656,102	575,660	(1)

1 Figures not yet available.

1 Appleby, M. P., Recent Developments in the Chemistry of Sulphur: Chem. and Ind., vol. 53, no. 52, Dec. 28, 1934, pp. 1097–1101.

The total production of sulphur in the United States through 1935 has amounted to more than 36 million long tons. Virtually all of this output has been made since 1900. The principal trends in the domestic sulphur and pyrites industries during the twentieth century are shown in figures 137 and 138.

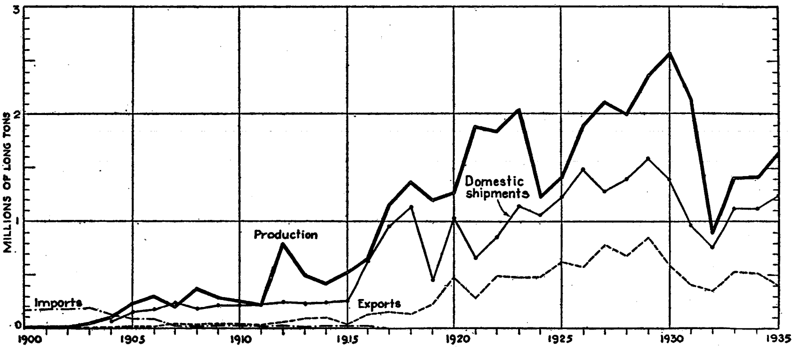

FIGURE 137.—Domestic production, domestic shipments, exports, and imports of crude sulphur, 1900–1935.

SULPHUR

Domestic production.—Production of sulphur in the United States in 1935 totaled 1,632,590 long tons, an increase of 15 percent over the 1,421,473 tons produced in 1934. The 1935 output was the largest since 1931. Shipments in 1935 were 1,634,990 tons, a small increase over 1934. The following table records American sulphur production and shipments from 1931 to 1935.

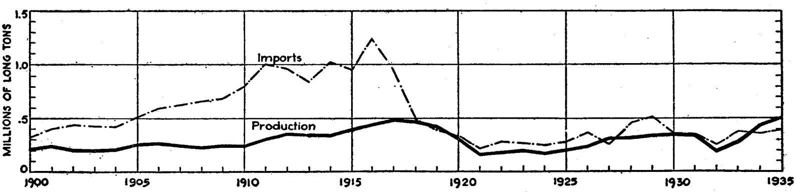

FIGURE 138.—Domestic production and imports of pyrites, 1900–1935.

Sulphur produced and shipped in the United States, 1931–35

Year	Produced (long tons)	Shipped		Year	Produced (long tons)	Shipped	
		Long tons	Approximate value			Long tons	Approximate value
1931	2,128,930	1,376,526	$24,800,000	1934	1,421,473	1,613,838	$28,900,000
1932	890,440	1,108,852	20,000,000	1935	1,632,590	1,634,990	29,300,000
1933	1,406,063	1,637,368	29,500,000				

Seventy-seven percent of the domestic output of sulphur reported for 1935 came from Texas and the bulk of the remainder from Louisiana. California and Utah produced much smaller amounts, contributing 5,493 long tons. Thus the two States, Texas and Louisiana, together produced more than 99 percent of the domestic output.

The following table lists the sulphur mines in the United States active in 1935.

Mines that produced sulphur in the United States in 1935

Operating company	Name of mine	Location of mine
California:		
Sulphur Products Co	Sulphur Queen	Inyo County.
Sulphur Refineries, Inc	Crater	Do.
West Coast Sulphur Co	do	Do.
Louisiana:		
Freeport Sulphur Co	Grande Ecaille	Plaquemines Parish.
Jefferson Lake Oil Co., Inc	Lake Peigneur	Iberia Parish.
Texas:		
Baker & Williams	Boling Dome	Boling, Wharton County.
Duval Texas Sulphur Co	do	Do.
Do	Palangana Dome	Benavides, Duval County.
Freeport Sulphur Co	Bryanmound	Freeport, Brazoria County.
Do	Hoskins Mound	Do.
Texas Gulf Sulphur Co	Boling Dome	Newgulf, Wharton County.
Do	Long Point Dome	Long Point, Fort Bend County.

Stocks.—Production and shipments of sulphur in 1935 were nearly equal, resulting in little or no change in the stocks at the mines. Such stocks, however, are large, amounting to 3,100,000 long tons on December 31, 1935.

Price.—The average quoted price for sulphur, as reported by the trade journals, was unchanged at $18 a ton f. o. b. mines throughout 1935. Spot prices for carlots were given at $21 per ton.

Byproduct sulphur.—Treatment of copper and zinc ores yields large quantities of sulphur, which are recovered at the mills as a pyrites concentrate or at the smelters as sulphuric acid. Production of pyrites concentrate is discussed in the pyrites section of this report. In smelting copper and zinc concentrates the sulphur is driven off as sulphur dioxide gas, which is used at many smelters in the manufacture of sulphuric acid. Over 150,000 tons of sulphur were recovered annually from this source during the 5 years ended in 1934. Such sulphur is not included in the sulphur-production figures for the United States.

The following table gives the output of sulphuric acid as a byproduct at both copper- and zinc-smelting plants and represents virtually all the byproduct acid produced in the United States. The acid reported is only that made from the sulphur content of the sulphide ores. The figures for 1934 do not include the acid made from pyrites concentrate in Tennessee but do include the relatively small amount of acid made from pyrites concentrate in Wisconsin. For previous years pyrites acid from both States is included. The figures for production of acid at copper plants include that made at Anaconda in 1932 and preceding years but exclude it for 1933 and 1934. Data for 1935 are not available.

Byproduct sulphuric acid (expressed as 60° B.) produced at copper and zinc plants in the United States, 1930–34, in short tons

	1930	1931	1932	1933	1934
Copper plants	651,702	436,111	258,994	[1] 301,075	[1,2] 168,676
Zinc plants	536,614	426,618	341,340	355,027	406,984
	1,188,316	862,729	600,334	[1] 656,102	[1,2] 575,660

[1] Excludes acid made by Anaconda Copper Mining Co. Part of the acid made by this company in 1931 and 1932 was from pyrites concentrates and all of the acid made in 1933 and 1934 was from this source.
[2] Excludes acid made from pyrites concentrates in Tennessee.

A small amount of byproduct sulphur is produced annually incident to the purification of manufactured fuel gas. In 1934, 1,500 long tons of sulphur were produced from this source. Only a minor part of the output is marketed; the remainder is stored or accumulated in dumps at the various plants. Such output is not included in the sulphur production figures for the United States.

Consumption.—The diversified application of sulphur in industry tends to preserve a consumption commensurate with the general rate of business activity, as is illustrated in figure 139, which compares the index of domestic sulphur consumption with that of industrial production as established by the Federal Reserve Board.

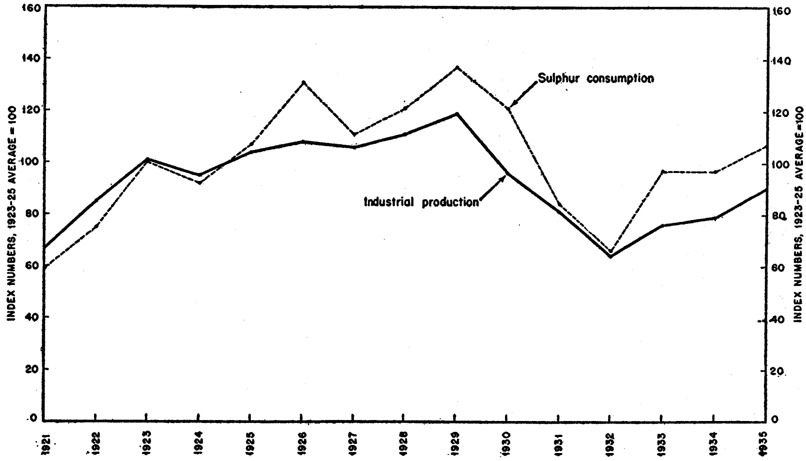

FIGURE 139.—Comparison of index of apparent domestic sulphur consumption with the Federal Reserve Board index of industrial production, 1921–35.

The apparent consumption of sulphur in 1935 was greater than in any year since 1930. The trend in sulphur consumption in the United States for the last 5 years is shown in the following table, in which it is assumed that stocks in consumers' hands are small and constant.

Apparent consumption of sulphur in the United States, 1931–35, in long tons

	1931	1932	1933	1934	1935
Shipments	1,376,526	1,108,852	1,637,368	1,613,838	1,634,990
Imports			4,773	5,839	1,763
	1,376,526	1,108,852	1,642,141	1,619,677	1,636,753
Exports:					
Crude	407,586	352,610	522,515	507,115	402,383
Refined	12,142	7,270	8,763	10,112	10,916
	419,728	359,880	531,278	517,227	413,299
Apparent consumption	956,798	748,972	1,110,863	1,102,450	1,223,454

The consumption of sulphur in the various domestic industries for the last 5 years has been estimated by Chemical and Metallurgical Engineering as follows:

Sulphur consumed in the United States, 1931–35, by uses, in long tons

Use	1931	1932	1933	1934	1935
Heavy chemicals	327,000	298,000			
Electrochemicals	16,000	13,000	491,000	512,000	596,000
Fine chemicals	12,000	10,000			
Fertilizer and insecticides	254,000	155,000	242,000	247,000	239,000
Pulp and paper	178,000	153,000	197,000	176,000	204,000
Explosives	39,000	27,000	37,000	43,000	42,000
Dyes and coal-tar products	39,000	34,000	40,000	34,000	39,000
Rubber	23,000	18,000	24,000	30,000	33,000
Paint and varnish	4,000	4,000	4,000	4,000	4,000
Food products	4,700	4,000	4,000	4,000	4,000
Miscellaneous	72,000	40,000	75,000	60,000	67,000
	968,700	756,000	1,114,000	1,110,000	1,228,000

Owing to extensive research the use of sulphur as an insecticide and fungicide is likely to increase in the future. Roark [2] has estimated that 30,000,000 pounds of sulphur dust and 43,000,000 pounds of lime-sulphur (dry basis, three-fourths sulphur) were consumed in the United States during 1934.

Production of sulphuric acid, the chief use of sulphur in the United States, increased slightly in 1935 over 1934, due to moderate increases in consumption in a rather wide range of industrial applications. Decreases, however, are noted in the two principal acid-consuming outlets, the fertilizer industry and the petroleum-refining industry, but in the former consumption was only slightly less than in 1934. More than half of the fertilizer made in the United States is phosphatic, and the bulk of this tonnage is superphosphate virtually all of which is made by treating phosphate rock with an equal quantity of sulphuric acid. Experiments by Jacob [3] and associates have developed a process for producing calcined phosphate which if applied to large-scale operation may reduce the cost, per unit of available phosphorus, below the present cost of superphosphate. Several small pilot plants are now in operation using this process. Typical superphosphate contains 16 to 20 percent available plant food, while calcined phosphate contains about 30 percent. Higher concentrations of phosphate, commonly called "triple superphosphate", have been made in the past but have not been well-received by farmers, who never clearly understood its economic utilization.[4] This product was made by treating phosphate rock with low-strength phosphoric acid, which in turn was made by treating phosphate rock with sulphuric acid. Although phosphoric acid has been produced in this country in the blast furnace and the electric furnace it has not been used to any great extent in fertilizer manufacture. During the past 2 years the Tennessee Valley Authority has been making higher-strength phosphate fertilizer utilizing phosphoric acid made in the electric furnace and has been testing the fertilizer on growing crops under various conditions in several Southern States.

[2] Roark, R. C., Insecticides and Fungicides: Ind. and Eng. Chem., vol. 27, no. 5, May 1935, p. 530.

[3] Jacob, K. D., Reynolds, D. S., and Marshall, H. L., Phosphate Fertilizers by Calcination Process—Volatilization of Fluorine from Phosphate Rock at High Temperatures: Am. Inst. Min. and Met. Eng. Tech. Pub. 695, 1936, pp. 1–14.

[4] Tennessee Valley Authority, Annual Report for the Fiscal Year Ended June 30, 1935: Washington, D. C., 1935, p. 60.

Consumption of sulphuric acid in the petroleum-refining industry, the second largest user of sulphuric acid, continued to decline in 1935 despite an increase in the production of motor fuel and lubricating oil. Technical developments in the refining of petroleum products tend to eliminate the use of sulphuric acid; moreover, the recovery of used acid from sludge has been given increasing attention. Solvent refining of lubricating oils, first begun in America 8 years ago, has been extended to the processing of a wide variety of crudes. From 1 plant in operation in 1930 the number has increased to 21 in operation and building in 1935.[5] The following table, which shows the consumption of sulphuric acid by industries from 1931 to 1935, is based largely on estimates by Chemical and Metallurgical Engineering. The figures on acid consumed by the fertilizer industry are supplied by the Bureau of the Census.

Sulphuric acid (expressed as 50° B.) consumed in the United States, 1931–35, by industries, in short tons [1]

Industry	1931	1932	1933	1934	1935
Fertilizer [2]	1,351,000	771,000	1,206,000	1,396,000	1,343,000
Petroleum refining	1,348,000	1,240,000	1,140,000	1,100,000	980,000
Chemicals	760,000	674,000	725,000	765,000	890,000
Coal products	570,000	375,000	468,000	535,000	585,000
Iron and steel	480,000	270,000	390,000	475,000	630,000
Other metallurgical	410,000	310,000	360,000	390,000	510,000
Paints and pigments	180,000	160,000	170,000	210,000	280,000
Explosives	175,000	120,000	140,000	180,000	175,000
Rayon and cellulose film	183,000	176,000	219,000	214,000	252,000
Textiles	81,000	75,000	90,000	75,000	90,000
Miscellaneous	262,000	230,000	223,000	250,000	285,000
	5,800,000	4,401,000	5,131,000	5,590,000	6,020,000

[1] Figures, except those for fertilizer industry, from Chem. and Met. Eng., February 1936, p. 83, and from earlier annual review issues.
[2] Bureau of the Census, Department of Commerce.

Plasticized sulphur made by the reaction of sulphur with organic sulphides, polysulphides, or polymers thereof has proved useful as a jointing material for clay products.[6]

Foreign trade.[7]—Imports of sulphur ore in 1935 were 1,763 long tons compared with 5,839 tons in 1934. Chile supplied the total quantities received in the United States in 1934 and 1935.

Exports were 402,383 long tons in 1935 compared with 507,115 tons in 1934, a decrease of 21 percent.

Sulphur imported into and exported from the United States, 1931–35

Year	Imports for consumption [1]		Exports			
			Crude		Crushed, ground, refined, sublimed, and flowers of	
	Long tons	Value	Long tons	Value	Long tons	Value
1931			407,586	$8,837,268	12,142	$431,785
1932			352,610	7,178,566	7,270	266,210
1933	4,773	$67,432	522,515	9,877,879	8,763	316,890
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

[1] From 1931 to 1932 classified as "sulphur and sulphur ore." Classified as "sulphur ore" from 1933 to 1935.

[5] American Petroleum Institute, American Petroleum Industry: New York, N. Y., 1935, p. 113.
[6] Rueckel, W. C., and Duecker, W. W., Plasticized Sulphur as a Jointing Material for Clay Products: Bull. Am. Ceram. Soc., vol. 14, no. 10, October 1935, pp. 329–332.
[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.

In addition to brimstone or crude sulphur the United States exports treated products, such as crushed, ground, refined, and sublimed sulphur and flowers of sulphur. Exports of these commodities in 1935 totaled 24,452,269 pounds valued at $418,532, an increase of 8 percent over 1934; the average value in 1935 was 1.71 cents per pound or about $38 per long ton.

Canada, despite a decrease of 18 percent from 1934, continued to be the best customer for American crude sulphur, taking 119,554 long tons or 30 percent of the total exports in 1935. United Kingdom with 14 percent, Australia with 12 percent, France with 11 percent, and Germany with 11 percent follow in order. Together these five countries imported 78 percent of the total crude sulphur shipped from the United States.

Sulphur exported from the United States in 1935, by destinations

Destination	Sulphur or brimstone		Crushed, ground, refined, sublimed, and flowers of	
	Long tons	Value	Pounds	Value
North America:				
Canada	119,554	$2,169,449	5,125,627	$101,023
Central America	112	3,682	191,783	5,387
Mexico	9,262	183,249	1,805,887	36,466
Newfoundland and Labrador	4,783	89,879	450	14
West Indies	6,295	116,458	219,169	6,642
Other			16,875	442
	140,006	2,562,717	7,359,791	149,974
South America:				
Argentina	5,500	106,000	3,163	835
Brazil	35	1,015	812,516	12,542
Colombia			276,218	7,145
Uruguay	507	11,423	641,860	15,118
Other			195,098	3,527
	6,042	118,438	1,928,855	39,167
Europe:				
Belgium			780,561	10,032
Denmark			931,977	12,441
France	45,455	855,300	584,677	7,953
Germany	42,839	868,464	1,787,214	24,051
Netherlands	19,714	398,404	731,275	8,771
Sweden	10,618	209,989	517,202	6,641
United Kingdom	56,252	1,023,326	2,698,488	33,255
Other	11,773	235,465	1,346,744	17,420
	186,651	3,590,948	9,378,138	120,564
Asia			1,090,730	17,807
Africa:				
Algeria and Tunisia	6,700	120,935		
Canary Islands			403,000	8,217
Mozambique			224,783	3,956
Union of South Africa			992,786	21,332
Other			265,384	5,034
	6,700	120,935	1,885,953	38,539
Oceania:				
Australia	46,348	880,789	2,554,743	44,341
New Zealand	16,636	308,466	251,509	8,082
Other			2,550	58
	62,984	1,189,255	2,808,802	52,481
	402,383	7,582,293	24,452,269	418,532

Canada is also the largest market for American treated sulphur taking 5,125,627 (21 percent of total) pounds in 1935; the United Kingdom with 2,698,488 pounds (11 percent) ranked second; and Australia with 2,554,743 pounds (10 percent) dropped from second to third place. Mexico and Germany followed in order; each required more than a million pounds in 1935.

Of the countries that received important quantities of American sulphur in 1935 only Germany, Australia, and New Zealand showed increases. Although shipments to Germany increased slightly over 1934 they were still far below the average for the 5-year period 1926–30. Shipments to New Zealand increased most, the sulphur being consumed largely in the manufacture of fertilizers, as in Australia. Canada and the other large consuming nations, located in Europe, required less sulphur in 1935 than in 1934. Shipments to France decreased most. Competition from pyrites and the production of byproduct sulphur in the treatment of sulphide ores and in the manufacture of industrial gases are tending to lower the demand for American sulphur in Europe.

THE INDUSTRY IN 1935, BY STATES

TEXAS

Texas, with an increase of 6 percent over 1934, accounted for 77 percent of the total output of domestic sulphur in 1935. The production was the largest since 1931. Seven operations contributed to the total, but the largest output came from the two properties 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 sulphur in Texas for 1935.

Sulphur produced in Texas in 1935, by companies, in long tons

Company	First quarter	Second quarter	Third quarter	Fourth quarter	Total
Texas Gulf Sulphur Co.	185,978	194,011	273,126	270,045	923,160
Freeport Sulphur Co.	61,630	72,815	66,410	63,145	264,000
Duval Texas Sulphur Co.	7,788	3,339	12,134	41,086	64,347
Baker & Williams		1,287	1,020		2,307
	255,396	271,452	352,690	374,276	1,253,814

Efforts to increase the tax on production of sulphur in Texas in 1935 were unsuccessful. The original proposal to increase the current tax of 75 cents to $2.25 per long ton was subsequently modified by increasing it to 90 cents a ton.

Texas Gulf Sulphur Co.—The bulk of the output of this company came from Boling Dome in Wharton County, which has been operated continuously since first production on March 20, 1929. Shipments began in 1935 from the smaller plant at Long Point, Fort Bend County, where production was normal during 1935. Shipments were also made from stocks at the original property of this company at Gulf, Matagorda County, which has been shut down for several years. Operations, however, were resumed on January 1, 1936, but unmined reserves may be exhausted after a relatively brief period of production.

Freeport Sulphur Co.—Operation at the Bryanmound property of this company were permanently discontinued on September 30 owing to exhaustion of reserves; approximately 5 million tons of sulphur had been produced at this property since the start of operation in 1912. Production was continued at Hoskins Mound during 1935.

Duval Texas Sulphur Co.—Operations at Palangana Dome in Duval County were discontinued in April 1935 after several years of production. The company, however, has started producing sulphur from its new plant on Boling Dome in Wharton County.

Baker & Williams.—This company produced a little sulphur from a new plant on Boling Dome in Wharton County during most of June and July 1935.

LOUISIANA

Production of sulphur in Louisiana in 1935 totaled 373,283 long tons, an increase of 62 percent over 1934. Output in the last half of the year was more than double that in the first half. The bulk of the output came from the Grande Ecaille plant of the Freeport Sulphur Co. A much smaller output was made by the Jefferson Lake Oil Co., Inc., in Iberia Parish.

Freeport Sulphur Co.—Continued application of the mudding process has improved working conditions at the Grande Ecaille property in Plaquemines Parish, and production was increased substantially in 1935. Output, according to the supervisor of public accounts, State of Louisiana, amounted to 348,810 long tons compared with 153,362 tons in 1934.

Jefferson Lake Oil Co.—This company continued to produce sulphur at the Jefferson Island salt dome but at a lower rate than in 1934. According to the Louisiana supervisor of public accounts, the output totaled 24,473 tons in 1935. O'Donnell has described the geology and mining operations at the Jefferson Island salt dome.[8]

CALIFORNIA

Three operators, all in Inyo County, reported production of sulphur in 1935. The largest producer was the West Coast Sulphur Co., which operated the Crater group of claims, 27 miles south of Oasis. Most of the sulphur was extracted from open pits, although there has been some underground work. The Sulphur Refineries, Inc., also produced sulphur from the Crater group in 1935. During the first part of the year this company constructed a sulphur refinery, but operations were closed down in August. The third producer, Sulphur Products Co., operated the Sulphur Queen mine situated some 4 miles southwest of the Crater group.

UTAH

Sulphur production was reported from Utah in 1935 after no production in 1934. The output came from the Utah Sulphur Industries plant at Beaver in Beaver County. It was reported in 1935 that Utah Sulphur, Inc., was about to develop sulphur deposits near Green River, Emery County.

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[8] O'Donnell, Lawrence, Jefferson Island Salt Dome, Iberia Parish, La.: Bull. Am. Assoc. Petrol. Geol., vol. 19, no. 11, November 1935, pp. 1602–1644.

WORLD PRODUCTION

World production of sulphur in 1935, including elemental sulphur recovered in the treatment of pyrites and from gas manufacture in Germany, amounted to 2,340,000 long tons. The following table shows the output of the principal producing countries during the last 5 years.

Production of sulphur in the principal producing countries, 1931–35, in long tons

[Compiled by M. T. Latus]

Country	1931	1932	1933	1934	1935
Chile	5, 018	11, 770	12, 558	20, 356	(1)
Italy [2]	348, 132	344, 450	370, 676	337, 966	365, 536
Japan [3]	60, 528	83, 195	112, 619	126, 395	(1)
Spain [4]	10, 867	8, 113	27, 128	31, 130	(1)
United States	2, 128, 930	890, 440	1, 406, 063	1, 421, 473	1, 632, 590

[1] Data not available.
[2] In addition, the following quantities of ground rock are reported: 1931, 19,502 tons; 1932, 25,119 tons; 1933, 24,569 tons; 1934, 21,820 tons; 1935, 13,538 tons.
[3] In addition, the following quantities of sulphur rock are reported: 1931, 2,195 tons; 1932, 2,591 tons; 1933, 2,657 tons. Similar data are not available for 1934 and 1935.
[4] Refined sulphur, exclusive of that made from imported crude sulphur.

Italy.—Preliminary reports indicate that the production of sulphur in Italy in 1935 was 365,536 long tons compared with 337,966 tons in 1934. About 70 percent of the Italian output in 1935 came from the Island of Sicily and the remaining 30 percent from mines on the mainland. In addition, 13,538 tons of ground sulphur ore for use in viticulture were produced in 1935 compared with 21,820 tons in 1934. Exports from Italy for the first 9 months of 1935 were 203,124 tons compared with 215,481 tons for all of 1934.

With the establishment of the Central Sulphur Sales Bureau (Officio Vendita di Zolfo) late in 1933 the Government guaranteed producers a preestablished minimum price for their product within the quotas established for each mine. Sulphur production in Italy is limited by law to 347,000 metric tons (Sicily 240,000 tons and continent 107,000), but increased supplemental quotas were established for the fiscal year 1934–35 that permitted a larger production (Royal Decree Law 2059, Dec. 13, 1934). Royal Decree Law 1312 of June 27, 1935, extended the sulphur subsidy through the fiscal years 1935–36 and 1936–37 but at slightly lower rates, as follows:

Grade:	*Lire per ton*
Superior yellow	280
Inferior yellow	270
Good	258
Ordinary	250

The decree also provides for an annual appropriation of 30,000,000 lire for the 2 fiscal years to meet any differences between the guaranteed minimum price and the sales price realized in the world market. The production quota for each mine during the fiscal years 1935–36 and 1936–37 will be calculated on the basis of the normal production quota, exclusive of supplementary quotas, assigned to each mine in 1934–35. Mines that did not take up their full quota in 1934–35 will be penalized and a certain percentage of their quota distributed among the more active mines.

The sale of the 1935–36 quota from the sulphur stocks taken over from the Sicilian Sulphur Consortium is suspended, but should the tonnage of sulphur sold and delivered by the Sales Bureau during 1935–36 exceed deliveries to the Sales Bureau by producers the excess will be considered as having been sold out of the 1935–36 sales quota of the old consortium stocks. Stocks of sulphur in Italy are about 200,000 tons, and if production is continued at the present rate these stocks will be nearly doubled by the end of 1936.

On October 15, the Central Sulphur Sales Bureau (Officio Vendita di Zolfo) made an agreement with the Sulphur Export Corporation of America by which the past agreement[9] as to sales quotas in Europe would be maintained after sanctions against Italy were lifted. Meanwhile the Sulphur Export Corporation will supply the sanctionist countries, and Italy will supply the full requirements of Germany, Austria, and Hungary and will continue to export to Argentina, Brazil, and Switzerland.

Japan.—Sulphur production in Japan has been increasing during the past several years, and it is estimated that output in 1935 reached 148,000 long tons, the largest on record. Exports were also much larger, amounting to 53,743 tons in 1935 compared with 44,988 tons in 1934 and 31,607 tons in 1933.

The sulphur-mining industry of Japan has been described by Akagi.[10]

Norway.—The sulphur produced in Norway comes from the treatment of cupreous pyrites at the Thamshavn plant of the Orkla Metal Co., a subsidiary of the Orkla Mining Co. Data on the output in 1935 are not yet available, but it is estimated at 65,000 long tons. It was reported during the year that the capacity of this sulphur plant will be increased to 150,000 tons of sulphur annually. The enlarged works will absorb 400,000 tons of the company pyrites production. Exports of sulphur from Norway in 1935 totaled 65,125 tons compared with 63,766 tons in 1934.

The following table, compiled from official sources, shows imports and exports of sulphur in Norway from 1930 to 1935.

Sulphur imported into and exported from Norway, 1930–35, in long tons [1]

Year	Imports	Exports			Year	Imports	Exports		
		Domestic	Other	Total			Domestic	Other	Total
1930	16,480	1,339	199	1,538	1933	7,831	58,950		58,950
1931	6,347	6,393		6,393	1934	10,997	63,766		63,766
1932	11,138	46,116	1	46,117	1935	14,149	65,125		65,125

[1] Manedsopgaver over Vareomsetningen med Utlandet.

Spain.—The output of sulphur in Spain was 31,130 long tons in 1934 compared with 27,178 tons in 1933 and 8,113 tons in 1932. Increased output in Spain during 1933 and 1934 was due to production of sulphur from pyrites in the Huelva district by the Rio Tinto Co., which produced 17,694 tons or 57 percent of the total Spanish

[9] Ridgway, Robert H., and Mitchell, A. W., Sulphur and Pyrites: Minerals Yearbook, 1935, Bureau of Mines, pp. 1011 and 1021–1022.
[10] Akagi, T., Sulphur-Mining Industry in Japan: Jour. Geog., vol. 47, no. 560, October 1935, pp. 475–486, and vol. 47, no. 561, November 1935, pp. 523–538.

output in 1934. The plant has an annual capacity of 27,000 tons of sulphur. Sulphur is also produced in Albacete, Almeria, Murcia, and Teruel. The geology of the producing deposits in Almeria, operated by the Tigon Mining & Finance Corporation, Ltd., has been studied by Williams [11] who concluded as follows regarding the origin of the sulphur:

> The sulphur is epigenetic, being due in part to interaction between ascending sulphuretted solutions and carbonate rocks and in part to the incomplete oxidation of hydrogen sulphide through the agency of atmospheric oxygen.

Exports of sulphur from Spain were 13,173 long tons in 1935 compared with 2,942 tons in 1934. The change in the position of Spain in the world sulphur market is illustrated in the following table.

Sulphur imported into and exported from Spain, 1932–35, in long tons

Year	Imports	Exports
1932	10,351	826
1933	3,954	900
1934	675	2,942
1935	5	13,173

Chile.—The output of sulphur in Chile, which has been increasing during the past few years, amounted to 20,356 long tons in 1934. Production in 1935 may drop owing to the shut-down of one of the large plants, but in coming years it is expected that an even greater increase will be realized. The Government, through the Mining Credit Institute (Caja de Credito Minero), has assisted the sulphur industry wherever possible and is now building a flotation plant near Ollagüe which will have a capacity of 250 to 300 tons a day. Sulphur exports from Chile, although small compared with those of the United States or Italy, were 14,822 tons in 1935, a slight decrease from the 17,083 tons shipped in 1934. Sixty-four percent of the total exports in 1935 went to other countries in South America and the bulk of the remainder to Europe.

Large deposits of sulphur are known to exist in Northern Chile near the Bolivian frontier, but lack of transportation facilities has hampered development. The only two producing areas are those around Mount Tacora in Arica Province and near Ollagüe in Antafagasta Province. The principal producer is the Cia. Azufrera y Minera del Pacifico, a subsidiary of the Tigon Mining & Finance Corporation, which operates on Mount Tacora. This property, which produced nearly half of the 1934 output, has run regularly for several years but was closed down in August 1935, ostensibly for installation of new equipment. The second largest Chilean producer in 1934 was the Sociedad Industrial Azufrera Minera Carrasco, S. A. The mine is located on Mount Aucanquilcho, and the caliche (sulphur ore) is trucked 20 kilometers to the company refinery at Ollagüe on the Antafagasta-Bolivia Railway. The plant has been in continuous operation for several years. The two operations produced 73 percent of the total output in 1934; seven other operations contributed the remaining tonnage.

[11] Williams, D., Sulphur Deposits of the Sierra de Gador, Province of Almeria, Spain: Inst. of Min. and Met., Bull. 378, Mar. 12, 1936, pp. 1–29.

Portugal.—The production of elemental sulphur from pyrite at the San Domingos mine in the Province of Alemtejo was begun in 1935. Output amounted to 8,566 long tons. Imports of sulphur in 1935 were 3,207 tons.

Germany.—Germany has no deposits of native sulphur, and in the past its requirements have been met by imports, largely from the United States. Much of the sulphur imported into Germany is transshipped to nearby countries. Although German imports were 60,095 long tons in 1935, exports were only 24,823 tons, giving a net import of 35,272 tons.

In recent years, production of byproduct sulphur from the manufacture of various industrial gases has been increasing, and half of Germany's requirements in 1934 and 1935 were met from domestic sources. Output in 1935 may reach 34,000 long tons. Kohl [12] has shown the estimated production by sources from 1930 to 1934 as follows:

German production of sulphur, 1930–35, in metric tons

Source	1930	1931	1932	1933	1934	1935 [1]
Sulphide ores	22	13	17	18	29	30
Heavy spar [2]	4,250	4,250	4,250	4,250	4,250	4,250
Coal:						
Gas:						
Purification mass	2,000	2,000	8,000	11,000	11,000	12,000
Thylox method	0	1,000	1,000	2,000	3,000	5,000
Coke	480	480	480	480	480	500
Lignite gas [3]	4,500	5,500	6,500	[4] 7,500	9,000	13,000
Total (approximate)	11,250	13,240	20,250	25,250	27,760	34,800

[1] Estimate, Lester L. Schnare, consul, Hamburg, Germany.
[2] 4,000 to 4,500 tons.
[3] For 1930–32, estimated.
[4] 7,000 to 8,000 tons.

Although production of sulphur in Germany has been impeded by a drop in world price due largely to depreciation of the dollar, difficulties as to foreign exchange and the desire to become independent of raw materials have stimulated domestic production. Thus, it appears likely that German production will continue to increase materially, with Government aid if necessary. An improvement in price in the international market would further sulphur development.

Sweden.—The production of elemental sulphur in Sweden in 1935 is expected to reach 10,000 long tons.[13] The entire output comes from the Boliden mines where sulphur is produced as a byproduct in the treatment of sulphide ores. By midyear in 1935, the construction of the new sulphur-recovery plant had advanced to a point where three furnaces were operating, and four additional units were being completed.

Turkey.—It has been estimated [14] that the sulphur mines belonging to the Sumer Bank and the Ish Bankassi at Kechiboriu produced 5,000 tons during 1935. The deposit is reported to be 2 to 20 meters thick and to contain 20 to 40 percent sulphur.

Other countries.—Less important quantities of sulphur are produced in Argentina, Bolivia, China, Ecuador, Greece, Mexico, Netherland East Indies, New Zealand, Southern Rhodesia, and the U. S. S. R. (Russia). Exploration for sulphur was reported in Costa Rica, Mexico, Nicaragua, and Palestine.

[12] Kohl, E., Deutschlands Versorgung mit elementarem Schwefel aus heimeschen Quellen: Ztschr. Berg-Hütten-und Salinenwesen im deutschen Reich, vol. 83, no. 1, April 1935, pp. 15–19.
[13] Industrial and Engineering Chemistry (News Edition), vol. 13, no. 16, Aug. 20, 1935, p. 33.
[14] Crushing-Grinding-Mining-Quarrying Journal (London), vol. 3, no. 2, July-August 1935, p. 85.

PYRITES

Domestic production.—Production of pyrites (ores and concentrates) in the United States totaled 506,215 long tons in 1935, an increase of 17 percent over the output of 432,524 tons in 1934. The following table gives production during the past 5 years.

Pyrites (ores and concentrates) produced in the United States, 1931–35

Year	Quantity		Value	Year	Quantity		Value
	Gross weight (long tons)	Sulphur content (percent)			Gross weight (long tons)	Sulphur content (percent)	
1931	330,848	36.7	$974,820	1934	432,524	38.8	$1,216,363
1932	189,703	35.0	498,570	1935	506,215	39.4	1,569,672
1933	284,311	37.9	769,942				

Of the total output in 1935, 97,011 long tons were lump and the remainder fines, the bulk of the latter being flotation concentrates. The sulphur content of the pyrites produced in 1935 was 39.4 percent (199,457 tons of sulphur) compared with 38.8 percent (167,645 tons) in 1934.

The quantity of pyrites (ores or concentrates) sold or consumed by producing companies totaled 504,825 long tons in 1935 compared with 431,340 tons in 1934. In 1935, 155,934 tons were sold by producers, all to domestic consumers. The prices of pyrites quoted by the trade journals are those for imported pyrites and are given in cents per long-ton unit of sulphur c. i. f. Atlantic ports; the average quoted was 12 to 13 cents per long-ton unit throughout the year.

Tennessee was the principal producing State in 1935; other producers were California, Colorado, Illinois, Kansas, Missouri, Montana, New York, Virginia, and Wisconsin.

THE INDUSTRY IN 1935, BY STATES

California.—The Mountain Copper Co. was the only producer of pyrites in California in 1935. The output came from the Hornet mine in Shasta County.

Colorado.—Shipments of pyrites continued from the mill-tailings dump of the Colorado Zinc-Lead mill in Lake County during 1935. The pyrites, which averaged 35 percent sulphur, was shipped to the Denver plant of the General Chemical Co., where it is used in the manufacture of sulphuric acid.

Illinois.—Output of coal brasses in Illinois in 1935, the first in a number of years, amounted to 1,114 long tons. It was produced by the Peabody Coal Co. from the mine-tipple waste of a group of six mines in Christian and Sangamon Counties. The mine pickings were assembled at a breaker at Carter, where the pyrites is hand-picked from the other refuse and shipped. The product, which was lump, contained about 42 percent sulphur.

Kansas.—The Pittsburg & Midway Coal Mining Co., produced a small quantity of coal brasses in Kansas in 1935 from West Mineral in Cherokee County, where a new concentrating plant having a capacity of 50 tons of mine refuse per hour was being built. The product, which was minus 60-mesh, contained 48 percent sulphur. The Mineral Products Co. was formed to treat the coal-mine refuse of the Pittsburg & Midway Co.

Missouri.—Three operators in Phelps County, two in Crawford County, and one in Franklin County reported a production of 24,883 long tons of pyrites in 1935, whereas seven operators produced 14,557 tons in 1934. The largest output came from Thomas and Williams, who operated the Mozell no. 10 mine in Phelps County.

The bulk of the pyrites produced in Missouri is marcasite, and the sulphur content ranges from 41 to 49 percent; the average sulphur content of the 1935 production was 48 percent. The output in 1935 was shipped to the Titanium Pigment Co. at St. Louis, Mo., where it was roasted for acid manufacture.

Montana.—The pyrites produced in Montana in 1935 came from the Anaconda Copper Mining Co. at Anaconda, Mont., where it is recovered as a flotation concentrate in the copper-plant operation.

New York.—During 1935 the St. Joseph Lead Co. produced 48,905 long tons of pyrites concentrates at its Balmat mine in St. Lawrence County. The pyrites, which ran 49.7 percent sulphur, 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 1935 came from operations of the Tennessee Copper Co. and the Ducktown Chemical & Iron Co., both in the Ducktown Basin, Polk County. The pyrites from Tennessee is a flotation concentrate and does not enter the market, as both companies use all their product in the manufacture of sulphuric acid.

Virginia.—The only pyrites mined in Virginia in 1935 came from the Gossan mine at Cliffview, Carroll County, operated by the General Chemical Co. The ore, both lump and fines, is mined by underground methods and is used in the manufacture of sulphuric acid in the company plant at Pulaski.

Wisconsin.—The only company reporting pyrites production in Wisconsin in 1935 was the Vinegar Hill Zinc Co., in Grant County, which makes a pyrites concentrate at its magnetic separation plant at Cuba City from several mines in the Platteville district.

FOREIGN TRADE [15]

Imports of pyrites were 397,113 long tons in 1935 compared with 366,315 tons in 1934. The 1935 figure is the largest since 1929. No pyrites was exported in 1934 or 1935. The following table shows imports from 1931 to 1935, by countries of origin.

Pyrites, containing more than 25 percent sulphur, imported into the United States, 1931–35, by sources

Country	1931		1932		1933		1934		1935	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Canada	24,245	$109,440	12,070	$53,618	29,970	$131,940	19,341	$83,086	9,888	$45,965
Mexico									85	430
Spain	327,771	1,386,457	241,178	637,526	341,878	995,551	346,974	1,162,574	387,140	1,266,606
U. S. S. R. (Russia)	50	300			2,569	4,646				
	352,066	1,496,197	253,248	691,144	374,417	1,132,137	366,315	1,245,660	397,113	1,313,001

[15] 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 customs districts into which pyrites has been imported during the last 5 years are shown in the following table.

Pyrites, containing more than 25 percent sulphur, imported into the United States, 1931–35, by customs districts, in long tons

Customs district	1931	1932	1933	1934	1935
Buffalo	114	----------	----------	44	94
Chicago	----------	----------	----------	----------	2,704
Georgia	5,628	----------	4,006	3,530	4,002
Los Angeles	----------	----------	----------	----------	848
Maryland	125,559	100,434	136,113	162,183	182,333
New York	55,225	33,596	54,536	46,358	56,725
Ohio	----------	----------	----------	12,668	----------
Philadelphia	128,650	95,640	135,392	116,361	129,793
San Diego	----------	----------	----------	----------	85
South Carolina	5,053	4,008	6,700	11,541	7,681
Vermont	24,131	12,070	28,446	6,629	6,242
Virginia	7,706	7,500	7,700	7,001	6,606
Washington	----------	----------	1,524	----------	----------
	352,066	253,248	374,417	366,315	397,113

If the recoverable sulphur content of the imported pyrites is considered as 45 percent, the quantity of sulphur available in imported pyrites in 1935 was approximately 180,000 long tons.

WORLD PRODUCTION

The following table shows world production of pyrites and the quantity of sulphur it is supposed to replace in the market. 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), 1933–35, in metric tons

[Complied by M. T. Latus]

Country [1]	1933		1934		1935	
	Gross weight	Sulphur content	Gross weight	Sulphur content	Gross weight	Sulphur content
Algeria	16,090	7,401	13,600	6,270	12,350	5,681
Australia (Tasmania)	1,522	[2]	12,223	[2]	25,965	[2]
Canada	53,164	25,563	10,040	4,990	[2]	[2]
Chosen	14,518	[2]	40,024	[2]	[2]	[2]
Cyprus [3]	213,340	106,670	152,606	76,303	[2]	[2]
Czechoslovakia	15,426	6,479	17,920	7,527	[2]	[2]
Finland	37,798	16,612	71,167	32,950	[2]	[2]
France	168,422	77,000	155,113	69,091	[2]	[2]
Germany	189,647	81,575	230,149	99,065	[2]	[2]
Greece	184,442	89,748	[2]	[2]	[2]	[2]
Italy	732,701	335,724	812,396	379,605	825,328	[2]
Japan	[4] 852,019	[4] 340,808	1,057,266	422,906	[2]	[2]
Norway	864,576	382,738	960,898	424,718	[2]	[2]
Poland	1,228	540	11,996	5,278	[2]	[2]
Portugal	210,660	100,000	220,869	103,808	[2]	[2]
Rumania	12,112	[2]	4,001	[2]	[2]	[2]
Southern Rhodesia	11,080	4,471	11,714	4,674	12,232	[2]
Spain	2,223,472	933,858	2,072,413	817,413	[2]	[2]
Sweden	86,295	33,489	100,572	40,084	[2]	[2]
Union of South Africa	3,664	[2]	15,767	[2]	[2]	[2]
U. S. S. R. (Russia)	378,200	[2]	381,900	[2]	[2]	[2]
United Kingdom	1,150	[2]	2,179	[2]	[2]	[2]
United States	288,874	109,508	439,466	170,336	514,340	202,658
Yugoslavia	20,077	9,035	22,513	10,131	[2]	[2]

[1] In addition to countries listed, Belgium reports production, but figures are not shown separately.
[2] Data not available.
[3] Exports.
[4] Incomplete. Output of more important mines only.

Spain.—Figures for the production of pyrites in 1935 in Spain, the principal world producer, are not yet available, but exports were slightly less than in 1934. Exports of iron pyrites decreased to 1,807,833 metric tons in 1935 from 1,820,438 tons in 1934. Exports of cupreous iron pyrites containing 1.5 to 5 percent copper but more than 45 percent sulphur declined from 248,698 tons in 1934 to 186,726 tons in 1935.

Portugal.—The production of pyrites in Portugal was 201,450 metric tons in 1935 compared with 205,670 tons in 1934. Exports, however, dropped considerably, amounting to only 123,961 tons in 1935 compared with 229,888 tons in 1934. The San Domingos mine in Alemtejo Province, the principal producer, should benefit by the improvement in shipping facilities upon completion of the Port works at Vila Real de San Antonio now in the process of construction. In the past the company has spent large sums annually in keeping the river channels open to enable the pyrites to be loaded at Pomorao.

Norway.—Production of pyrites is the principal mining industry of Norway, the third largest world producer of this commodity. The production figure for 1935 is not yet available, but it is believed that output will decrease slightly from the record figure of 960,898 tons in 1934. The output of the largest producer, the Orkla-Grube-Aktiebolag, was about 500,000 tons of cupreous iron pyrites containing about 43 percent sulphur and 2.3 percent copper. About 200,000 tons [16] of the company output is now treated at the Thamshavn smelter to produce 70,000 tons of sulphur and 12,000 tons of 35 percent copper matte. The remaining 300,000 tons are exported. The Thamshavn smelter is to be enlarged to treat 400,000 tons of pyrites annually, which will reduce the company exports to 100,000 tons. Exports from Norway decreased slightly in 1935 to 601,355 metric tons, of which 294,547 tons were cupreous and 306,808 tons contained little copper.

Japan.—Japan is an important producer of pyrites, but the entire output is consumed locally. Production in recent years has been stimulated by an increased demand for sulphuric acid, and Japan is now the second largest pyrites producer; output in 1934 totaled 1,057,266 metric tons, a large increase over 1933.

Italy.—According to preliminary figures the production of pyrites in Italy was 825,328 metric tons in 1935 compared with 812,396 tons in 1934.

Virtually the entire Italian pyrites industry is in the hands of the Societa di Montecatini. The principal mines are near Gavoranno in Tuscany, at Agardo near Belluno in Venitia, and at Brosso in Piedmont. The Gavoranno deposits are large, irregular bodies up to 50 meters thick and a few hundred meters in length and depth, occurring at the contact of a granite intrusive with tertiary limestone beds. There are three mines in Tuscany—Gavoranno, Ravi, and Boccheggiano. Present production is about 650,000 tons a year containing 46 percent sulphur. The mines are developed by underground methods, and reserves are estimated at 8,200,000 tons of positive and 8,340,000 tons of probable ore. A much smaller annual production comes from the Agardo deposit, which consists of a single mass 60 by 100 meters in section and 600 meters in length; reserves are estimated at 500,000 tons. The ore, which is extracted by under-

[16] The Mining Journal (London), Norway in 1935: Vol. 192, no. 5245, Feb. 29, 1936, p. 213.

ground methods, averages 42 percent sulphur and 1 percent copper, but in places the copper runs as much as 3 or 4 percent. Production in 1933 was 30,000 tons. The deposits at Brosso consist of lenticular beds of pyrite interstratified in mica schists. The largest of these masses is at the Santa Maria mine, where the bed is 130 meters thick. This mine has an annual production of 35,000 tons, or about two-thirds of the output of the district. The ore contains one-half to 2½ percent copper and 39 percent sulphur, and reserves are estimated at 500,000 tons.

In addition to the mines mentioned, there are numerous small pyrites mines both on the continent and in Sardinia.

Some of the Italian pyrites is exported, but Italy also imports pyrites, chiefly from nearby Mediterranean countries. This import and export trade is made possible by varying costs of transportation from mines to plants.

The recovery of pyrites sinter, which is used as an ore of iron, is important in evaluating the pyrites industry of Italy. Probably as much as 400,000 metric tons of pyrites sinter was produced and consumed in Italy in 1935, and there are large stocks at the sulphuric acid plants. Each ton of pyrites roasted for sulphuric acid production yields about 0.7 ton of sinter carrying 56 to 58 percent iron. Italy's dearth of iron ores is well known, and the increased use of pyrites sinter makes the domestic iron and steel industry less dependent on foreign sources of raw material. In addition, Italy exports considerable sinter; in 1934, 85,584 metric tons were exported.

Yugoslavia.—The production of pyrites in Yugoslavia in 1935 totaled 80,000 [17] metric tons, a large increase over the 26,000 tons produced in 1934. Pyrites is produced principally as a byproduct concentrate in the treatment of base-metal ores by the Trepca Mines, Ltd., near Kos Mitrovica. Production of pyrites by this company amounted to 39,340 metric tons for the fiscal year ended September 30, 1935, and sales were 38,288 tons compared with 9,337 during the preceding fiscal year. The concentrates were delivered to chemical works in Yugoslavia, Austria, Hungary, and Holland.

During 1935 a company was formed in London [18] with a capital of £100,000 to reopen the old pyrites mine at Bakovici near Fojniza.

Canada.—Production of pyrites in Canada in 1935 totaled 26,494 metric tons containing 13,174 tons of sulphur compared with 10,040 tons containing 4,990 tons of sulphur in 1934. Of the total output, 12,848 tons containing 6,488 tons of sulphur came from British Columbia and 13,646 tons containing 6,686 tons of sulphur from Quebec. In addition, a considerable tonnage was produced and stored in Quebec, and 20,156 tons of auriferous pyrite concentrate were shipped to the Tacoma smelter from British Columbia for metal content only.

Output from British Columbia came from the Britannia mill, where pyrites concentrate is produced in the treatment of ores for the extraction of copper.

Quebec's production in 1935 came from the Eustis mine of the Consolidated Copper & Sulphur Co. In 1934 the Eustis mine produced 65,053 metric tons of ore averaging 3.712 percent copper and 32.1 percent iron, a small amount of silver, and a trace of gold. The

[17] Die chemische Industrie, Jugoslawien: Jahrg. 59, no. 15, Apr. 11, 1936, p. 307.
[18] Metal Bulletin, London, English Mining Interest in Bosnio: No. 2001, June 28, 1935, p. 4.

ore is mined by shrinkage stopes, and costs per ton of the ore hoisted in 1934 have been given as $2.0974 per ton.[19] The Eustis ore, which in 1934 averaged 10 percent chalcopyrite and 56 percent iron pyrites, is treated in the concentrator at the rate of 250 tons per day.[20] It is treated by preferential flotation. First, the copper sulphides are floated and the iron pyrites is depressed, then the iron pyrites is reactivated and floated. In 1934 about 70 percent of the iron content of the ore was recovered as pyrites concentrate containing 49.173 percent sulphur. The output of pyrites was 33,498 tons in 1934.

Canada is an important producer of sulphur in the form of sulphuric acid from smelter gases. In 1935, 48,012 metric tons of sulphur were recovered as acid manufactured from smelter gases at Copper Cliff, Ontario, and at Trail, British Columbia. Elemental sulphur is also being recovered from smelter gases at Trail.

[19] Snow, Fred W., and Brownhill, H. F., Mining Methods and Costs at the Eustis Mine: Canadian Min. and Met. Bull. 286, February 1936, p. 85.
[20] Baxter, H. A., and Snow, Fred W., Milling Methods and Costs at Eustis Concentrator: Canadian Min. and Met. Bull. 286, February 1936, pp. 86–97.

FULLER'S EARTH

By W. W. Adams and R. W. Metcalf

SUMMARY OUTLINE

In 1935 the production of fuller's earth in the United States increased notably both as to quantity and value, with a higher average selling price per ton. Operations generally were more successful than at any time since 1930, when production was larger than at any time since the mining of fuller's earth on a commercial scale was begun in Florida in 1895. Compared with 1934 reports from producing companies for 1935 revealed an increase of 3.4 percent in total output, 7 percent in total value at the mines, and 3.4 percent in the average value per ton.

The total quantity of fuller's earth produced in the United States during 1935 was 227,745 short tons valued at $2,230,229, an average of $9.79 per ton. The chief facts of interest in connection with the year's operations, together with comparative data for 1934, are shown in the following table.

Salient statistics of the fuller's earth industry in the United States, 1933–35

	1933	1934	1935	Percent of change in 1935 from 1934
Sold or used by producers:[1]				
Short tons	224,152	220,264	227,745	+3.4
Value	$2,080,640	$2,085,081	$2,230,229	+7.0
Average per ton	$9.28	$9.47	$9.79	+3.4
Distribution of domestic production, by uses:				
Bleaching, clarifying, decolorizing, or filtering—				
Mineral oils:				
Short tons	206,100	201,902	202,525	+0.3
Percent of total	92.0	91.7	88.9	
Vegetable oils and animal fats:				
Short tons	15,765	16,281	21,496	32.0
Percent of total	7.0	7.4	9.4	
Miscellaneous uses:				
Short tons	2,287	2,081	3,724	+79.0
Percent of total	1.0	0.9	1.6	
Imports:				
Unwrought or unmanufactured:				
Short tons	17	34	137	+302.9
Value	$260	$406	$1,873	+361.3
Wrought or manufactured:				
Short tons	4,078	4,278	2,798	−34.6
Value	$42,050	$53,145	$35,350	−33.5
Total imports:				
Short tons	4,095	4,312	2,935	−31.9
Value	$42,310	$53,551	$37,223	−30.5
Exports:				
Short tons	4,870	6,740	8,160	+21.1
Value	$38,255	$61,974	$81,231	+31.1

[1] Does not include untreated bentonite reported as used for filtering purposes.

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All of the plants, except one, that produced in 1934 were active in 1935; three new plants were opened, and one plant that had been idle for several years was reopened. The 19 plants that were productive during 1935 were situated in 8 States. Three western States—Texas, Colorado, and Nevada—in which eight plants were operated, produced 49,036 tons valued at $481,083, an average of $9.81 per ton. The larger part of the year's output (78 percent of the total), 178,709 tons valued at $1,749,146 (an average of $9.79 per ton), came from 11 plants operating in five States, east of the Mississippi, namely, Florida, Georgia, Illinois, Indiana, and New Jersey. Of 15 plants that reported production in both 1934 and 1935, 11 reported an increase in output in 1935.

Production of fuller's earth in the United States, 1933–35, by States

State	1933		1934		1935	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	266	$2,028	(1)	(1)		
Florida and Georgia	153,703	1,426,979	148,319	$1,407,380	145,236	$1,491,764
Nevada	5,974	61,571	(1)	(1)	(1)	(1)
Texas	31,893	308,096	32,763	325,397	40,925	391,641
Other States [2]	32,316	281,966	39,182	352,304	41,584	346,824
	224,152	2,080,640	220,264	2,085,081	227,745	2,230,229

[1] Included under "Other States."
[2] 1933: Colorado and Illinois; 1934: Alabama, Colorado, Illinois, Indiana, and Nevada; 1935: Colorado, Illinois, Indiana, Nevada, and New Jersey.

Definition.—Fuller's earth is a mineral substance resembling clay and having physical properties that make it capable of removing basic colors from solution in mineral, vegetable, or animal oils. The name does not imply any particular chemical composition but was derived from the use to which the earth was formerly put by fullers to full or scour and cleanse cloth of grease and by furriers to remove grease from fur. For statistical purposes the Bureau of Mines classes as fuller's earth all natural bleaching or filtering claylike materials that have high adsorptive capacity without previous chemical treatment for activation. Hatmaker and Middleton [1] have supplied an interesting description of the physical and chemical properties of fuller's earth and of the qualities the material should possess to insure satisfactory clarifying of oils and fats.

Uses.—Nearly 90 percent of the fuller's earth produced during 1935 was used in the filtering of mineral oils, and more than 9 percent was used in the treating of vegetable oils and animal fats. Less than 2 percent of the total amount produced was employed for miscellaneous purposes. During the past 5 years the amount used in clarifying mineral oils has been from 94.4 to 88.6 percent of the total output. During the same years 4.9 to 9.4 percent of the total quantity produced was used in treating vegetable oils and animal fats; the proportion so used has increased within the past few years, while the percentage used in treating mineral oils, though representing much larger absolute quantities, has decreased slightly.

[1] Hatmaker, Paul, and Middleton, Jefferson, Fuller's Earth: Mineral Resources in the United States, 1931, Bureau of Mines, pt. 2, pp. 73–98.

Fuller's earth sold or used by producers in the United States, 1927–35, 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
1927	243,009	(1)	15,363	(1)	6,106	(1)	264,478	$3,767,038
1928	258,645	$3,579,273	24,288	$277,197	4,079	$39,521	287,012	3,895,991
1929	301,607	4,164,093	10,685	112,902	3,691	32,728	315,983	4,309,723
1930	326,087	4,220,751	8,312	93,367	1,245	12,587	335,644	4,326,705
1931	272,177	2,883,074	14,133	159,073	2,090	13,423	288,400	3,055,570
1932	208,715	2,034,955	17,248	177,016	2,346	15,756	228,309	2,227,727
1933	206,100	1,896,501	15,765	169,186	2,287	14,953	224,152	2,080,640
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
	PERCENT OF TOTAL							
1927	91.9	(1)	5.8	(1)	2.3	(1)	100	100
1928	90.1	91.9	8.5	7.1	1.4	1.0	100	100
1929	95.4	96.6	3.4	2.6	1.2	.8	100	100
1930	97.1	97.5	2.5	2.2	.4	.3	100	100
1931	94.4	94.4	4.9	5.2	.7	.4	100	100
1932	91.4	91.4	7.6	7.9	1.0	.7	100	100
1933	92.0	91,2	7.0	8.1	1.0	.7	100	100
1934	91.7	90.8	7.4	8.5	.9	.7	100	100
1935	88.9	88.6	9.4	10.0	1.6	1.3	100	100

1 Figures not available.

REVIEW BY STATES

Colorado.—The output of fuller's earth in Colorado in 1935 was produced in Mineral and Weld Counties.

Florida.—From 1895 through 1935 Florida has been a consistent and important producer of fuller's earth. Florida led in production until 1924; since then it has ranked second to Georgia. The output of the State in 1935 was from Gadsden and Marion Counties.

Georgia.—Georgia led all States in the production of fuller's earth in 1935, as it has since 1924, when the State took first position from Florida. The output in 1935 was from Decatur, Thomas, Twiggs, and Wilkinson Counties.

Illinois.—The output of fuller's earth in Illinois in 1935, as in other recent years, was entirely from deposits in Pulaski County.

Indiana.—Fuller's earth was produced in Indiana for the first time in 1934, the output for that year and for 1935 having been from Floyd County.

Nevada.—Lyon and Nye Counties provided all of the fuller's earth mined in Nevada in 1935.

New Jersey.—In New Jersey a small quantity of fuller's earth was produced in 1935 from a deposit in Sussex County.

Texas.—All fuller's earth produced in Texas in 1935 was from deposits in Fayette and Walker Counties.

Long-time trends.—The annual production of fuller's earth in the United States since 1895 was summarized in Minerals Yearbook, 1934, page 971. These data are shown graphically in figure 143. From an output of 6,900 tons in 1895, production had more than trebled by 1905, and by 1915 it had grown to 48,000 tons, or nearly seven times the output reported 20 years before. Production climbed to 207,000 tons in 1925 and reached an all-time high in 1930 with an output of 336,000 tons, more than 48 times the output in 1895. Production dropped sharply after 1930 until 1934, when the total

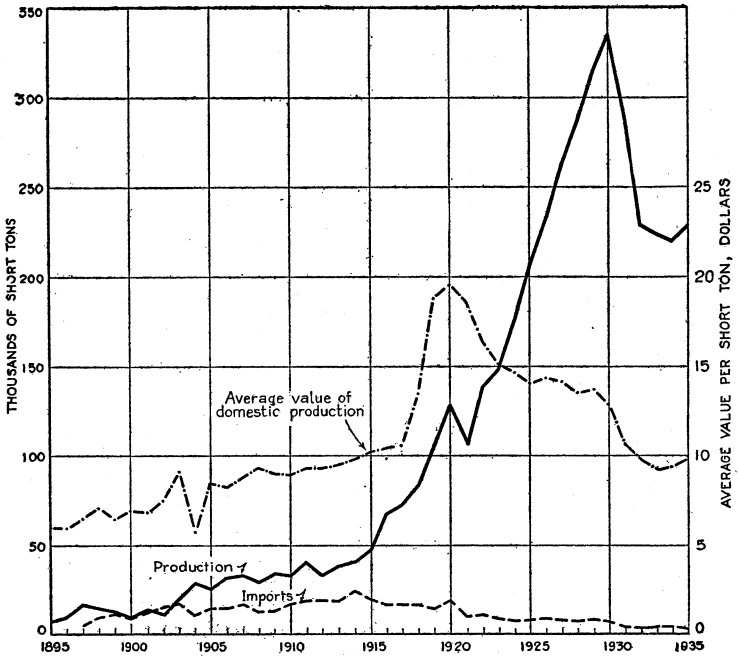

FIGURE 143.—Trends in production, imports, and average value per short ton of fuller's earth, 1895–1935.

output of the country was only 65.6 percent of what it had been in 1930; in the following year (1935) production reached 67.9 percent of what it had been in 1930.

ALL-TIME PRODUCTION OF FULLER'S EARTH IN THE UNITED STATES, BY STATES

Although only 8 States were represented among the producers in 1935, fuller's earth has been mined in 18 States since 1895, when the total output of the country was obtained from deposits in Florida. The following list shows the States from which production has been reported at any time and the year in which the first output was recorded.

State	*Year of first recorded output*	*State*	*Year of first recorded output*
Alabama	1904	Indiana	1934
Arizona	1927	Massachusetts	1904
Arkansas	1901	Nevada	1918
California	1908	New Jersey	1934
Colorado	1897	New York	1897
Florida	1895	Pennsylvania	1922
Georgia	1907	South Carolina	1907
Idaho	1931	Texas	1907
Illinois	1922	Utah	1898

The all-time production of fuller's earth in the United States from 1895 to 1935, inclusive, is 4,379,846 short tons having a value, based upon the market at the time of production, of $54,955,724. About 40 percent of the total quantity was produced in Florida and 33 percent in Georgia. Texas ranks third, with 11 percent of the total output. The following table shows the quantity and value of production, by States, as far as the data can be given without revealing operations in States in which less than three producers reported.

Total production of fuller's earth in the United States, by States, 1895–1935

State	Short tons	Value
Florida	1,800,252	$24,634,778
Georgia	1,432,583	18,524,184
Texas	484,186	4,965,849
Illinois and Indiana	362,025	3,818,669
Nevada	215,358	2,093,458
Arizona, Colorado, Idaho, Utah	27,322	389,607
Arkansas	34,045	301,460
Massachusetts, New Jersey, New York, Pennsylvania	12,062	102,676
Alabama and South Carolina	6,876	73,930
California	5,137	51,113
	4,379,846	54,955,724

FOREIGN TRADE [2]

Imports.—The quantity of fuller's earth imported into the United States dropped in 1935, being only 2,935 tons valued at $37,223 compared with 4,312 tons valued at $53,551 in the previous year, or less than 2 percent of the amount mined in the United States. Except for 1 ton of wrought or manufactured fuller's earth with a value of $71, which came from Germany, all of the 1935 imports were from the United Kingdom.

Fuller's earth imported for consumption in the United States, 1933–35, by countries

	Unwrought or unmanufactured		Wrought or manufactured		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1933						
Germany			7	210	7	210
Japan	1	8			1	8
United Kingdom	16	252	4,071	41,840	4,087	42,092
	17	260	4,078	42,050	4,095	42,310
1934						
Germany			(1)	29	(1)	29
Japan			1	7	1	7
United Kingdom	34	406	4,277	53,109	4,311	53,515
	34	406	4,278	53,145	4,312	53,551
1935						
Germany			1	71	1	71
United Kingdom	137	1,873	2,797	35,279	2,934	37,152
	137	1,873	2,798	35,350	2,935	37,223

[1] Less than 1 ton.

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

Exports.—As exports of fuller's earth are not shown separately in the records of the Bureau of Foreign and Domestic Commerce, information as to the quantity and value of the material exported is obtained annually by the Bureau of Mines from reports furnished directly to the Bureau by the producing companies. Exports in 1935 were 8,160 short tons valued at $81,231. Compared with 1934 shipments to foreign countries in 1935 increased 21 percent in quantity and 31 percent in value. Canada took about 30 percent of the American exports in 1935 and Germany almost an equal amount. England and U. S. S. R. (Russia) ranked next as importers of fuller's earth from the United States. Smaller quantities were exported to Mexico, Cuba, South America, and South Africa.

TALC AND GROUND SOAPSTONE [1]

By Alden H. Emery and B. H. Stoddard

SUMMARY OUTLINE

Sales of talc and ground soapstone in the United States in 1935 reached 172,716 short tons valued at the mine shipping point at $1,848,055, a gain of 25 percent in quantity and nearly 28 percent in value over the output in 1934. The average value per ton in 1935 was $10.70 compared with $10.46 in 1934. Sales of sawed and manufactured talc (841 tons) were nearly five times as great as in 1934. However, the value per ton in 1935 was only $75.16 as against $269.64 in the previous year.

Talc and ground soapstone sold by producers in the United States, 1931–35, by classes

Year	Crude		Sawed and manufactured		Ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1931 [1]	6,673	$47,382	181	$51,740	156,898	$1,753,350	163,752	$1,852,472
1932 [1]	5,635	51,657	107	17,749	117,479	1,292,227	123,221	1,361,633
1933	5,985	46,553	246	31,686	159,792	1,653,643	166,023	1,731,882
1934	[2] 8,767	[2] 55,659	174	46,918	129,564	1,346,108	[2] 138,505	[2] 1,448,685
1935	10,725	57,259	841	63,211	161,150	1,727,585	172,716	1,848,055

[1] Includes talc only.
[2] Revised figures.

REVIEW BY STATES

The order of importance of the States as producers of talc was the same in 1935 as in 1934, and all the leading States show substantial gains both in quantity and value of output. Arkansas enters the list of producers through development of a deposit near Waterloo, Nevada County.

According to report,[2] a large body of talc is being developed near Randsburg, Calif., by the West Coast Borax Co. A road has been built to the property, storage bins have been constructed, and processing machinery is being erected. Actual production is expected to start about the middle of 1936.

The Cohutta Talc Co., Chatsworth, Ga., by adding a small Williams hammer mill to take the tailings of a previously installed Grundler pulverizer, has increased its production of 300-mesh material from 5 to 6 tons per day. Hammers of the talc company's own design are used in the new mill.

[1] Soapstone sold in slabs or blocks is included under "Dimension stone" in the chapter on Stone.
[2] Pit and Quarry, vol. 28, May 1936, p. 44.

A new talc and soapstone plant has been completed at Chatsworth, Ga., by the Southern Talc Co. Equipment includes Link-Belt conveyors and elevators, Williams hammer and roller mills, and vibrating screens.

Stuckey[3] has described the talc deposits in Macon and Cherokee Counties, Ga., and discussed their origin.

Pyrophyllite, a mineral similar to talc in physical properties, is mined extensively in North Carolina and sold for the same uses as talc. The Standard Mineral Co. has been a steady producer near Hemp, Moore County, for some years; and in 1935 a second producer—the Carolina Pyrophyllite Co.—began production at Staley, Randolph County.

The Virginia Mining & Management Corporation continued development of its property near Somerset, Va.

During 1935, Merten[4] published a description of the growth of the Washington talc industry, including some details of the mining operations of the Skagit Talc Co. One of the accomplishments of this company has been the development of a more efficient saw for mining talc. Wilson and Pask have described this occurrence in detail in a recent paper.[5]

The following table shows production by States in 1934 and 1935:

Talc and ground soapstone sold by producers in the United States, 1934–35, by States

State	1934		1935	
	Short tons	Value	Short tons	Value
Arkansas			17	$82
California	15,880	$164,777	21,464	290,439
New York	57,580	681,184	69,125	[1] 817,092
North Carolina	15,367	165,523	20,913	220,074
Vermont	34,243	313,346	42,739	381,643
Washington	[2] 500	[2] 1,250	633	2,550
Undistributed [3]	14,935	122,605	17,825	136,175
	[2] 138,505	[2] 1,448,685	172,716	1,848,055

[1] Partly estimated.
[2] Revised figures.
[3] 1934: Georgia, Maryland, Michigan, New Jersey, Pennsylvania, and Virginia; 1935: Georgia, Maryland, New Jersey, Pennsylvania, and Virginia.

The following list comprises producers of talc and ground soapstone who reported to the Bureau of Mines in 1935:

Producers of talc and soapstone in the United States in 1935

Producer	Material	Product	Location of mine
ARKANSAS			
Mrs. Ida Arnett, Hope	Talc	Rough	Near Waterloo, Nevada County.
CALIFORNIA			
Blue Star Mines, Ltd., 840 San Julian St., Los Angeles.	do	Ground	Near Bigpine, Inyo County.
Glendinning & Co., 1031 South Broadway, Los Angeles.	do	Rough	Near Darwin, Inyo County.
Frank McDonald, Shingle	Soapstone	do	1¼ miles from Shingle.
W. S. McLean, 419 Bay Shore Blvd., San Francisco.	do	do	Butte County.

[3] Stuckey, J. L., North Carolina Talc Deposits: Jour. Elisha Mitchell Sci. Soc., vol. 50, 1934, pp. 41–42.
[4] Merten, Hermann, Beginning of the Washington (State) Talc Industry: Rock Products, vol. 78, December 1935, pp. 30–31.
[5] Wilson, Hewitt, and Pask, Joseph A., Talc and Soapstone in Washington: Am. Inst. Min. and Met. Eng. Contrib. 99, 1936, 25 pp.

Producers of talc and soapstone in the United States in 1935—Continued

Producer	Material	Product	Location of mine
CALIFORNIA—continued			
Pacific Coast Talc Co., 2149 Bay St., Los Angeles.	Talc	Rough, ground	7 miles north of Silver Lake Station, San Bernardino County.
Pacific Minerals Co., Ltd., 337 10th St., Richmond.	Soapstone	Ground	Shrub, Eldorado County.
Sierra Talc Co., 428 Union League Bldg., Los Angeles.	Talc	do	Near Darwin, Inyo County.
Victorville Limerock Co., 357 South Hill St., Los Angeles.	Soapstone	Crude	Saugus, Los Angeles County.
Western Talc Co., 1901 East Slauson Ave., Los Angeles.	Talc	Rough, ground	Tecopa, Inyo County.
GEORGIA			
Cohutta Talc Co., Dalton	do	Crayons, ground	Chatsworth, Murray County.
Georgia Talc Co., Asheville, N. C.	do	do	Do.
MARYLAND			
Harford Talc & Quartz Co., P. O. Box 63, Towson.	Talc, massive steatite, or "lava" grade.	Rough, ground	Near Dublin, Harford County.
Herbert I. Oursler, Marriottsville.	Talc schist	Rough	Near Henryton, Carroll County.
NEW JERSEY			
Jersey Materials Co., 412 Easton Trust Bldg., Easton, Pa.	Talc and serpentine	Ground	Above Marble Hill, on Delaware River near Phillipsburg, Warren County.
NEW YORK			
Carbola Chemical Co., Inc., Natural Bridge.	Talc	do	1¼ miles from Natural Bridge, Lewis County.
International Pulp Co., 41 Park Row, New York.	do	do	Talcville, St. Lawrence County.
W. H. Loomis Talc Corporation, 223 East Main St., Gouverneur.	do	do	Gouverneur, Lawrence County.
NORTH CAROLINA			
Carolina Pyrophyllite Co., Greensboro.	Pyrophyllite	Crude	Staley, Randolph County.
Carolina Talc Co., Murphy	Talc	Crude, crayons, ground.	Near Murphy, Cherokee County.
Nantahala Co., Andrews	do	Crude	Hewitt, Swain County.
Standard Mineral Co., Inc., 230 Park Ave., New York, N. Y.	Pyrophyllite	Ground	2½ miles from Hemp, Moore County.
Talc Mining & Milling Corporation, 150 Whiton Street, Jersey City, N. J.	Talc	do	Glendon, Moore County.
PENNSYLVANIA			
C. K. Williams & Co., 640 North 13th St., Easton.	Soapstone	Crude	Near Easton, Northampton County.
VERMONT			
American Soapstone Finish Co., Inc., Chester.	Talc	Ground	Chester, Windsor County.
Eastern Magnesia Talc Co., Inc., Burlington.	do	Crayons, ground	Johnson, Lamoille County and Waterbury, Washington County.
Vermont Mineral Products, Inc., Chester.	do	Ground	Near Chester, Windsor County.
Vermont Talc Co., Chester	do	do	Windham, Windham County.
VIRGINIA			
Blue Ridge Talc Co., Inc., Henry.	Soapstone	Rough, ground	Near Henry Station, Franklin County.
Alberene Stone Corporation, Schuyler.	do	Dimension stone, furnace blocks, special products, ground.	Schuyler, Nelson County.
WASHINGTON			
Asbestos-Talc Products of Washington, Inc., Burlington.	Talc	Crude	Burlington, Skagit County.
H. P. Scheel, Jr., Rockport	do	Rough	Near Marblemount, Skagit County.
Skagit Talc, Inc., 300 Shubert Bldg., St. Paul, Minn.	Soapstone	Furnace blocks	Near Rockport, Skagit County.

FOREIGN TRADE [6]

Imports.—In 1935 the United States imported 23,896 tons of talc valued at $492,274, an increase of about 17 percent in tonnage and nearly 15 percent in value compared with 1934. The average value per ton ($20.60 as against $20.85 in 1934) was a little less than twice the average value of domestic production—$10.64. In 1931 imports for consumption were equivalent to 14.3 percent of sales (tonnage) of domestic talc; in 1932, 16.3 percent; in 1933, 13.2 percent; in 1934, 14.7 percent; and in 1935, 13.8 percent.

Of foreign supplies Canada furnished about 34 percent, Italy 31, France 23, and Japan 7.

The trade agreement with Canada that became effective January 1, 1936, provides for a reduction of the duty on talc, steatite, or soapstone imports into the United States (except toilet preparations) from 35 to 25 percent ad valorem on material valued at not over $12.50 per long ton.

The chief center of talc production in Canada is near Madoc, Hastings County, in southeastern Ontario. These deposits yield a fine, white, foliated talc of superior quality. When finely ground, it is employed in the manufacture of lubricants, toilet preparations, glass, paper, textiles, foundry facings, insecticides, and many other products. It is also used as a polishing agent for rice, peanuts, and glass and as an insulating material.

According to a report submitted by vice consul George C. Cobb in 1935, ground talc was first shipped from the Madoc district in 1906, although the two mines there have been in operation since 1900. Each mine has its own mill for crushing, drying, grinding, and bolting the product, most of which is exported. Production from the Madoc mines had ranged in recent years from 12,000 to 15,000 tons annually. In 1934, it dropped to 13,934 tons valued at $136,480 compared with 15,181 tons valued at $143,156 in 1933. These figures represent virtually the entire Canadian output. Over three-fourths of the talc exported from Canada is shipped to the United States, largely for use in the cosmetic and paint industries. However, shipments are also made to Great Britain for reexport to continental countries. The ground product is marketed in three grades, according to fineness and purity. Prices in 1934 were $17.50, $11, and $8 per ton, respectively, for the three grades. These figures showed little change from the 1933 level.

Talc is widely distributed in India, but most of the deposits are of inferior quality. Jaipur State is the largest producer. The most important deposits are those of Dagotha, which have been worked for about one hundred years. A deposit opened in 1931 is being advertised as "The best talc the world has yet produced, 99 percent pure." The occurrence has been described by Chowdhry.[7]

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[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.

[7] Chowdhry, W., Talc (Steatite) in Jaipur State, India: Mining Jour. (London), Centenary No., 1935, p. 136.

The following tables show imports by years and by countries of origin:

Talc imported for consumption in the United States, 1931–35

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
1931	146	$7,755	23,335	$425,927	23,481	$433,682
1932	162	4,099	19,926	355,836	20,088	359,935
1933	248	2,628	21,899	388,888	22,147	391,516
1934	204	4,729	20,245	421,640	20,449	426,369
1935	298	5,856	23,598	486,418	23,896	492,274

Talc, steatite, or soapstone, and French chalk, crude, manufactured, or ground, imported into the United States, 1934–35, by countries

Country	1934		1935	
	Short tons	Value	Short tons	Value
Austria	1	$69	12	$138
Canada	8,198	84,499	8,030	81,292
China	197	28,872	492	32,564
Egypt	(1)	7	11	340
France	3,874	72,270	5,514	111,954
Germany	2	822	(1)	3
Hong Kong	(1)	46	(1)	31
India (British)	56	1,187	34	646
Italy	6,025	211,535	7,323	236,187
Japan	1,520	21,690	1,709	23,115
Kwantung	101	945	145	1,433
Norway	230	2,465	166	1,442
Spain	(1)	30		
Union of South Africa	26	634		
U. S. S. R. (Russia)	219	1,268	437	2,472
United Kingdom	(1)	30	23	657
	20,449	426,369	23,896	492,274

[1] Less than 1 ton.

Exports.—The following table shows exports of talcum and other powders from the United States. The figures are not strictly comparable because exports are classified differently in some years than in others.

Exports of talcum and other powders from the United States, 1931–35

Year	Description	Short tons	Value
1931	Powders—talcum, face, and compact	(1)	$1,244,525
1932	do	(1)	646,605
1933	Talc, crude, in bulk	3,956	68,389
	Powders—talcum (in packages), face, and compact	(1)	618,026
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

[1] Quantity not recorded.

WORLD PRODUCTION

The following table shows world production of talc and soapstone, 1931 to 1935, insofar as figures are available:

World production of talc and soapstone, 1931–35, by countries, in metric tons

[Compiled by M. T. LATUS]

Country [1]	1931	1932	1933	1934	1935
Australia:					
New South Wales	230	293	398	341	(2)
South Australia	817	1,071	1,399	1,419	(2)
Tasmania	15	5	9	6	(2)
Austria (exports)	16,979	17,289	20,871	20,673	20,786
Canada [3]	10,710	10,980	13,772	12,663	12,522
China (Manchuria)	42,891	44,316	62,430	(2)	(2)
Egypt	----------	232	2,531	2,603	(2)
Finland	3,000	1,625	1,288	1,586	(2)
France	83,900	68,500	(2)	(2)	(2)
Germany (Bavaria)	4,208	3,197	5,107	6,934	(2)
Greece	484	617	1,272	(2)	(2)
India (British)	5,217	6,617	17,322	9,525	(2)
Italy	38,620	32,404	34,487	37,671	43,200
Morocco, French (exports)	693	837	526	788	(2)
Norway	11,392	13,536	19,885	34,474	(2)
Rumania	3,068	1,798	1,112	1,933	(2)
Spain	6,585	6,574	10,064	5,285	(2)
Sweden	4,837	4,525	4,396	6,501	(2)
Union of South Africa (Transvaal)	337	251	271	218	(2)
United Kingdom	163	262	169	----------	(2)
United States	[4] 148,553	[4] 111,784	[5] 148,840	[5][6] 127,948	[5] 166,594
Uruguay (exports)	1,789	2,625	1,270	879	1,200

[1] In addition to the countries listed talc is produced in Argentina, Brazil, and the U. S. S. R. (Russia), but data of production are not available.
[2] Data not available.
[3] Excluding soapstone, which is reported only by value and was as follows: 1931, $34,439; 1932, $46,751; 1933, $43,593; 1934, $44,297; 1935, $32,053. Soapstone is sold in the form of both blocks and powder.
[4] Figures represent sales of talc only. Bureau of Mines not at liberty to publish figures for soapstone.
[5] Figures represent total mine production of talc and ground soapstone.
[6] Revised figure.

TECHNICAL DEVELOPMENTS

Flotation.—The Mississippi Valley Experiment Station of the Bureau of Mines at Rolla, Mo., has investigated, on a laboratory scale, the froth flotation of talc from the property of the Eastern Magnesia Talc Co., Burlington, Vt. From an ore containing 50 percent talc a concentrate assaying 96 percent talc and 0.2 percent iron has been made, with recovery of about 75 percent of the talc. About 95 percent of the iron is rejected in the tailings.

In England, the General Electric Co. was granted a patent [8] covering the flotation of talc from magnesite and small quantities of other impurities, using a fatty acid and a metallic salt of a fatty acid. Known frothing agents are employed. In the example given, 1 part of an ore containing 49 percent talc, 41 percent magnesite, 6 percent iron and aluminum oxides, and 4 percent other silicates, ground to pass 50-mesh, is mixed with 5 parts water and put in the flotation cell with 0.05 pound terpineol per ton of ore. To this is added 0.3 pound of oleic acid and 0.1 pound of lead nitrate per ton, and the mixture is floated for 12 minutes. The resulting concentrate contains 97.5 percent talc and 2.5 percent magnesite; the magnesite may be removed by acid treatment. The tailing assays magnesite

[8] The General Electric Co., Ltd., and Jackson, Alexander Bloomer, Improvements in or Relating to the Separation of Minerals by Flotation: British Patent 425362, Mar. 12, 1935.

80 percent, talc 5 percent, iron and aluminum oxides 9 percent, and other silicates 6 percent.

This movement toward purification of talc by flotation may be important in connection with some of the newer ceramic uses, because some ceramists have difficulty in obtaining talcs low in lime and iron and of constant and dependable composition.

Heat treatment.—The Bureau of Standards [9] found that water in excess of 1 molecule was driven off largely between 380° and 500° C. This water loss was accompanied by a small endothermic heat effect but not by any change in crystal structure or optical properties. The molecule of combined water was eliminated at 800° to 840° C. and was accompanied by a large endothermic heat effect, by an increase in true specific gravity from 2.83 to 2.91, and by break-down of the talc into enstatite and amorphous silica. On heating to 1,435 ° C. the specific gravity increased gradually to 3.01.

Inversion of enstatite to clinoenstatite took place gradually, both phases being observed in material heated at 1,200° C. Samples heated to 1,300° C. contained only clinoenstatite and cristobalite, the final products of the thermal decomposition of talc.

The data support the hypothesis of Foshag and Wherry [10] and the results of Gruner that water in talc in excess of 1 molecule is not constitutional and may be held electrostatically between basal cleavage planes.

Ceramic uses.—King [11] lists the following advantages and disadvantages in the use of talc in ceramic bodies:

Advantages:
- (*a*) Is a cheap source of MgO, which acts as a flux.
- (*b*) Imparts to a body high resistance to thermal shock and high electrical resistance at elevated temperatures.
- (*c*) Has a high specific heat and a high resistance to acid attack.

Disadvantages:
- (*a*) Has a short fusion range which may impart a short firing range to a body.
- (*b*) Talcs high in iron may give the body an undesirable color.
- (*c*) Use in large proportions would increase costs as it is an expensive source of SiO_2.

Rigby and Green [12] found that the reported great increase in resistance to thermal shock produced by the addition of steatite to fireclay products is due mainly to the reduction in thermal expansion. For each mix there is a definite maturing temperature below which the steatite does not exert its full effect. Samples of a talc-free body fired to 1,100°, 1,200°, and 1,240° C. had a thermal expansion of 0.546, 0.532, and 0.533, respectively. With addition of 10-percent talc the corresponding figures were 0.504, 0.300, and 0.266. The authors conclude: "It should be emphasized that the addition of steatite must result in some reduction in the refractoriness of the product."

Ominin [13] found that dunites—basic igneous rocks consisting essentially of olivine—can be substituted for talc in ceramic mixes in the manufacture of products having a dark body. The use of dunite in

[9] Ewell, R. H., Bunting, E. N., and Geller, R. F., Thermal Decomposition of Talc: Nat. Bur. of Stand., Jour. of Research, vol. 15, 1935, pp. 551–556.
[10] Foshag, W. F., and Wherry, E. T., Am. Mineral., vol. 7, 1922, pp. 167, 171.
[11] King, R. M., Talc as a Ceramic Body Ingredient: Ceram. Ind., vol. 25, no. 2, 1935, pp. 70–71.
[12] Rigby, G. R., and Green, A. T., A Note on the Effect of Steatite Additions to Fireclay Mixes: Inst. Gas Eng., Communication 103, 1934, pp. 77–78.
[13] Ominin, L. V., Dunites in Ceramics as Substitute for Talc: Keram. i. Steklo, vol. 11, no. 2, 1935, pp. 29–32.

saggers to increase their refractoriness is not excluded. Peters[14] found that dunite could be used to replace talc in the production of enamel cements.

During the year Geller and Creamer[15] of the Bureau of Standards reported before the White Wares Division of the American Ceramic Society the results of their studies on talc in white-ware bodies. A series of specimens containing 2.5 to 43 percent talc was heated at 1,120°, 1,180°, 1,260°, and 1,325° C.

A variation in MgO content from 3 to 14 percent did not significantly alter the water absorptivity of the heated bodies, this property being influenced much more, relatively, by the alkalis in the feldspar in combination with CaO. The shrinkage, also, was influenced significantly by the CaO in the lime-bearing talc and the alkalis in the feldspar. In general, total linear shrinkage was decreased by the talc; for example, the expansion of specimens heated at 1,260° C. was decreased from a maximum of 8 percent for a body containing no talc to a minimum of 0.7 percent for a body containing 43 percent of talc. Moisture expansion was practically eliminated, but this must be accounted for in part by the low feldspar content. In general, the thermal expansions of bodies containing lime-free talc were higher than those of the comparable bodies containing the lime-bearing talc. * * * The manufacture of vitreous bodies containing talc involves the greatest care in kiln temperature control.

The authors conclude:

(1) In semivitreous bodies, talc may be expected to increase porosity slightly and materially decrease shrinkage when 40 percent or less is used.

(2) The effect of talc, in quantities of 40 percent or less, on resistance to crazing due to poor "glaze fit" will depend on the amount used, the temperature, and the content of lime. Small variations in any one of these factors are sufficient to change the thermal expansion through a wide range.

(3) Glazed porous bodies containing as little as 10 percent of talc (either lime bearing or lime free) may be expected to show excellent resistance to "moisture crazing", providing the feldspar content also is low.

Hagar[16] in a paper before the same symposium concluded that wall-tile bodies of low-moisture expansion and high resistance to delayed crazing can be developed by the use of tremolitic talc in conjunction with the other materials studied. The use of talc decreases shrinkage and increases transverse strength. He also concludes that bodies of lowest moisture expansion can be developed at cone 10, using both intermediate (20 to 40) and high (above 60) percentages of the talc. Bodies matured at this temperature, however, require the development of special glazes. Bodies of high crazing resistance, low shrinkage, adequate strength, and long-firing range can be produced at cones 1 and 6. Although these bodies do not have moisture expansions as low as those matured at cone 10, they are more easily made and are more resistant to crazing than ordinary wall tile. In general, bodies of high talc content (above 50 percent) are better than those containing the intermediate talc percentages (20 to 40), but the latter bodies are highly resistant to crazing and less susceptible to production difficulties. The effect of the talc in lowering the maturing point of the body permits lower operating temperatures, with consequent saving of fuel.

Heindl[17] of the National Bureau of Standards studied the effect of magnesia additions on sagger bodies, using both Greek magnesite

[14] Peters, Carl Heinrich, Various Possibilities for Using Dunite: Feuerungstechnik, vol. 22, no. 8, 1934, p. 97.

[15] Geller, R. F., and Creamer, A. S., Talc in White-Ware Bodies of the Wall-Tite Type: Jour. Am. Ceram. Soc., vol. 18, 1935, pp. 259–269.

[16] Hagar, Donald, Effect of a Tremolitic Talc in White-Ware Bodies: Jour. Am. Ceram. Soc., vol. 19, 1936, pp. 14–23.

[17] Heindl, Raymond A., A Study of Sagger Clays and Sagger Bodies: Nat. Bureau of Standards, Jour. of Research, vol. 15, 1935, pp. 255–270.

and New York talc containing about 30.5 percent magnesium oxide. He found that the addition to a sagger body of magnesia either as talc or magnesite increases the life of the sagger, but care must be taken to control the quantity of magnesia present, since both the refractoriness and plastic deformation may be affected detrimentally by an excess. The refractoriness of the original body, as indicated by the pyrometric cone equivalent, was reduced from 1½ to 5 cones (15° to 110° C.) by magnesia additions, talc having the greater effect. The total linear thermal expansion was reduced almost equally by talc or magnesite. The extensibility of the body measured at room temperature and the plastic deformation measured at 1,200° C. increased with increase in magnesia. The addition of small amounts of magnesium oxide, either as talc or magnesite, to clay sagger bodies is beneficial with respect to resistance to thermal shock and plastic deformation. The resistance to thermal shock may be attributed primarily to the decided reduction in the thermal expansion of the body and secondarily to the increased extensibility or stretch of the body before rupture. Any beneficial effect in reducing plastic flow depends on the temperature at which the saggers are used; if the temperature is too high, deformation is increased greatly, since talc increases the percentage of low-fusing glasses.

Parmalee and Thiernauer [18] investigated possible additions to talc bodies to give a low thermal expansion and a practicable firing range. Data were obtained on the vitrification, thermal expansion, crystalline structure, and X-ray diffraction patterns with $Al(OH)_3$, alundum, BaO, TiO_2, ZrO_2, and $ZrSiO_4$ in the talc body. Alumina lowers the thermal expansion, but the firing range is short. Zirconium increases the firing range, and the thermal expansion is low. The most desirable amount of zirconium oxide is between 20 and 30 percent. The use of titanium oxide is not advantageous.

Ceramic compositions consisting mainly of ground talc or steatite (70 percent or more) have a very narrow firing range when fired to vitrification. The usual vitrifying agents, such as clays, feldspar, sodium silicate, and iron oxide, lower the electrical resistivity as the percentages of these fluxes are increased.

Nagai [19] and his associates have continued their research on molded talc products. The higher the molding pressure of dry mixes, the greater were the transverse and compressive strengths and the lower the porosity of the products fired to 1,400° C. Longer heating was less effective than higher pressure. Small additions of $MgCl_2$ solution or B_2O_3 favorably affected bending strength and porosity, though the products tended to disintegrate on storing. Various properties can be changed by MgO or Al_2O_3 additions.

Talc in electrical porcelains.—The manufacture of talc insulators is described in detail by Kolyun in a Russian bulletin.[20]

Fallan [21] found that steatite porcelains were superior to other electrical porcelains except in thermal expansion. By combining the proper ingredients so that the main constituent formed on firing was

[18] Parmalee, C. W., and Thiernauer, H., Some Effects of the Additions of Compounds of Zirconium, Titanium, Aluminum, and Barium to a Talc Body: Presented at 37th Ann. Meeting, Am. Ceram. Soc., Buffalo, N. Y., Feb. 19, 1935; abstract in Bull. Am. Ceram. Soc., vol. 14, 1935, p. 69.

[19] Nagai, Shochiro, and Fukai, Kichinosuke, Magnesium Silicates. Steatite III: Jour. Japanese Ceram. Asso., vol. 43, 1935, pp. 55–63. Nagai, Shochiro and Inone, Giichi, Magnesium Silicates. Steatite IV: Jour. Japanese Ceram. Asso., vol. 43, 1935, pp. 133–141; V, pp. 263–265; VI, pp. 343–352.

[20] Kolyun, N. E., Spark Plugs: Their Manufacture and Use in Engines of Internal Combustion: State Chem.-Tech. Pub. House, Leningrad, 1932, 136 pp.

[21] Fallan, Frank J., Talc for Use in Electric Porcelains: Ceram. Ind., vol. 25, 1935, pp. 201–204.

cordierite, a very low coefficient of thermal expansion was obtained. By varying the percentage of talc in an electrical porcelain, almost any desired property can be secured.

Most authorities agree that steatite compositions give (1) mechanical toughness, (2) high dielectric values, (3) high density, and (4) accuracy of dimensions due to low shrinkage.

Talc refractories.—Birch and Harvey,[22] of the Harbison-Walker Refractories Co., have found that talc and soapstone are not suitable for use as refractories above moderately low temperatures. Since forsterite ($2 MgO.SiO_2$) is the only stable magnesium silicate above 1,562° C., the development of magnesium silicate refractories requires that the ultimate product should be mainly forsterite. Talc, on being heated, dehydrates and forms cristobalite and clinoenstatite. The change is accompanied by a 10.6-percent volume shrinkage. At 1,547° C. all of the clinoenstatite melts.

NEW USES

Singleton-Green [23] reports that the strength of concrete is increased by addition of 5 percent talc.

For many years talc, kaolin, and other forms of white mineral deposits have been used to lighten the color of leather and give it a softer and smoother feel. According to Wilson [24] they are often used in the oil wheel in the manufacture of sole leather and in the fat liquor drum in the manufacture of white leathers. They are also used to impart a soft and velvety feel to suede leathers, buck, and chamois.

[22] Birch, Raymond E., and Harvey, Fred A., Forsterite and Other Magnesium Silicates as Refractories: Jour. Am. Ceram. Soc., vol. 18, 1935, pp. 176–192.

[23] Singleton-Green, J., Admixtures and Workability of Concrete: Cement, Lime, and Gravel, January 1935, pp. 65–66.

[24] Wilson, John Arthur, Colloidal Clay in Leather Manufacture: Hide and Leather, Sept. 14, 1935, pp. 32–33; Chem. Industries, vol. 37, 1935, pp. 567, 569.

FLUORSPAR AND CRYOLITE

By H. W. Davis

SUMMARY OUTLINE

FLUORSPAR

Consumption of fluorspar at steel mills in 1935 increased 19,700 tons over 1934 owing to accelerated activity that raised the operating rate of the steel industry from 37 percent of capacity in 1934 to 49 percent in 1935. Both domestic producers and importers shared in the increase; in fact, total sales of fluorspar to the steel industry were the largest since 1930, and sales by domestic producers exceeded those of any year since 1929.

Glass manufacturers purchased 12,225 tons of fluorspar in 1935—the most ever recorded. Sales to enamel and hydrofluoric acid plants increased 1,800 and 400 tons, respectively, over 1934, and consumption of acid-grade fluorspar as a refrigerating medium was 61 percent greater.

Total sales of fluorspar to consumers in the United States in 1935 were 139,867 short tons, of which 123,561 tons were from domestic mines and 16,306 tons imported compared with a total of 101,662 tons in 1934, of which 85,264 tons were from the domestic mines and 16,398 tons imported.

Despite the improved demand for fluorspar in 1935 the selling price by producers was lower than in 1934. For example, the average selling price of fluxing-gravel fluorspar decreased from $15.28 a ton f.o.b. Illinois-Kentucky mines in 1934 to $13.76 a ton in 1935. The average selling price of all grades declined from $16.22 a short ton in 1934 to $15.04 in 1935.

Other noteworthy developments in 1935 were the substantial reduction in stocks of fluorspar in the hands of producers, the high level of shipments from Kentucky (which have been exceeded only in 1918, 1928, and 1929), and the movement of fluorspar from Colorado to eastern markets.

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Available data on trends in production, imports, consumption, and average value of fluorspar over a series of years are shown in figure 144.

Salient statistics of the fluorspar industry in the United States, 1934–35

	1934		1935	
	Short tons	Value	Short tons	Value
Domestic shipments:				
Gravel	74, 249	$1, 121, 974	105, 280	$1, 452, 733
Lump	3, 101	60, 135	5, 268	101, 578
Ground	8, 436	209, 296	13, 013	304, 023
	85, 786	1, 391, 405	123, 561	1, 858, 334
Stocks at mines or shipping points:				
Ready-to-ship	50, 586	(1)	33, 389	(1)
Crude	33, 326	(1)	27, 363	(1)
	83, 912	(1)	60, 752	(1)
Imports for consumption:				
Containing more than 97 percent CaF_2	10, 632	145, 454	10, 578	149, 823
Containing not more than 97 percent CaF_2	6, 073	37, 832	5, 762	29, 226
	16, 705	183, 286	16, 340	179, 049
Exports	522	8, 602	313	4, 651
Consumption (by industries):				
Metallurgical	88, 100	(1)	108, 400	(1)
Ceramic	11, 500	(1)	16, 700	(1)
Chemical	11, 000	(1)	12, 900	(1)
	110, 600	(1)	138, 000	(1)
Stocks at consumers' plants Dec. 31:				
Metallurgical	47, 400	(1)	49, 600	(1)
Ceramic	2, 500	(1)	2, 800	(1)
Chemical	7, 700	(1)	5, 600	(1)
	57, 600	(1)	58, 000	(1)

[1] Figures not available.

Trends in employment and output per man-hour at fluorspar mines.—Data are not yet available on employment and output per man in the fluorspar industry in 1935. In 1934, however, expanded activity at plants using fluorspar—chiefly steel mills—resulted in gains of about 31,700 short tons in production of merchantable fluorspar and about 600,000 man-hours of labor at fluorspar mines and mills. The average output of merchantable fluorspar per man-hour increased slightly—from 100 to 102 pounds—in 1934 compared with 1933, in spite of the fact that considerably more labor was expended in 1934 in development work and in making improvements and additions to mills. However, the average output of 102 pounds of merchantable fluorspar per man-hour in 1934 was 9 percent less than the average of 112 pounds per man-hour in the 4-year period 1930–33. This was because relatively less human energy was expended in development and more in mining of ore during 1930–33 and also because more selective mining followed the development of many large new ore bodies discovered during the extensive exploratory program largely completed in 1929. On the other hand, the average output per man-hour in 1934 closely approximated the average for the 4-year period 1926–29, when a relatively large proportion of the workers was engaged in exploration and development.

Summary of employment at fluorspar mines and mills in the United States, merchantable fluorspar produced, and average output per man, 1926–34 [1]

Year	Employment at mines and mills			Production		
	Average number of men employed	Time employed		Merchantable fluorspar (short tons)	Average pounds of merchantable fluorspar per man	
		Average number of days	Average number of man-hours per day		Per day	Per hour
1926	1,168	269	8.23	125,600	799	97
1927	1,113	238	8.21	105,100	794	97
1928	1,008	279	8.22	112,500	800	97
1929	1,181	254	8.14	138,200	921	113
1930	1,126	210	8.19	118,700	1,003	122
1931	742	135	8.34	49,300	981	118
1932	314	147	8.11	14,100	611	75
1933	577	195	8.02	45,200	805	100
1934	1,038	177	8.02	75,500	822	102
Average, 1926–34	919	223	8.17	87,100	852	104

[1] Covers operations at mines and mills furnishing from 66 percent in 1932 to 92 percent in 1926 and averaging 89 percent of the total fluorspar produced during the 9-year period covered by study.

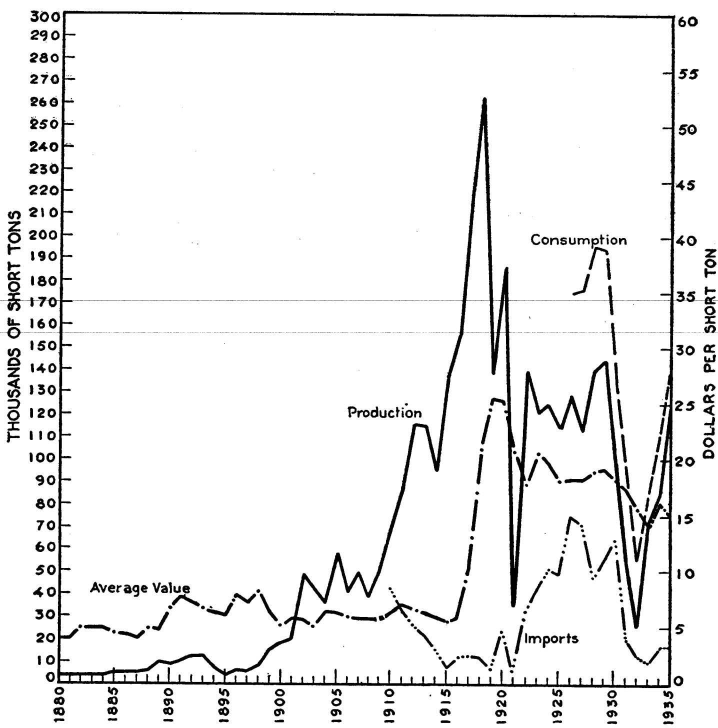

FIGURE 144.—Trends in production and average value per ton of fluorspar in the United States, 1880–1935; in imports, 1910–35; and in consumption, 1926–35.

Although the output of merchantable fluorspar in Illinois was less in 1934 than in 1933, more employment was provided because of development work and improvements to mills. In 1934 about 597,000 man-hours were worked and only 30,200 tons of fluorspar produced, whereas in 1933 about 514,500 man-hours were worked and 32,000 tons of fluorspar produced. Thus, the average output of merchantable fluorspar was only 101 pounds per man-hour in 1934 compared with 124 pounds in 1933.

The output of fluorspar in Kentucky increased from 24,300 tons in 1933 to 50,400 tons in 1934, the total man-hours worked from about 692,000 to about 1,030,000, and the average output per man-hour from 70 to 98 pounds. The improved performance in 1934 was due chiefly to the fact that a larger proportion of the ouptut came from mines equipped with mechanical equipment, whereas in 1931, 1932, and 1933 the chief sources of supply were shallow deposits worked by primitive methods and having a low output per worker.

The following table gives details on employment at fluorspar mines and mills, the quantity of ore mined and milled, and the average output of fluorspar per man-hour for 1932–34, by years, States, and groups of States. Corresponding statistics by States and groups of States for the 6-year period 1926–31 and supplementary data are given in the chapter on Fluorspar and Cryolite in Minerals Yearbook 1935. Although information on employment at all operations was not reported, the compilations include mines producing about 84 percent of the total output for the 3-year period 1932–34, therefore the figures are regarded as representative. The reports received from the producing companies do not include salaried officials and office workers nor an undetermined number of employees engaged in hauling fluorspar, as such work usually is done on a contract basis and no record of it is kept by the mining companies.

Employment at fluorspar mines and mills in the United States, quantity of ore mined and milled, and average output of fluorspar per man 1932–34, by States [1]

State	Employment at mines and mills[1]: Average number of men employed	Time employed: Average number of days	Time employed: Total man-shifts	Man-hours: Average per day	Man-hours: Total	Crude ore mined (partly estimated): Total (short tons)	Crude ore mined, covered by study: Short tons	Crude ore mined, covered by study: Percent of total	Total crude ore[2] washed or milled (partly estimated) (short tons)	Total merchantable fluorspar recovered (short tons)	Covered by study, crude ore[2] washed or milled (partly estimated): Short tons	Covered by study, crude ore[2] washed or milled (partly estimated): Percent of total	Merchantable fluorspar recovered: Short tons	Merchantable fluorspar recovered: Percent of total	Average pounds per man: Per day	Average pounds per man: Per hour
1932																
Illinois	180	115	20,711	8.00	165,687	7,500	7,400	98.67	24,200	6,600	24,200	100.00	6,600	100.00	637	80
Kentucky	123	197	24,236	8.22	199,146	18,000	9,700	53.89	18,000	13,500	9,700	53.89	7,100	52.59	586	71
Colorado, New Mexico	11	110	1,213	8.00	9,704	1,100	500	45.45	1,100	900	500	45.45	400	44.44	660	82
Total	314	147	46,160	8.11	374,537	26,600	17,600	66.17	43,300	21,000	34,400	79.45	14,100	67.14	611	75
1933																
Illinois	307	204	62,493	8.00	499,968	66,000	63,500	96.21	92,400	32,000	90,800	98.27	31,100	97.19	995	124
Kentucky	246	194	47,842	8.04	384,474	39,100	25,400	64.96	39,500	24,300	25,600	64.81	13,500	55.56	564	70
Colorado, Nevada, New Mexico	24	80	1,931	8.00	15,448	3,100	600	19.35	3,100	2,300	600	19.35	600	26.09	621	78
Total	577	195	112,266	8.02	899,890	108,200	89,500	82.72	135,000	58,600	117,000	86.67	45,200	77.13	805	100
1934																
Illinois	374	195	72,837	8.00	582,696	68,700	67,900	98.84	69,500	30,200	68,800	98.99	29,500	97.68	810	101
Kentucky	563	169	95,343	8.10	772,621	86,700	66,900	77.16	92,800	50,400	72,900	78.56	37,800	75.00	793	98
California, Colorado, Nevada, New Mexico	101	154	15,593	7.58	118,264	19,300	17,700	91.71	19,300	9,700	17,700	91.71	8,200	84.54	1,052	139
Total	1,038	177	183,773	8.02	1,473,581	174,700	152,500	87.29	181,600	90,300	159,400	87.78	75,500	83.61	822	102

[1] Includes men and employment at mines and mills producing from 66 percent in 1932 to 87 percent in 1934 and averaging 84 percent of the total fluorspar produced during the 3-year period covered by study; excludes officials, clerks, and other subordinate salaried employees as well as all men engaged in contract hauling of fluorspar.

[2] Includes a comparatively small quantity of run-of-mine fluorspar not washed or milled.

Production and shipments.—In 1935 fluorspar was produced at mines and prospects and reclaimed from mill ponds, old workings of abandoned mines, and waste dumps; all operations yielded about 102,000 tons of merchantable fluorspar compared with about 87,000 tons in 1934.

Shipments of fluorspar from domestic mines aggregated 123,561 short tons valued at $1,858,334 in 1935, increases of 44 percent in quantity and 34 percent in total value over 1934. Shipments in 1935 were equivalent to 99 percent of the average annual tonnage shipped in the 5-year period 1926–30. Of the 1935 shipments, 23,800 tons were shipped by barge for delivery at upper Ohio River landings compared with 23,302 tons in 1934.

The average value of all grades was $15.04 a ton in 1935, or $1.18 less than the 1934 average. The value recorded for domestic fluorspar is the price paid f.o.b. mine shipping point by the consumer and excludes the cost of containers. The average value per ton of the fluorspar shipped to steel plants from the Illinois-Kentucky district was $13.76 in 1935 compared with $15.28 in 1934.

The following table presents such details of shipments of fluorspar by States from 1932 to 1935 as may be published without revealing, except by permission, data supplied by individual producers.

Fluorspar shipped from mines in the United States, 1932–35, by States

State	Gravel			Lump			Ground			Total		
	Short tons	Value		Short tons	Value		Short tons	Value		Short tons	Value	
		Total	Average		Total	Average		Total	Average		Total	Average
1932												
Colorado	333	$3,330	$10.00							333	$3,330	$10.00
Illinois	7,460	99,554	13.35	542			1,613			9,615	156,279	16.25
Kentucky	10,920	124,417	11.39	668	$22,155	$17.16	3,137	$137,993	$28.63	14,725	225,052	15.28
New Mexico	427	5,050	11.83	32			70			529	7,838	13.56
Nevada				49						49		
	19,140	232,351	12.14	1,291	22,155	17.16	4,820	137,993	28.63	25,251	392,499	15.54
1933												
Colorado	742	6,778	9.13							742	6,778	9.13
Illinois	29,694	395,492	13.32	357			6,024			36,075	543,060	15.05
Kentucky	30,035	371,669	12.37	1,716	34,401	16.17	2,863	221,801	23.14	34,614	469,451	13.56
New Mexico	294	9,037	12.13				700			994	19,889	13.27
Nevada	451			54						505		
	61,216	782,976	12.79	2,127	34,401	16.17	9,587	221,801	23.14	72,930	1,039,178	14.25
1934												
Colorado	6,537	83,132	12.72							6,537	83,132	12.72
Illinois	28,922	457,050	15.80	572	60,135	19.39	3,740			33,234	567,396	17.07
Kentucky	37,942	570,538	15.04	2,529			2,692	209,296	24.81	43,163	690,990	16.01
Nevada	627						4			631		
New Mexico	40	11,254	13.27				2,000			2,040	49,887	17.49
California	181									181		
	74,249	1,121,974	15.11	3,101	60,135	19.39	8,436	209,296	24.81	85,786	1,391,405	16.22
1935												
Illinois	36,766	505,370	13.75	1,013	99,009	20.16	6,341			44,120	685,794	15.54
Kentucky	60,799	847,660	13.94	3,897			3,983	304,023	23.36	68,679	1,017,451	14.81
New Mexico	51						2,675			2,726		
Nevada	974	99,703	12.92	52	2,453	6.97	14			1,040	154,973	14.41
Colorado	6,678			300						6,978		
New Hampshire	12									12		
Tennessee				6	116	19.33				6	116	19.33
	105,280	1,452,733	13.80	5,268	101,578	19.28	13,013	304,023	23.36	123,561	1,858,334	15.04

Shipments, by uses.—The following tables show the relative dependence of the fluorspar industry upon the different industries in which fluorspar is used. The predominance of the steel industry as a purchaser of fluorspar is evident.

Fluorspar shipped from mines in the United States, 1934–35, by uses

Use	1934				1935			
	Percent	Short tons	Value		Percent	Short tons	Value	
			Total	Average			Total	Average
Steel	82.38	70,672	$1,061,864	$15.03	81.73	100,988	$1,390,357	$13.77
Foundry	1.74	1,489	23,807	15.99	1.89	2,336	29,068	12.44
Glass	8.56	7,343	167,182	22.77	8.30	10,256	227,917	22.22
Enamel and vitrolite	3.02	2,590	67,849	26.20	3.31	4,087	100,686	24.64
Hydrofluoric acid and derivatives	1.94	1,666	35,708	21.43	2.70	3,333	74,732	22.42
Miscellaneous	1.75	1,504	26,393	17.55	1.82	2,248	30,923	13.76
	99.39	85,264	1,382,803	16.22	99.75	123,248	1,853,683	15.04
Exported	.61	522	8,602	16.48	.25	313	4,651	14.86
	100.00	85,786	1,391,405	16.22	100.00	123,561	1,858,334	15.04

Fluorspar shipped from mines in the United States, 1931–35, by uses

Year	Steel		Foundry		Glass		Enamel and vitrolite	
	Short tons	Average value	Short tons	Average value	Short tons	Average value	Short tons	Average value
1931	39,832	$14.16	1,123	$16.10	5,279	$30.74	1,996	$32.79
1932	18,881	12.13	524	14.57	3,596	28.30	1,261	28.80
1933	60,279	12.77	1,039	13.27	6,778	21.83	3,100	24.82
1934	70,672	15.03	1,489	15.99	7,343	22.77	2,590	26.20
1935	100,988	13.77	2,336	12.44	10,256	22.22	4,087	24.64

Year	Hydrofluoric acid and derivatives		Miscellaneous		Exported		Total	
	Short tons	Average value	Short tons	Average value	Short tons	Average value	Short tons	Average value
1931	4,386	$24.65	557	$14.13	311	$18.00	53,484	$17.41
1932	738	19.79	226	11.91	25	22.12	25,251	15.54
1933	950	19.58	713	15.44	71	13.62	72,930	14.25
1934	1,666	21.43	1,504	17.55	522	16.48	85,786	16.22
1935	3,333	22.42	2,248	13.76	313	14.86	123,561	15.04

Consumption—stocks at consumers' plants.—The following table gives data on consumption of fluorspar in 1934 and 1935 and on stocks at consumers' plants at the close of these years.

Fluorspar consumed and in stock in the United States, 1934–35, by industries, in short tons

[Partly estimated by Bureau of Mines]

Industry	1934		1935	
	Consumption	Stocks at consumers' plants Dec. 31	Consumption	Stocks at consumers' plants Dec. 31
Basic open-hearth steel	81,000	45,500	99,600	47,500
Electric furnace steel	4,300	800	5,400	900
Foundry	1,600	500	1,900	800
Ferro-alloys	500	200	700	300
Hydrofluoric acid and derivatives	11,000	7,700	12,900	5,600
Enamel and vitrolite	3,500	700	4,900	900
Glass	7,700	1,600	11,600	1,700
Miscellaneous	1,000	600	1,000	300
	110,600	57,600	138,000	58,000

The following table shows the relation of consumption of fluorspar to production of basic open-hearth steel, 1931–35, and stocks of fluorspar at such steel plants at the close of each year.

Consumption and stocks of fluorspar at basic open-hearth steel plants, 1931–35

	1931	1932	1933	1934	1935
Production of basic open-hearth steel ingots and castings ....long tons..	22,130,398	11,742,682	20,057,146	23,440,000	30,447,000
Consumption of fluorspar in basic open-hearth steel production ....short tons..	66,200	36,300	61,300	81,000	99,600
Consumption of fluorspar per ton of steel made ....pounds..	6.0	6.2	6.1	6.9	6.5
Stocks of fluorspar on hand at steel plants at end of year ....short tons..	67,600	55,000	56,000	45,500	47,500

The quantity of fluorspar used by individual plants per ton of basic open-hearth steel produced ranges from 1 to 50 pounds. The average is generally 5 to 8 pounds—a very small proportion of the furnace charge. The average quantity of fluorspar used per ton of basic open-hearth steel produced decreased from 6.9 pounds in 1934 to 6.5 pounds in 1935. The average for 1935, however, is slightly more than the average for the 6-year period 1929–34, which was 6.4 pounds. The following table shows the variation in average consumption of fluorspar per ton of basic open-hearth steel over a 5-year period in certain plants that make about 88 percent of the total.

Average consumption of fluorspar per ton of steel, 1931–35, in pounds

1931	1932	1933	1934	1935	1931	1932	1933	1934	1935
16.111	14.176	18.944	14.443	13.243	6.219	6.646	6.754	6.584	9.347
5.781	4.572	3.864	4.766	4.182	7.784	6.056	8.148	9.820	8.168
4.613	5.122	4.687	5.141	4.803	2.437	2.636	4.097	4.511	5.728
2.431	6.136	5.731	9.958	8.452	5.774	6.356	5.386	5.900	5.236
4.867	6.281	6.871	6.195	7.027	5.822	6.118	6.590	6.429	6.764
5.856	5.171	5.858	5.768	5.658	3.791	6.260	6.099	6.780	5.257
4.978	6.842	4.289	5.046	6.857	7.049	6.322	7.449	8.331	7.390
6.590	5.302	5.659	7.488	7.048					

Quoted prices.—The following table shows representative quoted prices in 1935 on fluxing-gravel and foundry-lump fluorspar at Illinois-Kentucky mines and fluxing-gravel fluorspar at seaboard. These prices are for carload or barge lots. Prices quoted for smaller lots generally are somewhat higher than those for large tonnages sold on contract.

Quoted prices per short ton of fluorspar in the United States in 1935

Month	Illinois-Kentucky (f. o. b. mines): Fluxing gravel (not less than 85 percent CaF_2 and not over 5 percent SiO_2) — Rail delivery	Illinois-Kentucky (f. o. b. mines): Fluxing gravel — Barge delivery at Ohio River landings	Illinois-Kentucky (f. o. b. mines): Foundry lump (not less than 85 percent CaF_2 and not over 5 percent SiO_2)	Imported (at seaboard, duty paid)[1]: Fluxing gravel (not less than 85 percent CaF_2 and not over 5 percent SiO_2)
January	$13.00	$13.00-$14.00	$14.00	$19.00
February	13.00	13.00- 14.00	14.00	19.00
March	13.00	13.00- 14.00	14.00	19.00
April	13.00	13.00- 14.00	14.00	19.00
May	13.00	13.00- 13.50	14.00	19.00
June	13.00	13.00- 13.50	15.00	19.00
July	13.00	13.00- 14.00	15.00	18.50- 19.00
August	14.00	14.00- 15.00	15.00	18.50
September	14.00	14.50- 15.50	15.00	18.50
October	14.50	15.00- 16.00	15.00	18.50- 20.00
November	16.00	16.00- 17.50	17.00	20.00
December	16.00	16.00- 17.50	18.00	20.00

[1] Iron Age, vols. 135 and 136, 1935.

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 1935 was 60,752 short tons, a decrease of 28 percent from 1934. These stocks comprised about 27,400 tons of crude fluorspar (calculated to be equivalent to 11,800 tons of ready-to-ship fluorspar) and 33,389 tons of ready-to-ship fluorspar. The substantial decrease (about 17,200 tons) in stocks of ready-to-ship fluorspar in 1935 and the smaller decline of about 6,000 tons in stocks of crude fluorspar were noteworthy.

Stocks of fluorspar at mines or shipping points in the United States, 1934–35, by States, in short tons

State	1934 Crude[1]	1934 Ready-to-ship	1934 Total	1935 Crude[1]	1935 Ready-to-ship	1935 Total
California	50	----------	50	50	----------	50
Colorado	235	78	313	350	29	379
Illinois	8,372	25,725	34,097	7,447	22,684	30,131
Kentucky	24,246	24,681	48,927	19,143	10,519	29,662
Nevada	375	50	425	325	75	400
New Hampshire	----------	----------	----------	----------	30	30
New Mexico	----------	52	52	----------	52	52
Texas	48	----------	48	48	----------	48
	33,326	50,586	83,912	27,363	33,389	60,752

[1] The greater part of this crude (run-of-mine) fluorspar must be beneficiated before it can be marketed.

INDUSTRY IN 1935, BY STATES

COLORADO

Shipments of fluorspar from Colorado in 1935 were 6,978 short tons compared with 6,537 tons in 1934. Of the 1935 shipments, 5,701 tons went to steel plants, 610 tons to foundries, and the remainder to makers of cement, ferro-alloys, and glass and refiners of metals. Shipments in 1935 consisted of 82 tons from Boulder County, 2,850 tons from Chaffee County, 57 tons from Jackson County, and 3,989 tons from Mineral County. The movement of considerable fluorspar from the Chaffee County field to eastern markets is noteworthy and indicates low production costs.

ILLINOIS

Approximately 87,000 short tons of fluorspar-bearing material, equivalent to about 40,000 tons of merchantable fluorspar, were mined at 18 mines or prospects in Illinois in 1935 compared with 68,700 tons, equivalent to about 29,700 tons of merchantable fluorspar, mined at 17 mines or prospects in 1934.

Fluorspar-bearing material milled in Illinois in 1935 totaled 88,400 tons, from which 42,000 tons of merchantable fluorspar were recovered—a ratio of 2.105 : 1.

Shipments from Illinois were 44,120 short tons in 1935 compared with 33,234 tons in 1934.

KENTUCKY

So great was the demand for Kentucky fluorspar in 1935 that shipments (68,679 tons) have been exceeded in only 3 years—1918, 1928, and 1929. Consequently, almost any source that would yield fluorspar was drawn upon to meet the needs of shippers, some of whom were unable at times to supply the demands of consumers. Although most of the output came from mines of the fissure-vein type, which use mechanical equipment and follow more or less orderly systems of mining, a considerable tonnage was reclaimed from mill ponds, waste dumps, and old workings of abandoned mines.

Caldwell County.—Fluorspar mining in Caldwell County in 1935 was confined chiefly to the Hollowell & Hobby and Walker mines, although some mining was done at the Tyrie and Crook mines. Production of merchantable fluorspar was about 2,400 tons in 1935, a slight decrease from the 1934 production of 2,600 tons. Sales in 1935, however, were about 3,000 tons compared with about 2,100 tons in 1934.

Crittenden County.—The Lafayette mines, the largest producing unit in Crittenden County, were inactive in 1935; in consequence, the production of merchantable fluorspar in Crittenden County declined from 35,500 tons in 1934 to 19,400 tons in 1935. About half the merchantable fluorspar produced in Crittenden County in 1935 came from five mines—Memphis, Watson (Eagle), Two Brothers, Bachelor, and Davenport; the remainder was produced at an undetermined number of mines, prospects, and old workings of abandoned mines and reclaimed from waste dumps and mill ponds.

Livingston County.—Livingston County was the chief producing county of Kentucky in 1935; the production of merchantable fluorspar was 29,500 short tons compared with 9,900 tons in 1934. The chief producing mine was the Klondike, which had an output of 19,100 tons. The Nancy Hanks mine was the next largest producer; most of the remainder of the output was from the John-Jim, Bonanza, Hudson, Gossage, and Split Nickel mines.

NEVADA

Shipments of fluorspar from Nevada were 1,040 short tons in 1935 compared with 631 tons in 1934. Of the 1935 shipments, 942 tons went to steel plants, 52 tons to foundries, 32 tons to cement plants, and 14 tons to makers of enamel.

The chief producing mine in Nevada in 1935 was the Baxter in Mineral County, which shipped 841 tons. The other active mine was the Daisy in Nye County, which shipped 199 tons, including 14 tons of ground spar.

NEW HAMPSHIRE

Fluorspar mines near Westmoreland, Cheshire County, where development and construction of a concentrating plant have been under way, produced and shipped a small quantity of fluorspar in 1935.

NEW MEXICO

Shipments of fluorspar from New Mexico were 2,726 short tons in 1935 compared with 2,040 tons in 1934 and comprised 2,675 tons of ground fluorspar and 51 tons of metallurgical-gravel fluorspar.

Production of fluorspar in New Mexico in 1935 came from deposits near Deming in Luna County. A carload of metallurgical-gravel fluorspar in stock at a property in Dona Ana County was shipped in 1935.

TENNESSEE

During prospecting at a property in Smith County in 1935, 6 tons of high-grade lump fluorspar were mined; a quantity of fluorspar suitable for optical purposes also was recovered.

IMPORTS AND EXPORTS [1]

The total imports of fluorspar for consumption in the United States were 16,340 short tons (10,578 tons containing more than 97 percent and 5,762 tons containing not more than 97 percent calcium fluoride) valued [2] at $170,049 in 1935, compared with 16,705 tons (10,632 tons containing more than 97 percent and 6,073 tons containing not more than 97 percent calcium fluoride) valued [2] at $183,286 in 1934. The value assigned to the foreign fluorspar in 1935 averaged $10.96 a ton. The cost to consumers in the United States also includes duty, loading charges at the docks, ocean freight, insurance, consular fee, and freight from docks to consuming points.

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[1] 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.

[2] 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."

About 33 percent of the imports in 1935 was metallurgical-gravel fluorspar, 19 percent ceramic-ground fluorspar, and 48 percent acid (chiefly lump) fluorspar. The metallurgical-gravel fluorspar was imported from Spain and Germany, chiefly Spain; the ceramic-ground fluorspar was imported chiefly from Germany, followed by Spain and Italy; and the acid-grade fluorspar was imported chiefly from Germany, followed by the Union of South Africa and Spain.

Imports were equivalent to 13 percent of the total shipments of domestic fluorspar in 1935 compared with 19 percent in 1934.

Fluorspar imported for consumption in the United States, 1934–35, by countries

Country	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
1934						
Canada	----	----	187	$2,962	187	$2,962
China	2	$31	110	959	112	990
Germany	7,518	94,291	706	4,274	8,224	98,565
Italy	----	----	60	587	60	587
Newfoundland	297	6,460	448	4,000	745	10,460
Spain	818	12,800	4,096	22,516	4,914	35,316
Union of South Africa	1,997	31,872	----	----	1,997	31,872
United Kingdom	----	----	466	2,534	466	2,534
	10,632	145,454	6,073	37,832	16,705	183,286
1935						
Canada	----	----	1	14	1	14
Germany	8,585	115,562	1,258	3,713	9,843	119,275
Italy	----	----	55	589	55	589
Spain	646	10,522	4,448	24,910	5,094	35,432
Union of South Africa	1,347	23,739	----	----	1,347	23,739
	10,578	149,823	5,762	29,226	16,340	179,049

Fluorspar imported into the United States, 1931–35, by countries

Year	Africa		Canada		France		Germany		Italy	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1931	3,672	$40,375	280	$2,313	4,462	$33,646	6,491	$77,067	1,523	$24,267
1932	1,587	14,809	----	----	1,578	9,588	5,842	70,294	1,457	11,848
1933	712	12,449	----	----	204	1,247	4,333	54,836	533	4,533
1934	1,997	31,872	187	2,962	----	----	8,224	98,565	60	587
1935	1,347	23,739	1	14	----	----	9,843	119,275	55	589

Year	Spain		United Kingdom		All other		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1931	4,068	$31,786	----	----	213	$1,981	20,709	$211,435
1932	2,659	24,881	1	$378	112	867	13,236	132,665
1933	4,262	28,690	17	229	[1] 347	3,059	10,408	105,043
1934	4,914	35,316	466	2,534	857	11,450	16,705	183,286
1935	5,094	35,432	----	----	----	----	16,340	179,049

[1] Includes imports (320 short tons) reported to the Bureau of Mines by the importer; Bureau of Foreign and Domestic Commerce records 560 short tons valued at $3,500 from Newfoundland.

The following table, compiled from data courteously furnished the Bureau of Mines by importers, shows the quantities of imported fluorspar delivered to consumers in the United States in 1934 and 1935 and the selling price at tidewater (duty paid), irrespective of the year of importation into the United States; it differs from the preceding tables, which show the quantities received in the United States during 1934 and 1935. The quantities in this table are based on the actual outturn weight ascertained by sworn weighers and represent the weight on which duty was paid and entries were liquidated.

Imported fluorspar delivered to consumers in the United States, 1934–35

Industry	1934			1935		
	Short tons	Selling price at tidewater, including duty		Short tons	Selling price at tidewater, including duty	
		Total	Average		Total	Average
Steel	5,394	$100,830	$18.69	5,702	$102,635	$18.00
Glass	1,257	36,120	28.74	1,969	49,803	25.29
Enamel	583	17,324	29.72	920	24,447	26.57
Hydrofluoric acid	8,982	217,650	24.23	7,715	189,794	24.60
Cement	182	4,100	22.53			
	16,398	376,024	22.93	16,306	366,679	22.49

Manufacturers of glass and enamel purchased about the same proportion of their fluorspar supply from importers in 1935 as in 1934. Specifically, in 1935, such manufacturers purchased 2,889 short tons from importers and 14,343 tons from domestic producers, whereas in 1934 they purchased 1,840 and 9,933 tons, respectively. In both 1934 and 1935 most of the acid-grade fluorspar was supplied by importers, but the proportion supplied by domestic producers in 1935 was greater than in 1934; in 1935, domestic producers supplied 3,333 tons and importers 7,715 tons, whereas in 1934 domestic producers furnished 1,666 tons and importers 8,982 tons.

Producers of fluorspar reported exports of 313 short tons valued at $4,651 in 1935 compared with 522 tons valued at $8,602 in 1934. In 1935 all the fluorspar exported went to Canada; in 1934, 491 tons were exported to Canada and 31 tons to Peru.

Fluorspar reported by producers as exported from the United States, 1931–35

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1931	311	$5,599	$18.00	1934	522	$8,602	$16.48
1932	25	553	22.12	1935	313	4,651	14.86
1933	71	967	13.62				

FLUORSPAR IN FOREIGN COUNTRIES

Canada.[3]—The production of fluorspar in Canada was 225 short tons valued at $2,700 in 1935 compared with 150 tons valued at $2,100 in 1934. The output in both years was from Hastings County, Ontario.

[3] Data from Dominion Bureau of Statistics, Preliminary Report on the Mineral Production of Canada During the Calendar Year 1935; Ottawa, 1936, p. 36.

Imports of fluorspar into Canada were 11,591 short tons valued at $92,775 in 1935 compared with 7,220 tons valued at $56,628 in 1934.

Newfoundland.—The deposits of fluorspar in the Districts of Burin East and Burin West, Newfoundland, at which mining was begun in 1933, yielded about 6,500 short tons of fluorspar in 1935, of which 4,500 tons were shipped to consumers in Ontario and Nova Scotia. Shipments in 1934 were 2,794 short tons, of which 877 tons were exported to the United States.

Union of South Africa.—According to the Department of Mines.[4]

There has been an increasing demand from America for the high-grade quality of fluorspar. Previous to this the market was very precarious with the result that work on several deposits ceased altogether. With the renewed demand, an endeavor is being made to increase production. Exports increased from 224 tons to 1,010 tons during the last quarters. Western Quarries, Ltd., is erecting a plant in the Marico District, capable of producing 500 tons of ground spar per month assaying +98 percent CaF_2 and −1 percent SiO_2. It is anticipated that this plant will be in operation within the next few weeks. No work is being done on either the Hlabisa Natal deposits or those on Gamib near Kalkfontein, S.W. Africa. Production from the Warmbad area, Transvaal, continues mainly for local consumption.

The fluorspar veins near Hlabisa, Zululand, are the subject of a paper by Kupferburger,[5] who describes the geology and individual occurrences. Kupferburger writes as follows on the economic considerations of the deposits:

Past experience has shown that profitable export business in fluorspar can only be done in high-grade material, containing not less than 98 percent CaF_2 and not more than 1 percent SiO_2 when shipped in bulk, and preferably in "lump" form.

In spite of the association of quartz with the fluorspar in the vein filling, it has been found possible by careful cobbing to obtain material of the desired purity in bulk. Owing to the presence of quartz in the forms described, i. e., either as thin stringers through the fluorspar or as a selvage to the veins, which unfortunately have a tendency to break away with the fluorspar, the wastage in cobbing operations is likely to be high, probably in the neighborhood of 30 percent.

Moreover, unless crushing and some method of mechanical separation is adopted, the smaller veins of less than 3 inches in width will have to be disregarded in any estimate of available tonnage for the production of commercial-grade "acid-lump" fluorspar.

At the time of my visit comparatively little prospecting work had been done except at Rabe's workings and Haupt's "Minnie" workings. Most of the other promising outcrops have been prospected to some extent, but the general practice of exposing only one side of the vein and the outer margins of the veined zones on both sides, instead of cutting the trenches right through the fluorspar, made the estimation of the total available tonnage of fluorspar somewhat uncertain. The individual veins, where opened up, show rapid variations in width, and are limited in their lateral extent. Vertical persistence has not been proved to more than 100 feet at most, and in most cases there is a gradual narrowing down in the width of the larger veins. In view of the deep-seated origin of the fluorspar, however, it is highly probable that, although some of the veins exposed near the surface may eventually pinch out, other parallel and related veins may be proved within the fissured zones and continue to greater depths. On account of the reasons given above, no definite estimate of tonnage can be given, but the available reserves of exportable fluorspar of the various deposits collectively is not large; and in view of the nature of the deposits, viz., fissure veins and the absence of any beds of limestone in the country rocks through which the fissures pass, it is unlikely that they will lead in depth to any larger bodies formed by metasomatic replacement such as those occurring in the dolomite of the Western Transvaal.

The comparative proximity to the port of Durban of these deposits (180–200 miles by road and railway), compared with the much greater distance over which

[4] Department of Mines, Union of South Africa, Pretoria, Industrial Minerals: Quarterly Inf. Circ., February 1936, p. 26.

[5] Kupferburger, W., Fluorspar Veins Near Hlabisa, Zululand: Trans. Geol. Soc. So. Africa, vol. 37, Johannesburg, 1935, pp. 87–96.

the fluorspar from the Western Transvaal has to be transported by rail to the ports, led to a good deal of optimism about the exploitation of these deposits.

Unfortunately, the export business in fluorspar has decreased greatly during the past year or two * * *. There has consequently been little justification and encouragement for the development of new properties.

Should there, however, be any revival in the demand for fluorspar and an increase in price, these deposits will no doubt be worked by mining the larger veins to such depths as the economic factors of cost of production and price of the mineral will permit.

WORLD PRODUCTION

World production of fluorspar, 1931–35, by countries, in metric tons [1]

[Compiled by M. T. Latus]

Country	1931	1932	1933	1934	1935
Argentina [2]		10	200	311	(3)
Australia:					
New South Wales	12		51	203	(3)
Queensland	529	1,240	749	1,328	(3)
South Australia		41	201	234	(3)
Canada	36	29	66	136	204
China [4]	7,100	7,100	7,100	7,100	(3)
Chosen	2,648	7,577	9,076	12,099	(3)
France	23,800	15,200	(3)	(3)	(3)
Germany:					
Anhalt	(3)	(3)	(3)	7,357	(3)
Baden	(3)	(3)	(3)	6,527	(3)
Bavaria	26,780	21,915	26,364	29,661	(3)
Prussia	12,842	7,794	10,653	21,555	(3)
Saxony	6,937	2,656	3,672	4,945	(3)
Italy	5,850	6,450	7,714	9,668	9,500
Mexico [4]	900	900	900	900	(3)
Newfoundland (shipments)			1,451	2,535	4,082
Norway	630	571	507	673	(3)
South-West Africa		610			(3)
Spain	6,017	7,018	3,564	6,365	(3)
Switzerland [4]	1,000	1,000	1,000	1,000	(3)
Union of South Africa	2,197	1,317	445	1,393	1,730
United Kingdom	20,242	15,675	28,508	34,765	(3)
United States (shipments)	48,520	22,907	66,161	77,823	112,092

[1] In addition to countries listed, U.S.S.R. (Russia) produces fluorspar, but data of output are not available.
[2] Railway shipments.
[3] Data not available.
[4] Estimated annual output.

CRYOLITE

Cryolite occurs in commercial quantity and is mined at only one place—Ivigtut, Greenland. The greater part of the product is shipped to Copenhagen; the remainder is exported to the United States, from which country some is reexported to Canada.

The ore shipped to the United States ranges from approximately 70 percent to more than 90 percent pure cryolite. The ores, of varying gradations of purity, generally are mixed in shipment; except in rare instances, the material is run through the purification plant as it is received. The method of purification consists essentially of a series of magnets, tables, jigs, and flotation.

The purified cryolite is used chiefly in the metallurgy of aluminum and in making opaque glass. Considerable ground cryolite is being used in insecticides. Although fine cryolite resulting from the purification process has been so used for many years, an efficient method of grinding cryolite to a fineness that would permit its use for insecticides was discovered only recently.

Imports.—The following table shows imports of cryolite into the United States in 1934 and 1935 by countries. As cryolite is mined only in Greenland, it is presumed that most of the importations credited to countries other than Greenland include artificial cryolite and reexports of natural cryolite.

Cryolite imported for consumption in the United States, 1934–35, by countries

Country	1934		1935	
	Long tons	Value	Long tons	Value
Belgium	9	$732		
Canada	192	21,453	637	$71,850
Denmark			10	1,936
France	361	52,709	323	15,246
Germany	675	106,074	1,029	173,321
Greenland	3,213	195,900	6,300	384,000
Netherlands			(1)	37
	4,450	376,868	8,299	646,390

1 Less than 1 ton.

FELDSPAR

By R. W. Metcalf

SUMMARY OUTLINE

Paralleling the sharp increase in construction of new residences and the accompanying activity in the glass and sanitary ware industries, crude and ground feldspar recovered substantially in 1935. Crude feldspar produced in the United States totaled 189,550 long tons valued at $1,005,021 in 1935 compared with 154,188 tons valued at

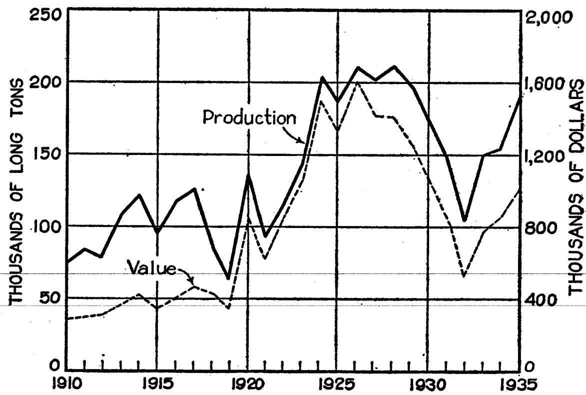

Figure 145.—Trends in production and value of crude feldspar in the United States, 1910–35.

$853,136 in 1934—increases of 22.9 percent and 17.8 percent, respectively. The average value per ton, however, decreased slightly from $5.53 in 1934 to $5.30 in 1935. Trends in production and value of crude feldspar since 1910 are shown in figure 145.

All States producing crude spar in 1935 shared the increased output except Arizona and New York. The output of feldspar mined in California and Colorado nearly doubled in volume over that in 1934, and production in South Dakota jumped 140.5 percent. Output in North Carolina, the leading producing State, increased 3.3 percent over 1934. Production in Maine increased 16.5 percent; in New Hampshire, 27.8 percent; and in Virginia, 22 percent.

Of particular interest are the shift in production and the much higher relative gains in output at the lower-cost operations in the West, notably in Colorado and South Dakota, which jumped from fifth and sixth, respectively, in order of output in 1934 to second and third in 1935.

The tonnage of domestic feldspar ground by merchant mills in 1935 again showed a greater increase over the previous year than the output of crude spar mined, indicating further withdrawals of accumulated crude stocks and reflecting the increased demand for ground spar created by awakening industrial activity. Total sales of ground feldspar by merchant mills increased 38.8 percent in tonnage and 42.3 percent in value over 1934; the 1935 figures rose to 200,095 short tons valued at $2,659,140, the highest levels since 1929. The average value per ton of domestic ground spar increased from $12.66 per short ton in 1934 to $13 per ton in 1935. The average value of Canadian spar ground by mills in the United States in 1935, although considerably higher than that of the domestic product, dropped about 1 percent to $18.42.

Salient statistics of the feldspar industry in the United States, 1934–35

	1934	1935	Percent of change in 1935
Crude feldspar sold or used by producers:			
Long tons	154, 188	189, 550	+22. 9
Value	$853, 136	$1, 005, 021	+17. 8
Average per long ton	$5. 53	$5. 30	−4. 2
Ground feldspar sold by merchant mills:			
Short tons	144, 178	200, 095	+38. 8
Value	$1, 868, 500	$2, 659, 140	+42. 3
Domestic:			
Short tons	136, 820	189, 289	+38. 3
Value	$1, 731, 528	$2, 460, 073	+42. 1
Average per short ton	$12. 66	$13. 00	+2. 7
Canadian:			
Short tons	7, 358	10, 806	+46. 9
Value	$136, 972	$199, 067	+45. 3
Average per short ton	$18. 62	$18. 42	−1. 1
Feldspar imported for consumption:			
Crude:			
Long tons	9, 744	8, 937	−8. 3
Value	$67, 258	$56, 175	−16. 5

Markets.—A sharp upturn in construction in 1935, particularly new residences and alterations, resulted in improved markets for sanitary ware and other building accessories consuming large quantities of feldspar. Full details of construction statistics are included in the chapter on Stone in this volume.

Production of all bathroom accessories, as reported by the Bureau of the Census, increased 25 percent—from 2,373,478 pieces in 1934 to 2,964,820 pieces in 1935. Shipments of vitreous-china plumbing fixtures were almost double those in 1934. Shipments of porcelain plumbing fixtures and porcelain enameled flatware increased 8 and 17 percent, respectively.

Electrical porcelain apparently consumed increased quantities of feldspar in 1935, as shipments of special and standard porcelain advanced 52 and 36 percent, respectively, over 1934.

Glass manufacture consumes more than half the output of ground feldspar. It is used primarily as a source of alumina, but also contains soda and potash, valuable ingredients of the mix. Shipments of glass containers in 1935 were 7 percent higher than in 1934, and production of illuminating glassware increased 32 percent.

Summary of data relating to markets for feldspar, 1934–35 [1]

	1934	1935	Percent of change in 1935
Bathroom accessories, production [2] ... pieces	2,373,478	2,964,820	+25
Porcelain plumbing fixtures, shipments [2] ... do	25,111	27,089	+8
Vitreous-china plumbing fixtures, shipments [2] ... do	1,361,139	2,479,913	+82
Porcelain enameled flatware, shipments [2]	$8,119,299	$9,481,343	+17
Electrical porcelain, shipments: [3]			
Special	$529,073	$805,750	+52
Standard	$277,808	$377,128	+36
Glass containers, shipments [4] ... gross	2,920,000	3,136,000	+7
Illuminating glassware, production [5] ... turns	1,517	2,005	+32

[1] Data in this table are published monthly in Survey of Current Business.
[2] U. S. Bureau of the Census.
[3] National Electrical Manufacturers' Association.
[4] Glass Containers Association.
[5] Illuminating Glassware Guild.

No data are available on production of opaque structural glass, tile, or pottery, also important outlets for feldspar.

Operators of merchant feldspar mills in 1935 were again requested to indicate sales of ground spar by uses. These data are summarized in the following table:

Ground feldspar sold by merchant mills in the United States in 1935, by uses

Use	Short tons	Percent of total	Use	Short tons	Percent of total
Glass	103,499	51.7	Other ceramic uses	1,511	0.8
Pottery	66,454	33.2	Soaps and abrasives	350	.2
Enamel and sanitary ware	21,014	10.5	Binder for abrasive wheels	241	.1
Insulators and other porcelain goods	4,058	2.0	Other uses	3	----------
Brick and tile	2,965	1.5		200,095	100.0

Capacity.—The feldspar industry maintains grinding equipment greatly in excess of that required to supply current demands. This condition has been apparent for many years. Even in 1929 mills were operated at only about 28 percent of capacity, and in 1933 the industry was operating at approximately 13 percent of capacity, according to the Administrator's report to the President [1] dated January 16, 1934, approving the Code of Fair Competition for the Feldspar Industry. Producers of ground spar were requested to give the capacity of their mills in 1935, that is, the number of short tons of ground feldspar that could have been produced during the year, working the usual number of hours a day, assuming a continuous demand and allowing for unavoidable shut-downs for repairs or other unforeseen delays. Mills producing 178,489 short tons (about 89 percent of the total output of ground spar in the United States in 1935) reported a capacity of 431,600 short tons, which indicated an approximate total capacity of grinding equipment in the industry of 485,000 short tons.

Prices.—Except for glass spar quoted prices on virtually all grades of feldspar did not fluctuate in 1935. North Carolina granular glass spar, 20-mesh, quoted from January to June at $11.50 per ton, advanced to $12.50 in July and remained at that price the rest of the

[1] National Recovery Administration, Code of Fair Competition for the Feldspar Industry: Approved Code 206, p. 155.

year. Potash spar, f. o. b. North Carolina, was quoted at $17 a ton throughout the year, while soda spar, also from North Carolina, was quoted at $19 a ton. Quotations on Maine white potash spar, 200-mesh, and Virginia No. 1, 200-mesh, also were unchanged at $17 a ton. Quoted prices on Virginia No. 1 glassmakers' spar advanced from $10.75 a ton from January through June to $11.75 for the rest of the year. Quotations on enamelers' spar were unchanged at $14 to $16, f. o. b. Virginia.

The average value of all ground feldspar sold by producers in the United States advanced from $12.66 in 1934 to $13 in 1935.

Nepheline syenite.—A recent development affecting the feldspar industry is the use of nepheline syenite as a glass-batch constituent to replace feldspar wholly or in part. Nepheline syenite is an igneous rock consisting of orthoclase, nephelite, and one or more of the following minerals: Hornblende, augite, and biotite. An analysis after removal of iron is as follows: Silica, 59.70 percent; alumina, 23.70 percent; iron oxide, 0.05 percent; titania, 0.01 percent; lime, 0.27 percent; magnesia, 0.02 percent; soda, 9.91 percent; potash, 5.10 percent; loss on ignition, 0.44 percent; and fusion point, 1,210° C.

A large deposit of nepheline syenite at Blue Mountain in Methuen Township near Peterboro, Ontario has been opened up by Canadian Nepheline, Ltd., and a grinding and concentrating plant has been erected at Lakefield, Ontario. High-grade reserves are said to be abundant, and the rock is uniform in character and contains a minimum of impurities. Although the material is not yet produced upon a large scale, its natural advantages, combined with an accessibility comparable to that of feldspar, indicate that it will have important industrial application in the glass and other ceramic industries.

REVIEW OF INDUSTRY BY STATES

The term "crude feldspar" is applied to the lump spar shipped from the mine or quarry contrasted with ground spar, the finished product of the crushing and pulverizing equipment. Statistics of production are presented separately for crude and ground spar; in accordance with the usual practice in the industry the crude is reported in long tons of 2,240 pounds and the ground in short tons of 2,000 pounds.

In years of normal business activity the quantity of ground spar produced from domestic crude averages about 87 percent of the crude output; the remaining 13 percent includes spar used for purposes not requiring fine grinding and that lost or discarded during grinding. Sales of ground domestic spar, which were only 75 percent of the total crude output in 1933 and 79 percent in 1934, increased to 89 percent in 1935, indicating that accumulated reserves of crude spar have been drawn upon more heavily than in other recent years.

Crude feldspar.—Crude feldspar sold or used by producers in the United States in 1935 totaled 189,550 long tons valued at $1,005,021, an increase of 22.9 percent in quantity and 17.8 percent in value over 1934. The average value of crude spar at the mine or shipping point was $5.30, a decrease of 23 cents (4.2 percent) from the 1934 realization of $5.53. The average value of crude feldspar as reported by individual producers ranged from $2.17 to $14.61 a long ton. For New England the value ranged from $3.38 to $14.61; for New York, Pennsylvania, and Virginia, from $4.45 to $8.92; for North Carolina, from $3.70 to $9.06; and for the Western States, from $2.17 to $7.

Crude feldspar sold or used by producers in the United States, 1930–35

Year	Long tons	Value: Total	Value: Average	Year	Long tons	Value: Total	Value: Average
1930	171,788	$1,066,636	$6.21	1933	150,633	$778,826	$5.17
1931	147,119	861,059	5.85	1934	154,188	853,136	5.53
1932	104,715	539,641	5.15	1935	189,550	1,005,021	5.30

Crude feldspar was produced in 13 States in 1935, the same number as in 1934; Maryland, Nevada, and Pennsylvania reported small outputs, while Minnesota produced no crude spar in 1935. North Carolina, with the largest output of crude spar of any State, increased its production to 82,499 long tons (3.3 percent more than in 1934) and accounted for 43.5 percent of the United States total. Colorado with 22,275 tons and South Dakota with 22,099 tons were next in order of production. Maine dropped to fourth place in 1935 with an output of 17,103 tons (16.5 percent more than in 1934). Output of spar in New Hampshire was 15,490 tons and in Virginia 14,810 tons, increases of 27.8 and 22.0 percent over 1934. The other producing States in order were New York, Connecticut, California, Arizona, Maryland, Pennsylvania, and Nevada.

Crude feldspar sold or used by producers in the United States, 1933–35, by States

[Value is at mine or nearest shipping point]

State	1933 Long tons	1933 Value	1934 Long tons	1934 Value	1935 Long tons	1935 Value
Arizona	(1)	(1)	(1)	(1)	(1)	(1)
California	1,433	$10,189	(1)	(1)	3,015	$21,105
Colorado	(1)	(1)	(1)	(1)	22,275	64,151
Connecticut	(1)	(1)	(1)	(1)	(1)	(1)
Maine	11,273	48,380	14,685	$82,854	17,103	99,770
Maryland	----------	----------	(1)	(1)	(1)	(1)
Minnesota	(1)	(1)	----------	----------	----------	----------
Nevada	----------	----------	(1)	(1)	(1)	(1)
New Hampshire	12,425	82,978	12,119	80,733	15,490	115,089
New York	6,138	41,736	6,262	37,275	5,468	39,904
North Carolina	85,962	471,312	79,844	465,214	82,499	482,729
Pennsylvania	213	1,442	64	456	245	1,847
South Dakota	3,220	12,058	9,190	30,892	22,099	62,498
Virginia	13,459	52,758	12,140	64,529	14,810	81,474
Undistributed	16,510	57,973	19,884	91,183	6,546	36,454
	150,633	778,826	154,188	853,136	189,550	1,005,021

[1] Included under "Undistributed."

Ground feldspar.—Almost all the feldspar consumed industrially is prepared by fine grinding. Even that used for facing cement blocks, covering prepared roofing, and similar purposes is crushed to small sizes and more or less graded by screening. It has not been practicable to canvass all consumers of feldspar to determine the quantities used by them, but all known merchant mills or grinders—that is, those that quarry or purchase crude spar and grind it for sale to other establishments—have been canvassed during recent years.

Ground feldspar sold by merchant mills in 1935 totaled 200,095 short tons, valued at $2,659,140, an increase of 38.8 percent in tonnage and 42.3 percent in value compared with 1934. In 1935, 29 mills were operated by 23 producing companies in 14 States. Domestic spar was handled exclusively by 25 mills and imported (Canadian) spar exclusively by 3 mills, while 1 mill ground both imported (Canadian) and domestic material. Approximately 95 percent of total quantity ground in both 1935 and 1934 was domestic and 5 percent Canadian spar.

Ground feldspar sold by merchant mills [1] in the United States, 1931–35

Year	Number of active mills	Domestic			Canadian			Total	
		Short tons	Value		Short tons	Value		Short tons	Value
			Total	Average		Total	Average		
1931	29	132,542	$1,630,917	$12.30	11,382	$222,476	$19.55	143,924	$1,853,393
1932	27	104,289	1,174,833	11.27	3,460	65,659	18.98	107,749	1,240,492
1933	25	126,418	1,491,904	11.80	6,590	125,648	19.07	133,008	1,617,552
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

[1] Does not include potters or others who grind for consumption in their own plants.

The average value of the ground feldspar from domestic crude was $13 in 1935, an increase of 34 cents (2.7 percent) over 1934; the average value reported for the various States ranged from $7.44 to $21.73 per ton. Ground feldspar from imported crude averaged $18.42—20 cents less than in 1934.

North Carolina was the largest producer of ground feldspar, followed by Tennessee and Colorado. These three States produced 50 percent of the total compared with 55 percent in 1933 and 1934. The other producing States in order were South Dakota, Virginia, New York, Maine, New Jersey, and New Hampshire, with smaller tonnages from Illinois, Arizona, California, Ohio, and Minnesota.

Production of ground spar showed substantial gains over 1934 in all States except North Carolina and Arizona, which produced less than in 1934, and Ohio, which showed only a slight gain.

Ground feldspar sold by merchant mills [1] in the United States, 1934–35, by States

State	1934					1935				
	Number of active mills	Domestic		Canadian		Number of active mills	Domestic		Canadian	
		Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
California	1	(2)	(2)			1	2,694	$37,552		
Colorado	1	12,417	$95,858			1	22,320	166,071		
Maine	3	8,979	136,672			4	14,154	212,486		
New Hampshire	1	6,565	83,470			2	(2)	(2)		
New Jersey	3	8,416	165,980			3	13,091	260,297		
New York	4	(2)	(2)	6,579	$125,572	4	(2)	(2)	8,556	$164,734
Ohio	2	(2)	(2)	(2)	(2)	2	(2)	(2)	(2)	(2)
North Carolina Tennessee	4 1	67,497	847,835			4 2	78,012	1,043,979		
Undistributed [3]	6	32,946	401,713	779	11,400	6	59,018	739,688	2,250	34,333
	26	136,820	1,731,528	7,358	136,972	29	189,289	2,460,073	10,806	199,067

[1] Does not include potters or others who grind for consumption in their own plants.
[2] Included under "Undistributed."
[3] 1934: Arizona, California, Illinois, Minnesota, New York, Ohio, South Dakota, and Virginia; 1935: Arizona, Illinois, Minnesota, New Hampshire, New York, Ohio, South Dakota, and Virginia.

IMPORTS [2]

After a sharp rise to 9,744 long tons valued at $67,258 in 1934, imports of crude feldspar dropped slightly to 8,937 tons valued at $56,175 in 1935. All imports of crude spar were from Canada except 50 tons valued at $343 from Sweden and 2 tons valued at $27 from Norway.

One short ton of ground feldspar valued at $106 was imported from Germany.

Imports of Cornwall stone in 1934 were only 10 long tons valued at $143. In 1935, however, imports of crude Cornwall stone were 817 long tons valued at $7,449 and of ground, 242 tons valued at $3,180. Complete figures on imports of Cornwall stone are given in Minerals Yearbook, 1934, page 1003.

Feldspar imported for consumption in the United States, 1930–35

Year	Crude		Crushed or ground		Year	Crude		Crushed or ground	
	Long tons	Value	Short tons	Value		Long tons	Value	Short tons	Value
1930	21,006	$167,157	57	$586	1933	3,239	$21,877	30	$242
1931	10,719	95,096	79	1,500	1934	9,744	67,258		
1932	1,872	14,346	28	218	1935	8,937	56,175	1	106

WORLD PRODUCTION

Aside from the United States the most important producing countries for feldspar are Sweden, Norway, Canada, and probably Czechoslovakia, although no official figures for Czechoslovak output are available. Virtually the entire production of Canada (16,762 metric tons in 1935) is shipped to the United States for grinding.

In Germany [3] flotation of granite has been undertaken to determine the possibility of producing feldspar commercially. It is reported that the feldspar thus obtained is suitable for ceramic mixtures and glass batches and that it can compete with Scandinavian spar.

Available figures on world production of feldspar are summarized in the following table.

World production of feldspar, 1931–35, by countries, in metric tons

[Compiled by M. T. Latus]

Country [1]	1931	1932	1933	1934	1935
Argentina (shipments)	172	369	376	431	(2)
Australia:					
New South Wales [3]	103	590	2,037	891	166
South Australia [3]		65	112	212	315
Western Australia (exports)	106	367	460	1,845	(2)
Canada (shipments)	16,640	6,393	9,669	16,603	16,762
Egypt	26	179	60		72
Finland (exports)	67	1,529	2,706	3,329	(2)
France	10,700	(2)	(2)	(2)	(2)
Germany (Bavaria)	5,000	3,550	4,490	6,808	(2)
India (British)	339	481	688	638	(2)
Italy	4,750	5,217	4,861	7,637	(2)
Norway (exports)	15,105	13,015	17,986	22,139	24,229
Rumania	3,068	681	1,309	1,026	(2)
Sweden	33,113	23,693	32,567	34,468	(2)
United States (shipments)	149,480	106,396	153,051	156,663	192,592

[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 available.
[3] Includes some china stone.

[2] Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.
[3] Chemical and Metallurgical Engineering, vol. 42, no. 7, July 1935, p. 399.

ASBESTOS

By Oliver Bowles and B. H. Stoddard

SUMMARY OUTLINE

As the United States furnishes only 2 to 4 percent of its own requirements of raw asbestos, sources of supply in foreign countries are of the utmost importance to the asbestos-product-manufacturing industries. Small quantities of high-grade spinning asbestos are obtained in Arizona, and an increasing tonnage of short fiber chrysotile is secured in Vermont. Amphibole asbestos (anthophyllite) is mined in a small way in Washington, Montana, Georgia, North Carolina, and Maryland. The United States depends mainly on Canada for its supply of nonspinning fiber and upon South Africa, Canada, and Russia for nearly all of its spinning asbestos.

The varieties, properties, occurrences throughout the world, uses, mining and milling methods, classification, and marketing of asbestos and the manufacture of asbestos products are discussed in a series of three reports issued recently.[1]

Domestic production of asbestos amounted to 9,415 short tons in 1935 compared with 6,544 tons in 1934, an increase of 43.9 percent. The quantity sold or used by producers in 1935 (8,920 tons valued at $292,927) increased 75.3 percent in quantity and 85 percent in value over 1934. Compared with 1934 the apparent consumption of asbestos in 1935 increased 41 percent in quantity and 55 percent in value. The value of exports of asbestos products increased 5.6 percent.

Salient statistics of the asbestos industry in the United States, 1934–35

	1934		1935	
	Short tons	Value	Short tons	Value
Domestic asbestos (chrysotile and amphibole) [1]—				
Produced	6, 544	(2)	9, 415	(2)
Sold or used by producers	5, 087	$158, 347	8, 920	$292, 927
Imports (unmanufactured)	120, 334	3, 377, 994	166, 585	5, 125, 413
Exports (unmanufactured)	1, 669	94, 182	850	87, 896
Apparent consumption	123, 752	3, 442, 159	174, 655	5, 330, 444
Exports of asbestos products	(2)	2, 142, 514	(2)	2, 261, 929

[1] Bureau of Mines not at liberty to publish figures separately for chrysotile and amphibole.
[2] Figures not available.

[1] Bowles, Oliver, Asbestos—Domestic and Foreign Deposits: Inf. Circ. 6790, Bureau of Mines, 1934, 24 pp. Asbestos—General Information: Inf. Circ. 6817, Bureau of Mines, 1935, 21 pp. Asbestos—Milling, Marketing, and Fabrication: Inf. Circ. 6869, Bureau of Mines, 1935, 26 pp.

Consumption trends.—The following table of apparent consumption of raw asbestos, value of products manufactured, and value of products exported shows major trends in recent years. Apparent consumption is determined by adding imports to domestic asbestos sold or used by producers and subtracting exports. No data are available to make adjustments for variation in consumers' stocks.

Raw asbestos consumed in the United States and asbestos products manufactured in and exported from the United States, 1931–35

Year	Raw asbestos—apparent consumption	Asbestos products		Year	Raw asbestos—apparent consumption	Asbestos products	
		Manufactured [1] (value)	Exported (value)			Manufactured [1] (value)	Exported (value)
	Short tons				*Short tons*		
1931	137,875	$56,164,690	$2,606,166	1934	123,752	(1)	$2,142,514
1932	98,606	(1)	1,608,880	1935	------------	(2)	(2)
1933	122,909	41,598,866	1,743,140				

[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] Figures not yet available.

The principal use of spinning asbestos is for the manufacture of automobile brake-band linings. During recent years increasing quantities of the shorter fiber are used for molded brake linings. Accordingly a close relationship exists between activity in the automobile industry and consumption of asbestos in the United States. Other important uses are in roofing and wallboard manufacture and for heat insulation; therefore consumption of asbestos tends to follow fluctuations in building activity. Figure 146 illustrates these relationships.

Market conditions.—The pronounced recovery in building construction in 1935, particularly during the latter part of the year, created a growing demand for asbestos used in building materials and for heat insulation. Similarly, the pronounced gain in automobile sales stimulated the market for the longer grades.

Prices.—Price quotations for Canadian asbestos were constant throughout the year as follows: Crude No. 1, $500; Crude No. 2, $200–$225; spinning fibers, $90–$135; magnesia and compressed sheet fibers, $90–$100; shingle stock, $45–$75; paper stock, $32.50–$37.50; cement stock, $19–$23; and floats, $16–$18.50.

Rhodesian Crude No. 1 was quoted at $210 throughout the year and Crude No. 2 at $160 until October and $185 during November and December.

Russian Crude No. 1 was not quoted until July. The price was $185 July to October and $200 November and December. Crude No. 2 was $165–$170 and Crude No. 3, $125–$135 all year. Shingle stock ranged from $45 to $60 throughout the year. Beginning July 1935 a new classification designated Crude "AA" was quoted regularly at $450 a ton.

Vermont shingle stock was quoted at $45–$47.50, paper stock at $35, and cement stock at $23 throughout the year. Canadian prices are f. o. b. Quebec mines, tax and bags included; Rhodesian and Russian, c. i. f. New York; and Vermont prices, f. o. b. mines, Vermont.

REVIEW BY STATES

Arizona.—A small production was recorded in 1935, and sales were somewhat larger than mine output.

Maryland.—The Powhatan Mining Corporation continued production and preparation of filter asbestos mined near Pylesville.

Montana.—The anthophyllite property operated for several years by Peter F. Karst was acquired by the Karstolite Co. in 1936. This firm manufactures the asbestos into a wall and ceiling insulation sold under the trade name "Karstolite."

North Carolina.—Mill equipment for treating mass-fiber anthophyllite at Minneapolis, Avery County, was improved considerably

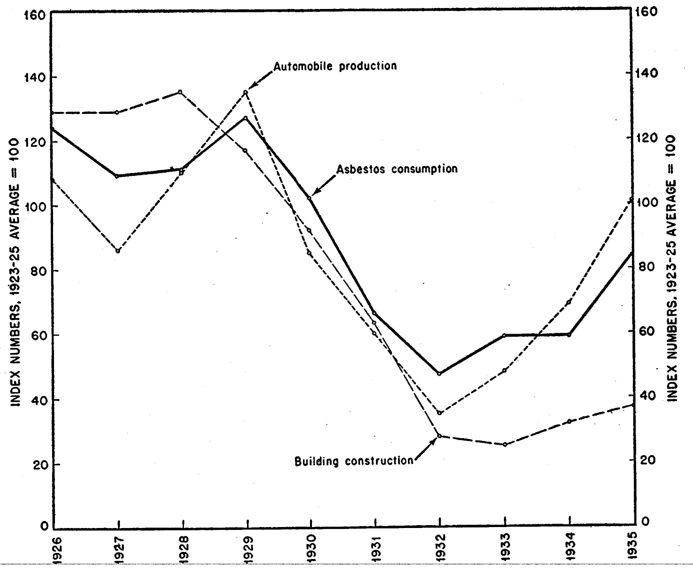

FIGURE 146.—Asbestos consumption compared with automobile production and building construction, 1926–35. Unlike units are reduced to percentages of the 1923–25 average. Statistics of asbestos are from the Bureau of Mines, automobiles from the Bureau of the Census, and building contracts from the Federal Reserve Board.

in 1935, and steps were taken to develop a market for prepared asbestos to be used in home insulation and in many other ways.

Vermont.—Production of nonspinning chrysotile fiber near Hyde Park, Lamoille County, is attaining increasing importance. In February 1936 the property of the Vermont Asbestos Corporation of America was acquired by Vermont Production Co., Inc., a subsidiary of the Ruberoid Co., and, with plant additions and improvements, an increase in output is anticipated.

Washington.—The material produced near Burlington, formerly included in the Asbestos chapter, is a mixture of talc and asbestos. As the major part of the marketed product is talc, the material has been included in the Talc chapter.

FOREIGN TRADE [2]

Imports.—The following table shows for 1934 and 1935 the imports of unmanufactured asbestos into the United States.

[2] Data 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 into the United States, 1934–35, by countries and classes

Country	Crude (including blue fiber)		Mill fiber		Stucco and refuse		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1934								
Africa, British:								
Union of South Africa	595	$62,667					595	$62,667
Other British	1,199	135,812					1,199	135,812
Canada	1,093	218,649	41,960	$1,807,512	70,007	$1,000,402	113,060	3,026,563
Egypt					100	1,417	100	1,417
Finland					38	1,920	38	1,920
Italy	16	9,775			246	1,774	262	11,549
Malta, Gozo, Cyprus					2,463	43,611	2,463	43,611
U. S. S. R. (Russia)	657	26,434			1,938	63,005	2,595	89,439
United Kingdom	22	5,016					22	5,016
	3,582	458,353	41,960	1,807,512	74,792	1,112,129	120,334	3,377,994
1935								
Africa, British:								
Union of South Africa	945	121,577					945	121,577
Other British	1,183	172,654					1,183	172,654
Canada	1,548	301,352	58,484	2,713,895	94,204	1,470,865	154,236	4,486,112
Finland					11	446	11	446
Italy	22	11,464			523	5,202	545	16,666
Malta, Gozo, Cyprus					4,628	87,844	4,628	87,844
Morocco	22	2,131					22	2,131
U. S. S. R. (Russia)	18	7,351	4,614	206,347	181	834	4,813	214,532
United Kingdom	202	23,451					202	23,451
	3,940	639,980	63,098	2,920,242	99,547	1,565,191	166,585	5,125,413

Exports.—The following table shows exports of asbestos products in 1934 and 1935.

Manufactured asbestos products exported from the United States, 1934–35, by kinds

Product	1934		1935	
	Quantity	Value	Quantity	Value
Brake lining:				
Molded and semimolded	(1)	$607,193	(1)	$651,338
Not molded ... linear feet	1,641,333	255,018	1,426,520	231,381
Paper, millboard, and roll board ... short tons	602	96,154	767	130,578
Pipe covering and cement ... do	1,389	[2] 126,190	1,233	143,357
Textiles, yarn, and packing ... do	619	[2] 594,625	715	662,321
Magnesia and manufactures ... do	1,277	241,410	922	146,068
Asbestos roofing ... squares	26,457	75,254	31,141	106,678
Other manufactures ... short tons	[2] 799	146,670	921	190,208

[1] Quantity not recorded.
[2] Revised figure.

WORLD PRODUCTION

Asbestos production is centered chiefly in Quebec (Canada), Southern Rhodesia, the Union of South Africa, the U. S. S. R. (Russia), and Cyprus. Relatively small quantities are produced in Italy, Australia, Finland, and several other countries. The following table shows world production, by countries, from 1931 to 1935 insofar as figures are available.

World production of asbestos, 1931–35, in metric tons [1]

[Compiled by M. T. Latus, Foreign Mineral Service Division]

Country	1931	1932	1933	1934	1935
Argentina	----------	[2] 7	----------	----------	(3)
Australia:					
New South Wales	8	----------	----------	----------	(3)
South Australia	6	20	13	----------	(3)
Western Australia	116	112	270	157	(3)
Bulgaria	----------	----------	----------	3	(3)
Canada [4]	149,047	111,562	143,667	141,502	190,931
China	264	[5] 500	[5] 500	[5] 500	[5] 500
Chosen	----------	----------	12	4	(3)
Cyprus [6]	3,628	1,626	4,640	7,712	(3)
Czechoslovakia	(3)	(3)	1,200	2,100	2,600
Finland	581	756	1,340	1,735	(3)
France	500	300	(3)	(3)	(3)
Greece	10	9	14	(3)	(3)
India, British	6	91	----------	25	(3)
Italy	632	1,284	3,267	2,252	(3)
Japan [7]	1,000	1,000	1,000	1,000	1,000
Southern Rhodesia	21,810	14,303	27,381	29,224	38,644
Swaziland	----------	5	----------	----------	(3)
Turkey	4	58	120	4	(3)
Union of South Africa	14,221	10,950	14,411	15,960	20,683
U. S. S. R. (Russia)	64,674	60,000	74,000	(3)	(3)
United States (sold or used by producers)	2,928	3,229	4,305	4,615	8,092

[1] In addition to countries listed, Bolivia, Brazil, and Madagascar are reported to produce small quantities of asbestos.
[2] Rail and river shipments.
[3] Data not available.
[4] Exclusive of sand and gravel, production of which is reported as follows: 1931, 6,540 tons; 1932, 3,151 tons; 1933, 5,850 tons; 1934, 4,238 tons; 1935, 2,744 tons.
[5] As estimated by Imperial Institute, London.
[6] Exports.
[7] Approximate production.

CANADA

Production of asbestos in Canada in 1935 increased about 35 percent in quantity and 43 percent in value over 1934. The entire output was from the eastern townships of the Province of Quebec. Considerable interest was shown in a chrysotile deposit in Bannockburn Township, about 30 miles from Timmins, Ontario, and erection of a mill is contemplated. The following table shows production in 1935 as published in the preliminary report of the Quebec Bureau of Mines.

Production of asbestos in the Province of Quebec for 1935

Grouping of grades	Shipments and sales		Average value per ton
	Short tons	Value	
Crudes	2,278	$539,558	$236.86
Fibers	102,270	4,873,255	47.65
Shorts	105,919	1,641,801	15.50
Total	210,467	7,054,614	33.52
Sand, gravel, and stone (waste rock only)	3,025	2,053	.68
Total	213,492	7,056,667	----------

Quantity of rock mined during the year 1935, 2,852,118 tons. Quantity of rock milled during the year 1935, 2,256,994 tons.

AFRICA

Rhodesia.—Production of asbestos in Southern Rhodesia in 1935 was the highest on record, except for the year 1929, when it was exceeded by 36 tons. The value, however, was less than 55 percent of that attained in 1929. The following table shows Rhodesian production from 1926 to 1935.

Asbestos produced in Rhodesia, 1926–35

Year	Short tons	Value	Year	Short tons	Value
1926–30 (average)	37,376	£949,770	1933	30,182	£555,993
1931	24,042	386,494	1934	32,214	402,745
1932	15,766	197,092	1935	42,598	646,658

Union of South Africa.—More asbestos was produced in the Union of South Africa in 1935 than in any previous year except 1929, when the output was 26,984 tons. The following table shows the output from 1926 to 1935.

Asbestos produced in the Union of South Africa, 1926–35, by sources

Year	Short tons				Total value
	Transvaal	Cape Province	Natal	Total	
1926–30 (average)	17,435	5,082	5	22,522	£359,510
1931	12,025	3,651		15,676	246,583
1932	9,106	2,964		12,070	116,401
1933	12,662	3,225		15,887	197,120
1934	14,783	2,810		17,593	203,033
1935	20,379	2,420		22,799	226,771

Production of all varieties mined in the Transvaal increased substantially. Blue asbestos was mined only in October, November, and December. Production of blue asbestos in the Cape Provinces decreased somewhat from the tonnage of 1934. The following table shows production from 1933 to 1935 by varieties:

Asbestos produced in the Union of South Africa, 1933–35, by varieties and sources

	1933		1934		1935	
	Short tons	Value	Short tons	Value	Short tons	Value
Amosite (Transvaal)	3,090	£31,099	3,757	£37,104	4,684	£46,170
Chrysotile (Transvaal)	9,572	105,715	11,025	114,241	15,620	137,903
Blue (Transvaal)			1	15	75	984
Blue (Cape)	3,225	60,306	2,810	51,673	2,420	41,714
	15,887	197,120	17,593	203,033	22,799	226,771

U. S. S. R. (RUSSIA)

No statistics of the Russian asbestos industry in 1935 are available. Some of the figures in the following table have been revised in accordance with more recent information than was available a year ago.

Production and exports of Russian asbestos, 1930–35, in metric tons

Year	Production	Exports	Year	Production	Exports
1930	54,083	15,749	1933	[1] 74,000	[2] 21,458
1931	64,674	13,239	1934	(3)	[2] 33,715
1932	[1] 60,000	[2] 16,551	1935	(3)	(3)

[1] Unofficial estimate.
[2] U. S. Bureau of Foreign and Domestic Commerce, Foreign Trade Notes: Vol. 4, no. 9, 1935, p. 14.
[3] Data not available.

CYPRUS

Early in 1936 the assets of the Cyprus & General Asbestos Co., Ltd., operating short-fiber chrysotile deposits at Amiandos, were acquired by the Tunnel Asbestos Cement, Ltd., a subsidiary of the Tunnel Portland Cement Co. of West Thurrock, England. Asbestos is shipped from Cyprus to England for manufacture of asbestos cement products. The following table, compiled mainly from the Annual Report of the Inspector of Mines and Labour—1934, shows exports during recent years.

Asbestos exported from Cyprus, 1930–35

Year	Long tons	Value	Year	Long tons	Value
1930	5,400	£116,092	1933	4,604	[1] £44,088
1931	3,571	66,381	1934	7,590	[1] 73,562
1932	1,600	27,214	1935	(2)	(2)

[1] Reported by Cyprus & General Asbestos Co., Ltd.
[2] Data not available.

OTHER COUNTRIES

According to the Bureau of Foreign and Domestic Commerce,[3] Czechoslovakia has become a producer. "Asbest" Gewinnung und Verwertung von Asbest Gesellschaft m. b. H. at Dobsina reports an output of 2,600 metric tons in 1935, 2,100 in 1934, and 1,200 in 1933. No data are available as to the nature or quality of the product.

Asbestos production in Finland is increasing. The fiber, which is of the anthophyllite type, is used chiefly in an asbestos-products factory in Helsingfors.

Discovery of a greenish white chrysotile in Bayerischer Wald, East Bavaria, was reported in 1935. This is said to be the only asbestos occurrence known in Germany and is of great importance because of increasing demands for home consumption.

A small output of asbestos is recorded for Italy, Australia, New Zealand, China, and Austria.

[3] U. S. Bureau of Foreign and Domestic Commerce, Foreign Metals and Minerals: Circ. 3, April 1936, p. 9.

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BARITE AND BARIUM PRODUCTS

By Bertrand L. Johnson and M. A. Cornthwaite

SUMMARY OUTLINE

The crude barite industry of the United States in 1935 was characterized by increases in quantity of crude barite mined; in quantity and value of sales; in quantity, total value, and average value per ton of imports; in new supply, of which domestic shippers furnished 82.7 percent; and in consumption. The total quantity and value of sales of barium products and the quantity of imports also increased. The value of imported barium products decreased, also the total quantity and value of barium products exported.

Figure 147 shows recent trends in sales of crude barite from domestic mines, imports, consumption, and average value per ton in the United States.

Salient statistics covering barite and leading barium products are summarized in the following table:

Salient statistics on barite and barium products in the United States, 1931–35

	1931	1932	1933	1934	1935
Crude barite:					
Produced — short tons	210,930	133,572	146,402	178,361	218,075
Sold or used by producers:					
Short tons	174,520	129,854	167,880	209,850	225,111
Value:[1]					
Total	$994,655	$745,955	$852,611	$1,109,378	$1,251,268
Average	$5.70	$5.74	$5.08	$5.29	$5.56
Imports for consumption:					
Short tons	73,080	45,758	49,958	40,031	47,047
Value:[2]					
Total	$329,114	$177,954	$216,955	$174,937	$246,254
Average	$4.50	$3.89	$4.34	$4.37	$5.23
Apparent new supply[3] — short tons	247,600	175,612	217,838	249,881	272,158
Domestic — percent	70.5	73.9	77.1	84.0	82.7
Reported consumption (total) short tons	265,270	189,409	223,047	250,476	290,344
Barium products:					
Sold or used by producers:					
Short tons	228,326	177,836	215,525	228,796	268,652
Value	$16,365,522	$12,191,374	$14,170,890	$15,173,923	$16,858,413
Imports for consumption:					
Short tons	12,912	10,561	12,236	9,459	11,671
Value	$624,272	$385,662	$464,812	$475,262	$404,601
Exports of lithopone:					
Short tons	3,821	3,212	1,186	2,401	2,372
Value	$341,257	$270,195	$107,923	$199,508	$221,611

[1] F. o. b. mine shipping point.
[2] Declared value f. o. b. foreign market.
[3] Barite sold or used by producers plus imports.

CRUDE BARITE

Production.—The production of crude barite in the United States comes from three areas—the southern, midwestern, and Pacific. The southern area supplies crude barite primarily to consumers in eastern and midwestern markets. Approximately four-fifths of the crude is shipped to eastern markets and the balance to midwestern. A little ground barite is produced in the local mills. The midwestern area, of which Missouri is the leading producing State, supplies the midwestern markets; only a small part of the production reaches other markets. Production in the Pacific area in recent years has come from California, Nevada, and Arizona.

Crude barite was mined in seven States in 1935, as in 1934. Producing States in 1935 were as follows: Pacific area, California and Nevada;

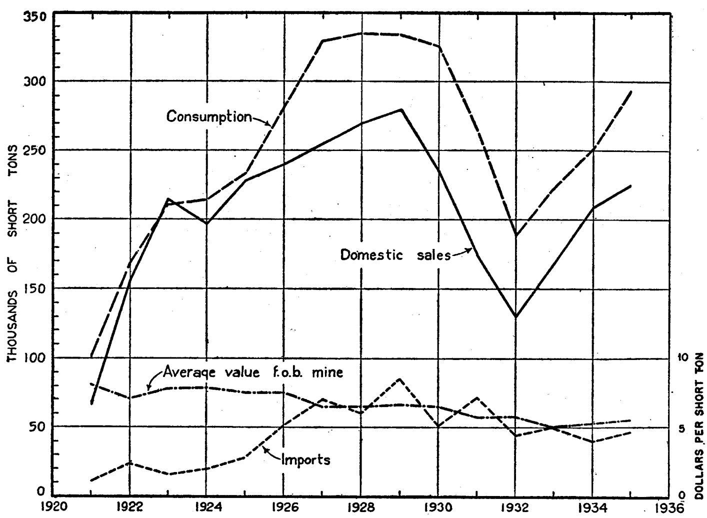

FIGURE 147.—Trends in production (domestic sales), imports, consumption, and prices (average value f. o. b. mines) of crude barite, 1921-35.

midwestern area, Missouri; and southern area, Georgia, South Carolina, Tennessee, and Virginia. Mined production in 1935 totaled 218,075 short tons—39,714 tons more than in 1934.

Sales.—Sales of crude barite totaled 225,111 short tons valued at $1,251,268 in 1935, compared with 209,850 tons valued at $1,109,378 in 1934. All seven producing States sold crude barite, Missouri with numerous producers leading with 131,921 tons. Next in order were Georgia (four producers), California (three producers), and Tennessee (one producer). Sales of the remaining States were relatively small. Nevada had two producers and South Carolina and Virginia had one each. The average value of the crude barite sold ranged from $4.22 to $5.83. Stocks on December 31, 1935, were somewhat less than on the same date in 1934 and were principally in Missouri.

Prices.—Market quotations for crude barite, f. o. b. mines, from California and Georgia, remained the same in 1935 as in 1934. The price quotations for Missouri crude (95 percent barium sulphate and less than 1 percent iron), however, ranged from $5 to $7 per short ton compared with $5 a ton in 1934. The average value f. o. b. mine shipping point for the entire United States, as calculated from values and tonnages reported by producers to the Bureau of Mines, increased from $5.29 in 1934 to $5.56 in 1935.

Range of quotations on barite, 1933–35 [1]

	1933	1934	1935
Crude barite, f. o. b. mines:			
California ... short ton	$5.50–$7.00	$6.00	$6.00
Georgia ... long ton	6.00– 7.00	7.00	7.00
Missouri [2] ... short ton	4.50– 5.00	5.00	$5.00– 7.00

[1] Metal and Mineral Markets, New York (weekly).
[2] 95 percent barium sulphate, less than 1 percent iron.

Markets for crude barite.—The markets for crude barite in the United States are three widely separated areas—the eastern, midwestern, and Pacific. The eastern market is the main competitive market. The supply of crude barite for this market comes mainly from foreign countries (imports) and the Southern States. Ordinarily, less than 1 percent of the domestic barite sold in this area comes from Missouri. The midwestern market obtains its supply mainly from Missouri, but about 20 percent comes from Georgia and Tennessee. The Pacific coast market is the smallest. Its barite comes from mines in Nevada and California and is consumed in plants at Modesto, El Portal, and Oakland, Calif. Practically no barite from other domestic or from foreign sources enters this market.

Consumption by uses.—The barite-consuming industries of the United States used 290,344 short tons of domestic and imported barite in 1935 compared with 250,476 short tons in 1934, an increase of 39,868 tons. Changes in the distribution of this crude barite according to specified consuming industries are shown in the following table. Figure 148 shows the trends in the consumption of crude barite for the principal uses in percentages of the total consumption.

The percentage of crude barite consumed for the production of barium chemicals, which increased from 1927 to 1931, when it was 27.4 percent of the total consumption of crude barite, has decreased since 1931. The percentage used for production of ground barite, which decreased from 1926 to 1931, increased in 1932 and in 1933 was 32.3 percent of the total consumption of crude barite, or nearly twice the percentage consumed in the production of barium chemicals. The percentage of crude barite consumed for the production of lithopone still continues to decline, and in 1935 this use, while the principal one, was only 50.3 percent of the total consumption for all uses.

Crude barite (both domestic and imported), used in the manufacture of barium products in the United States, 1931–35, in short tons

Year	In manufacture of—			Total	Year	In manufacture of—			Total
	Ground barite	Lithopone	Barium chemicals			Ground barite	Lithopone	Barium chemicals	
1931	35,393	157,181	72,696	265,270	1934	61,123	140,734	48,619	250,476
1932	36,402	120,378	32,629	189,409	1935	93,692	146,164	50,488	290,344
1933	38,026	131,761	53,260	223,047					

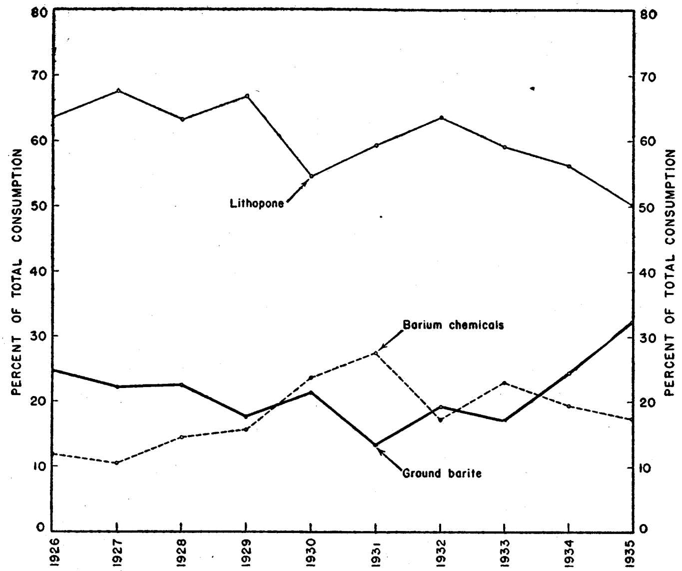

FIGURE 148.—Crude barite (domestic and imported) used in the manufacture of barium products in the United States, 1926–35, in percentages of total consumption.

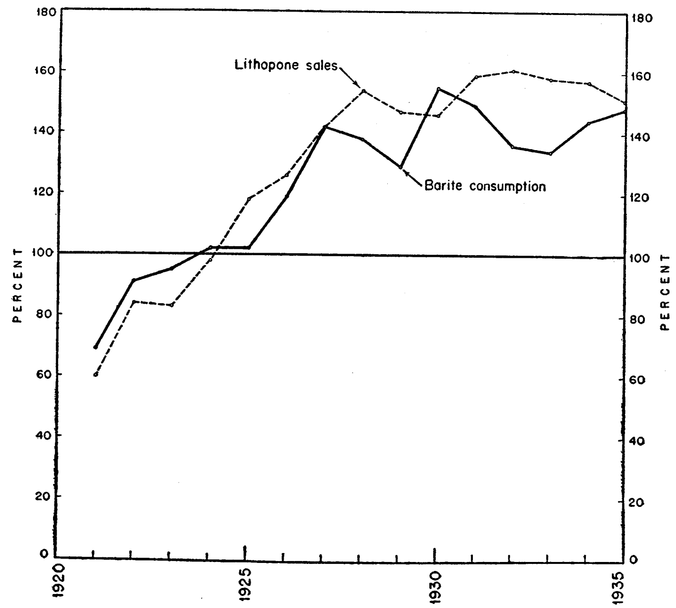

FIGURE 149.—Ratio of indexes of crude-barite consumption and lithopone sales (domestic) (1923–25 average=100) to Federal Reserve Board index of industrial production (1923–25 average=100), 1921–35.

Figure 149 shows the relationship of the indexes of barite consumption and lithopone sales (1923–25 average=100) to industrial production, as represented by the Federal Reserve Board index of industrial production (1923–25 average=100).

Consumption by States.—Crude barite was consumed in 30 plants in 12 States in 1935 compared with 30 plants in 13 States in 1934. The number of plants using crude barite increased only in New York—Texas, with one plant in 1934, was not a consumer in 1935. California, with four plants and a consumption of 37,136 short tons of crude barite, is in the Pacific market area; Missouri, Illinois, and Kansas, with 12 plants and a consumption in excess of 120,000 tons, in the midwestern area; and the remaining States, with 14 plants and a consumption of less than 100,000 tons, in the eastern area.

Domestic and imported crude barite used in the manufacture of barium products in the United States in 1935, by States, in short tons

State	Product manufactured	Plants [1]	Barite used
Missouri	Ground barite and chemicals	5	74,749
Illinois	Ground barite, lithopone, and chemicals	6	45,647
California	do	4	37,136
New Jersey	Lithopone and chemicals	3	32,984
Delaware and Maryland	Lithopone	2	99,828
Pennsylvania	Lithopone and chemicals	2	
West Virginia	Chemicals	2	
Georgia	Ground barite	1	
Kansas	Lithopone	1	
New York	Ground barite and chemicals	3	
South Carolina	Ground barite	1	
		30	290,344

[1] A plant producing more than 1 product is counted only once in arriving at State totals.

FOREIGN TRADE [1]

Imports.—Total imports of crude barite, which dropped from 85,729 short tons in 1929 to 40,031 tons in 1934, increased to 47,047 tons valued at $246,254 in 1935. Imports from Germany reached a new low for recent years of only 6,720 short tons, having declined steadily from 41,117 tons in 1931. Netherlands was the leading source of crude-barite imports, with 20,752 short tons. Spain likewise has become an important source of barite for the United States; imports from that country rose from 1,187 tons in 1933 to 15,401 short tons in 1935. Russian imports increased to 3,153 tons from 2 tons in 1934, after a series of years of declining shipments. The average value per ton declared on foreign market rose from $4.37 in 1934 to $5.23 in 1935.

Crude barite imported into the United States, 1934–35, by countries

Country	1934		1935	
	Short tons	Value	Short tons	Value
Belgium	397	$2,847		
France	114	876	1,018	$5,073
Germany	16,643	63,845	6,720	42,700
Greece			3	50
Italy	56	352		
Netherlands	15,651	89,850	20,752	120,228
Spain	6,720	13,882	15,401	58,465
U. S. S. R. (Russia)	2	20	3,153	19,738
United Kingdom	448	3,265		
	40,031	174,937	47,047	246,254

Exports.—Exports of crude barite from the United States are not separately recorded.

[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.

WORLD PRODUCTION

The following table shows the output of barite in various countries from 1931 to 1935, as far as statistics are available.

Germany is by far the largest foreign producer of crude barite and in 1934 greatly increased its lead over other countries; 1933 production was more than doubled, and the recorded production of any previous year was exceeded. Great Britain, France, and Italy are the other large barite-producing countries.

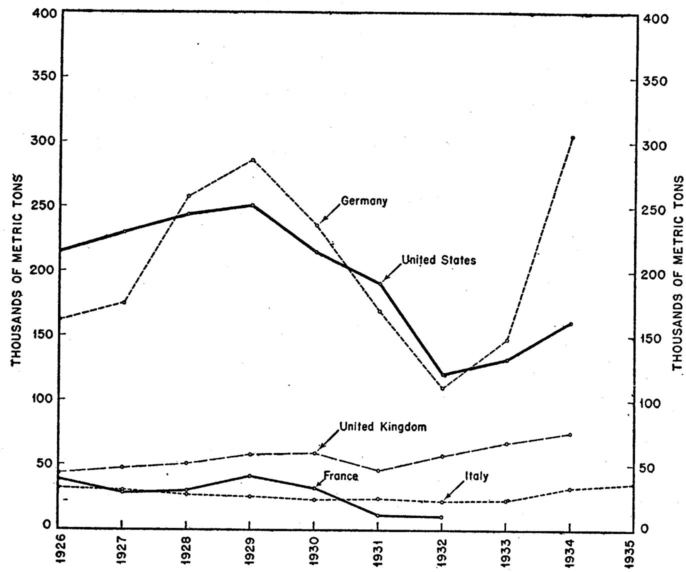

FIGURE 150.—World production of crude barite, by countries, 1926–35.

Figure 150 shows graphically the output of the principal producing countries from 1926 to 1935, insofar as statistics are available.

World production of barite, 1931–35, in metric tons

[Compiled by M. T. Latus]

Country	1931	1932	1933	1934	1935
Algeria	944	890	10	(1)	(1)
Australia:					
New South Wales	124	309	323	187	(1)
South Australia	1,468	1,728	1,800	2,345	(1)
Tasmania			5		
Austria	87	275	1,030	1,025	(1)
Canada	15		18		(1)
Chosen	5,460	6,569	4,969	5,935	(1)
France	11,300	10,400	(1)	(1)	(1)
Germany:					
Baden	(1)	(1)	(1)	19,681	(1)
Bavaria	7,835	5,853	4,146	8,385	(1)
Prussia [2]	160,482	102,167	143,465	326,318	(1)
Saxony	2,534	2,446	130	484	(1)
India (British)	5,745	3,004	5,742	3,874	(1)
Irish Free State	864				(1)
Italy	24,326	21,861	23,444	32,408	35,600
Portugal	80		2	1	(1)
Southern Rhodesia				14	
Spain	8,539	8,934	4,605	17,528	(1)
United Kingdom	46,312	57,548	67,689	75,182	(1)
United States	191,351	121,174	132,813	161,806	197,794

[1] Data not available.

[2] Official figures which, it is reported, cover only output of mines included under the mining law.

BARIUM PRODUCTS

Sales.—Sales of ground barite, lithopone, and artificial barium carbonate continued their recovery from the depression of 1932, while sales of blanc fixe decreased slightly from 1934. Sales of ground barite increased from 53,326 tons in 1934 to 76,250 tons in 1935 with two less plants shipping. Sales of lithopone increased 13,921 tons to 159,486 tons in 1935, owing to improvement in the principal consuming industries. Paint, enamel, and lacquer manufacturers took 10,143 tons more in 1935 than in 1934 and the floor-covering and textile industries 4,629 tons more, and in all consumed 90.3 percent of the lithopone sales. Sales of lithopone to rubber and other industries were 851 tons less than in 1934 and only 9.7 percent of the total sales of lithopone in 1935.

Barium products sold or used by producers in the United States, 1931–35 [1]

Year	Ground barite			Lithopone			Blanc fixe (precipitated barium sulphate)		
	Plants	Short tons	Value	Plants	Short tons	Value	Plants	Short tons	Value
1931	9	32,297	$656,769	11	151,850	$12,999,590	7	31,151	$1,827,713
1932	12	33,842	563,902	11	121,667	10,176,856	7	14,454	933,068
1933	13	34,601	683,432	11	140,831	11,751,500	9	30,744	1,197,131
1934	13	53,326	1,006,905	11	145,565	12,235,624	6	18,115	1,084,733
1935	11	76,250	1,407,787	11	159,486	13,470,274	6	18,067	980,191

Year	Artificial barium carbonate (chemically precipitated)			Barium chloride			Other barium chemicals [3]		
	Plants	Short tons	Value	Plants	Short tons	Value	Plants	Short tons	Value
1931	6	5,687	$253,189	(2)	(2)	(2)	7	7,341	$628,261
1932	6	3,295	149,869	3	3,955	$240,843	5	623	126,836
1933	4	3,810	181,857	(2)	(2)	(2)	9	5,539	356,970
1934	4	4,706	245,315	(2)	(2)	(2)	7	7,084	601,346
1935	4	7,329	357,585	(2)	(2)	(2)	5	7,520	642,576

[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; the total for barium chemicals is therefore not shown here.
[2] Included under "Other barium chemicals."
[3] Figures cover chemicals as follows, in order of importance: 1931: Chloride, oxide, sulphide and binoxide; 1932: Oxide, binoxide, sulphide, and hydroxide; 1933: Chloride, sulphide, binoxide, and hydroxide; 1934 and 1935: Chloride, binoxide, sulphide, and hydroxide.

Lithopone sold or used by producers, 1933–35, by consuming industries

Industry	1933		1934		1935	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Paints, enamels, and lacquers	106,995	76.0	114,472	78.6	124,615	78.1
Floor coverings and textiles	18,472	13.1	14,811	10.2	19,440	12.2
Rubber	5,078	3.6	4,596	3.2	4,435	2.8
Other	10,286	7.3	11,686	8.0	10,996	6.9
	140,831	100.0	145,565	100.0	159,486	100.0

Prices.—Prices for ground barite and ground witherite were the same as in 1934. The quoted price of ground barite, $23 per short ton f. o. b. St. Louis, has not changed for several years. Lithopone price quotations were the same in 1935 as in December 1934. Quotations for barium chemicals changed little. Prices for barium carbonate, barium chloride, and blanc fixe were the same in both years. Prices for barium dioxide ranged from 11 to 12 cents in 1935 instead of 11 to 13 cents as in 1934, and those for barium chlorate ranged from 14 to 17½ cents as against 14 to 16 cents in 1934. Quotations for barium hydrate changed from 0.04¾ to 0.06 in 1934 to 0.05½ to 0.06 in 1935, and those for barium nitrate, in 700-pound casks, remained 0.08¼ cents per pound, the upper limit of 1934.

Range of quotations on barium products, 1933–35 [1]

	1933	1934	1935
Ground barite, barrel, St. Louis .... short tons..	$23.00	$23.00	$23.00
Ground witherite, works [2] .... do....	40.00	$42.00–45.00	$42.00–45.00
Lithopone, January–November, 400-pound barrel, l. c. l. .... pound..	$0.04¾– .05	.04¾– .05	----------------
Domestic, ordinary, delivered, bags .... do....	----------------	[2] .04½– .04¾	.04½– .04¾
Barrels .... do....	----------------	[3] .04¾– .05	.04¾– .05
High strength, bags .... do....	----------------	[3] .06 – .06¼	.06 – .06¼
High strength, barrels .... do....	----------------	[3] .06¼– .06½	.06¼– .06½
Titanated, bags .... do....	----------------	[3] .06 – .06¼	.06 – .06¼
Titanated, barrels .... do....	----------------	[3] .06¼– .06½	.06¼– .06½
Barium carbonate, 200-pound bags .... short tons..	56.50 –61.00	56.50 –61.00	56.50 –61.00
Barium chlorate, 112-pound kegs, New York .. pound..	.13¾– .16	.14 – .16	.14 – .17½
Barium chloride, 600-pound barrel, works .. short ton..	61.50 –74.00	72.00 –74.00	72.00 –74.00
Barium dioxide (binoxide or peroxide), 88 percent, 690-pound drums .... pound..	.11 – .13	.11 – .13	.11 – .12
Barium hydrate, 500-pound barrel .... do....	.04¼– .05	.04¾– .06	.05½– .06
Barium nitrate, 700-pound casks .... do....	.07¼	.07¼– .08¼	.08¼
Barium sulphate, precipitated (blanc fixe), 400-pound barrel .... short ton..	[4] 42.50 –75.00	[4] 42.50 –75.00	[4] 42.50 –70.00

[1] Chemical Industries (formerly Chemical Markets), New York (monthly); New York (weekly).
[2] 90 percent through 300-mesh.
[3] Quotations for December only.
[4] Lowest price for pulp grade, highest for high-grade precipitated.

FOREIGN TRADE [2]

Imports.—A variety of barium products is imported annually, but these form a small part of the total domestic consumption. Lithopone, ground barite, and witherite comprise the larger part of these imports. The following tables show imports of the various barium compounds during the past 5 years. Of the products listed imports of ground barite, lithopone, barium binoxide, artificial barium carbonate, and barium chloride increased over 1934 both in quantity and value. Imports of witherite increased in quantity but declined markedly in value. Imports of other barium compounds decreased both in quantity and value.

[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.

Barium compounds imported for consumption in the United States, 1931–35

[Value at port of shipment]

Year	Ground barite		Lithopone		Barium binoxide		Blanc fixe (precipitated barium sulphate)		Artificial barium carbonate (chemically precipitated)	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1931	1,851	$22,415	5,674	$428,523	(1)	$11	930	$38,083	1,110	$20,839
1932	1,594	16,757	4,724	271,678	(2)	27	656	24,100	303	5,630
1933	2,632	30,492	5,596	313,341	1	82	245	12,093	49	1,632
1934	1,863	16,916	3,927	219,752	(3)	58	459	26,156		
1935	3,354	28,766	4,603	256,731	(4)	72	140	9,403	11	631

Year	Witherite, crude, unground [5]		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	Short tons	Value	Short tons	Value
1931	2,352	$39,964	6	$201	423	$29,796	345	$25,570	221	$18,870	(6)	(6)
1932	2,680	34,336	39	1,208	330	21,421	235	10,494	(7)	11	(6)	(6)
1933	2,949	47,324	6	526	359	31,140	281	15,542	110	9,416	8	$3,224
1934	2,358	143,808	107	4,808	454	44,884	287	17,548	(8)	66	4	1,266
1935	2,634	48,551	392	17,170	258	24,412	271	16,987	(9)	26	8	1,852

1 122 pounds.
2 328 pounds.
3 370 pounds.
4 450 pounds.
5 Recorded as "Witherite" prior to June 18, 1930.
6 Not separately recorded prior to 1933.
7 22 pounds.
8 132 pounds.
9 33 pounds.

Exports.—Exports of lithopone decreased from 2,401 short tons in 1934 to 2,372 tons in 1935 but increased $22,103 in value to $221,611. The unit value of exports of lithopone during 1935 was $93.43, an increase of $10.34 over 1934 and the highest since 1930 when the unit value was $103.70.

Lithopone exported from the United States, 1931–35

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1931	3,821	$341,257	$89.31	1934	2,401	$199,508	$83.09
1932	3,212	270,195	84.12	1935	2,372	221,611	93.43
1933	1,186	107,923	91.00				

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POTASH

By J. H. Hedges

SUMMARY OUTLINE

All previous records of output and use of potash in the United States were broken in 1935. Domestic producers not only strengthened their position in the home market but were able to expand their export sales moderately. Consumption reached the all-time peak of 420,000 tons of pure potash, about 48 percent of which came from domestic mines and plants. Capacity to manufacture high-grade salts was again enlarged by completion of a concentrating plant in New Mexico.

World output and consumption likewise attained new highs. The development of new supplies continued at a rapid rate. The impetus given by World War shortage to discovery of new resources still carries on, and growing surplus capacity to produce continues to harass the industry. Rapidly expanding markets seem to remain always a step behind.

Most important in its broad effects on all competing factors was the consummation in April of a trade pact between the Franco-German Cartel and Spanish producers, ending the trade war that demoralized the market in 1934 and resulting in stabilized prices at substantially higher levels. Due in part to long-term contracts, stated values in export and import declarations did not reflect the price improvement indicated by published schedules, but the full effect should be realized in the 1936–37 fertilizer season if stability can be maintained.

The International Potash Cartel now includes in its membership all important European producers except the U. S. S. R. (Russia) and Palestine. The U. S. S. R., because of her great domestic need for potash, is content for the present to refrain from offering large quantities abroad at destructive price levels; and Palestine, restrained by legal difficulties from joining the cartel, has made a short-term "gentlemen's agreement" with respect to export trade. So the situation appears to be well in hand for the immediate future, and some further stiffening of prices would not be surprising.

Salient statistics of the domestic potash industry for 1934 and 1935 are summarized in the following table:

Salient statistics of the potash (crude and refined potash materials) industry in the United States, 1934–35

	1934	1935
Production short tons	275, 732	357, 974
Sales:		
Short tons	224, 875	406, 922
Value at plant	$2, 813, 218	$4, 993, 481
Average per ton	$12. 51	$12. 27
Imports:		
Short tons	486, 167	603, 595
Value	$11, 616, 918	$12, 512, 711
Exports:		
Fertilizer material:		
Short tons	27, 988	75, 983
Value	$918, 169	$1, 992, 062
Other:		
Short tons	2, 121	3, 641
Value	$466, 929	$637, 473

The relation between consumption, unit value at the plant, and domestic sales from 1913 to 1935, inclusive, in terms of short tons of K_2O, is shown graphically in figure 151.

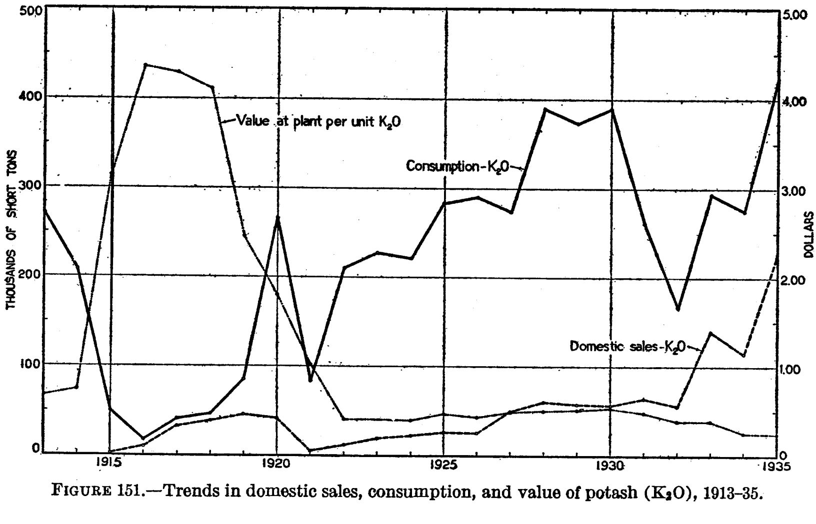

FIGURE 151.—Trends in domestic sales, consumption, and value of potash (K_2O), 1913–35.

PRICES

January to April are quiet months in the potash trade. Customarily the previous year's list prices prevail without discount until new schedules are issued about May 1, the beginning of the fertilizer year. Apparently most buyers anticipated their 1935 spring requirements at 1934 bargain prices, and shipments during the early months of the year generally represented delivery on old contracts, with very little new buying in evidence. Primary prices were steady at net list, but some speculative resale offerings were reported below list prices. April passed without any intimation of what prices for the 1935–36 season were to be, but Spain's withdrawal from the American market in the early spring strengthened belief in persistent rumors that Spanish producers had joined the European cartel and foreshadowed a strengthened price structure and stabilized market.

On May 11 the leading importers issued their initial price schedule for the 1935–36 season. List prices of the previous season were continued but without the usual seasonal discounts, thus representing a substantial increase over prices prevailing in 1934 and suggesting the possibility of further increases later in the season unless the traditional policy of offering inducements for early summer purchases were to be abandoned. Net quotations for the various grades of potash salts, c. i. f. Atlantic, Gulf, and Pacific ports, were as follows:

Muriate of potash, 80 to 98 percent KCl, 40 cents per unit K_2O equal to, for 2,000 pounds of muriate testing 50 percent K_2O	$20.00
Manure salts, minimum 30 percent K_2O, 43 cents per unit K_2O equal to, for 2,000 pounds of manure salts testing 30 percent K_2O	12.90
Kainite, minimum 20 percent K_2O, 50 cents per unit K_2O equal to, for 2,000 pounds of kainite testing 20 percent K_2O	10.00
Sulphate of potash, 90/95 percent K_2SO_4, basis 90 percent K_2SO_4 per 2,000 pounds in 200-pound bags	29.85
Sulphate of potash-magnesia, 48/53 percent K_2SO_4, basis 48 percent K_2SO_4 per 2,000 pounds in 200-pound bags	19.75

The three principal domestic producers followed shortly with lists quoting virtually the same prices and terms for their respective products.

Early in July new price schedules were issued raising base quotations for spot delivery or monthly installments to January 31 to 45 cents per unit of K_2O for muriate, 48 cents for 30-percent manure salts, 55 cents for 20-percent kainite, $33.75 per ton for 90-percent sulphate of potash, and $22.25 per ton for 48-percent sulphate of potash-magnesia, but offering discounts of 12 percent and 6 percent for business prior to August 1 and October 1, respectively, and net list thereafter. These prices were guaranteed against reduction until May 1, 1936. This was a slight reduction from the initial schedules for sales through July but a substantial increase on later purchases. A third set of schedules sent out at the end of the year continued the base prices of schedule 2, without discount, on purchases for delivery prior to May 1, 1936.

The net results of these various maneuvers was a steady price that prevailed throughout the year, with the usual concessions for early contracts, in marked contrast to the demoralization that characterized 1934. Published schedules were said to be pretty generally adhered to by the principal suppliers. Resulting stabilization at higher price levels combined with increased sales to produce improvement in the potash trade, although unfilled contracts and speculative resales postponed full enjoyment of higher quotations.

Base prices of certain standard grades of foreign potash materials prevailing from 1929 to 1935, as shown in price schedules supplied by N. V. Potash Export My., Inc., are given in the following table.

Quoted prices (subject to varying discounts) per short ton of different grades of potassium salts, c. i. f. Atlantic and Gulf ports, 1929–36

		May 1, 1929, to Feb. 24, 1930	Feb. 25, 1930, to Apr. 30, 1932	May 1, 1932, to Dec. 31, 1932 [1]	May 1, 1934, to Apr. 30, 1935 [2]	May 1, 1935, to Apr. 30, 1936 [3]
Sulphate, 90 to 95 percent K_2SO_4	in bags	$47.75	$48.25	$47.50	$35.00	$33.75
	in bulk	46.15	[4] 46.65			
Muriate, 80 to 85 percent KCl	in bags	36.75	37.15	37.15	22.00	24.50
	in bulk	35.15	35.55	35.55	20.00	22.50
Potash-magnesia sulphate (double manure salts), 48 to 53 percent K_2SO_4	in bags	27.50	27.80	27.80	22.50	22.25
	in bulk	25.90	[4] 26.20			
Manure salts, 30 percent K_2O	in bags	21.95	[4] 22.15			
	in bulk	18.95	19.15	19.15	12.90	14.40
Kainite, 20 percent K_2O	in bags	15.50	[4] 15.65			
	in bulk	12.50	12.65	12.00	8.60	11.00
Kainite, 14 to 16 percent K_2O	in bags	12.60	[4] 12.70			
	in bulk	9.60	9.70	9.70	8.50	
Kainite, 12.4 percent K_2O	in bags	12.10				
	in bulk	9.10				

[1] The 1932 list price was continued through 1933 except for sulphate, 90 to 95 percent K_2SO_4, which was reduced to $42.15 per ton. Discounts were 10½ percent from May to Oct. 15 and 5 percent from Oct. 16 to Dec. 31.
[2] Discounts; 12 percent to July 16; 6 percent to Oct. 1; net thereafter.
[3] Discounts; 12 percent to Aug. 1; 6 percent to Oct. 1; net thereafter.
[4] Price not quoted after May 1, 1931.

Base prices quoted by domestic producers of muriate of potash and manure salts over the period covered by the above table have been approximately equivalent to those published by importers. Domestic quotations for 1935, c. i. f. Atlantic, Gulf, and Pacific ports, subject to 12-percent discount on orders accepted prior to August 1 and 6-percent discount on orders accepted from August 1 to September 30, inclusive, for spot delivery or delivery in substantially equal monthly quantities to January 31, 1936, were 45 cents per unit of K_2O for high-grade muriate of potash (50 percent to 60 percent K_2O) and 48 cents per unit of K_2O for manure salts.

CONSUMPTION AND USES

Domestic consumption of potash in 1935 was approximately 930,000 short tons of material of all grades containing 420,000 short tons of potash, an average of slightly more than 45 percent K_2O. This material was valued at about $14,900,000. Consumption in terms of K_2O exceeded that in 1934 by 152,000 tons, an increase of 56.7 percent, and surpassed the previous peaks of 1928 (390,863 tons) and 1930 (390,000 tons) by 30,000 tons (7.7 percent). The increasing importance of exports tends to reduce the accuracy of domestic-consumption estimates based on subtraction of exports from the sum of imports and domestic sales, because export statistics do not indicate origin or grade of potash material exported. Also, it was particularly true of the 1935 season that a substantial but indeterminate proportion of export shipments came from carry-over stocks in the hands of brokers or speculators. However, it is believed to be a safe assumption that fertilizer salts exported were mainly high-grade muriate averaging 50 percent K_2O or better. It is estimated that domestic producers supplied around 200,000 tons—about 48 percent—of the 420,000 tons of K_2O consumed in the United States and exported about 25,000 tons of K_2O, to make up their total reported sales of 406,922 tons of products containing 224,721 tons of K_2O. The total of imports and sales of domestic products was 1,010,517 tons of material containing 466,231 tons of potash (K_2O) valued at $17,506,192. Of this amount domestic producers supplied 40 percent of the gross tonnage, containing 48 percent of the potash. The total trade thus calculated showed an increase of 63 percent in quantity (K_2O) and 21.3 percent in value over 1934. In terms of K_2O, domestic sales increased 96.9 percent and imports 40.4 percent. The relatively small increase in total value, in spite of higher unit quotations prevailing in 1935, may be due to long-term commitments at low prices; 97.2 percent of the total K_2O was reported to be fertilizer salts, the balance being consumed by the chemical industries.

PRODUCTION AND SALES

Domestic production of merchantable potash salts increased 29.8 percent to 357,974 short tons. The average grade of these products was 53.85 percent K_2O and the total potash produced 192,793 tons, an increase of 33.6 percent over the 1934 output. Sales exceeded production by 48,948 gross tons equivalent to 31,928 tons of potash. The corresponding reduction in stocks lowered the carry-over 63.9 percent compared with 1934, to 18,060 tons of K_2O. Sales expanded to 406,922 tons equivalent to 224,721 tons K_2O, an increase of 81 percent in gross tonnage and 96.9 percent in K_2O compared with 1934, signalizing the highest point yet reached in domestic turnover.

The total tonnage of potash materials, as reported by producers, is made up of both crude and refined salts containing varying quantities of K_2O; to avoid duplication, however, for refined material only the final weight is included rather than the larger tonnage of crude required in its production. Hence, the domestic production of crude salts in 1935 is larger than is shown in the following table, although the figure truly represents the operators' output of both crude and refined salts without duplication. To reduce different grades of salts to a common denominator, the production and sales also are calculated in terms of K_2O content. The resulting figures are reliable indicators of trends in the industry and are generally used in the trade because potash commonly is sold on the K_2O basis.

Production and sales by States and by sources cannot be given without disclosing individual output. Production and sales of potassium salts and stocks in the hands of producers for the past 5 years are summarized in the following table:

Potassium salts produced, sold, and in stock in the United States, 1931-35

Year	Production			Sales				Stocks		
	Number of operators	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)	Number of operators	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)	Value f. o. b. plant	Number of operators	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)
1931	6	133,920	63,880	6	133,430	63,770	$3,086,955	3	20,000	10,500
1932	5	143,120	61,990	5	121,390	55,620	2,102,590	3	41,000	28,000
1933	4	333,110	143,378	4	325,481	139,067	5,296,793	4	46,943	20,891
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

GOVERNMENT ACTIVITIES

The well-recognized desirability of avoiding overdevelopment of potash resources with its attendant economic waste, emphasized by disturbed conditions in the industry, led the Secretary of the Interior, in April 1934, to suspend action on prospecting permits for a period of 90 days. This suspension was extended by subsequent orders and made indefinite by order of April 5, 1935. Under provisions of the Potash Leasing Act of February 27, 1927, permits may be granted to prospect a given area for a period of 2 years, and satisfactory showing of discovery entitles the permittee to a lease for any or all of the land embraced in the prospecting permit. According to H. I. Smith, of the Geological Survey, 322 prospecting permits for land in New Mexico have been issued. Of these, 101, covering 217,448 acres, remained in effect January 31, 1936, and several were then in process of being converted into leases. During 1935 consideration was given to modification of the leasing law to permit better control and regulation of potash development on the public land. No action was taken, but an outgrowth of this study was Senate Resolution 274, introduced in February 1936 by Senator Pittman, that would authorize the Committee on Public Lands and Surveys to conduct a thorough investigation of all phases of the potash industry. The domestic industry came into being as a result of Government search for sources of potash that would free this country from dependence on foreign supplies. All important producers now operate on public land leased from the Government. Capacity of existing plants could easily be expanded to meet all domestic needs. In the public interest, development of extensive deposits as yet untouched must be safeguarded if waste is to be avoided and a continuing supply at reasonable cost assured.

REVIEW BY STATES

The bulk of domestic potash was supplied, as usual, by the American Potash & Chemical Corporation, 70 Pine Street, New York, from Searles Lake brine refined at its plant at Trona, Calif.; and by the United States Potash Co., 40 Rockefeller Plaza, New York, and the Potash Co. of America, First National Bank Building, Denver, Colo., from saline deposits mined and refined near Carlsbad, N. Nex. In addition, the U. S. Industrial Chemical Co., 60 East Forty-second Street, New York, and Baltimore, Md., and the North American Cement Corporation, Albany, N. Y., and Security, Md., contributed important amounts of byproduct potash-bearing materials. Small lots of alunite and cotton-boll ashes also were sold.

California.—Enlargement in 1934 of the refinery of the American Potash & Chemical Corporation at Trona for treatment of Searles Lake brine raised the annual capacity of this plant to 180,000 tons of high-grade potassium chloride. The plant also extracts borax, soda ash, and salt cake from the complex brine. This company is the only potash producer in the State.

New Mexico.—The two potash mines in the Carlsbad area hoisted nearly 500,000 tons of ore during 1935 to supply New Mexico's output of crude and refined potash salts. At these properties rich ore is mined from extensive beds at a depth of about 1,000 feet. Some of the ore is shipped as mined or roughly sorted to supply the demand for

25- to 30-percent manure salt, but the greater part is refined to high-grade potassium chloride. The mine of the United States Potash Co. is equipped to handle 2,000 tons a day and its refinery now has a capacity of about 140,000 tons a year of high-grade muriate.

The Potash Co. of America began in October operation of its concentrating plant for mechanical separation by flotation methods of the potash salts from the rock salt in the ore. An unusual feature of the process is that separation is obtained by floating the impurities rather than the potash mineral. The product is potassium chloride running 50 to 60 percent K_2O. The capacity of this plant is reported to be about 70,000 tons of muriate a year. The United States Bureau of Mines, in cooperation with the Potash Co. of America, pioneered in the adaptation of ore-dressing methods to these soluble salts. From this beginning the company continued experimentation and developed the method employed at its plant.

There was little exploratory activity during the year among holders of prospecting permits, in marked contrast to recent years. Efforts to consolidate the most promising holdings as a basis for proceeding to lease and financing development are continuing. A recent development was organization of the Union Potash & Chemical Co. In January 1936 this new company took over the interests of the General Potash Co. and will continue that company's efforts to establish a third producing mine in the Carlsbad area. It is officered by the same men as the General Potash Co.

Maryland.—There were no additions to the list of Maryland producers. The United States Industrial Chemical Co. at Baltimore and the North American Cement Corporation at Security continued to recover byproduct potash, the one from alcohol-distillery waste and the other from cement-kiln dust. There was little change from the previous year in their output, which, of course, is governed by the market for their principal products rather than that for potash.

Utah.—Four Marysvale shippers of small lots of alunite for fertilizer were reported to supply the perennial but very limited market for this material. One small lot went to Salt Lake for use in experiments in making alumina and byproducts. During the World War, when potash prices rose to fantastic figures and present low-cost domestic sources were undeveloped or undiscovered, alunite was mined for its potash content. Normally, however, it merits consideration only as an ore of aluminum, with potash as a valuable byproduct. Until such time as shifting markets, technologic improvements, exhaustion of cheaper source materials, or other changing conditions bring about utilization of alunite for production of aluminum, no important quantity of potash will be derived from this source.

IMPORTS [1]

Imports of potash materials for consumption in the United States increased 24.2 percent, to 603,595 short tons. The average grade was 40 percent K_2O equivalent to 241,510 tons of pure potash, an increase of 40.4 percent over the potash equivalent of 1934 imports but 100,000 tons below the 1930 peak.

Fertilizer salts comprised 94.6 percent of the total potash, the balance being destined for chemical and other industrial uses.

[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 quantity, average grade, and total declared value of the various potash salts imported in 1934 and 1935, classified by uses, 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, 1934–35

Material	Approximate equivalent as potash (K_2O) (percent)	1934				1935			
		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	21,413	2,998	1.7	$170,906	1,845	258	0.1	$11,315
	20.0	107,275	21,455	12.5	945,017	81,043	16,209	6.7	578,714
Manure salts	30.0	87,675	26,303	15.3	1,028,958	95,563	28,669	11.9	1,054,181
Muriate (chloride)	52.0	142,200	73,944	43.0	3,671,857	262,370	136,432	56.5	4,743,913
Nitrate (saltpeter) (Chilean)	14.0	25,300	3,542	2.1	575,835	31,631	4,428	1.8	689,564
Potash-magnesia sulphate	27.0	20,957	5,658	3.3	438,292	25,876	6,987	2.9	515,281
Sulphate	50.0	48,242	24,141	14.0	1,511,705	70,819	35,410	14.6	2,014,626
Other potash fertilizer material [1]	60.0	394	236	.1	2,551	272	163	.1	1,849
	------	453,456	158,277	92.0	8,345,121	569,419	228,556	94.6	9,609,443
Used chiefly in chemical industries:									
Bicarbonate	46.0	102	47		16,795	219	101		35,529
Bitartrate (argols)	20.0	6,989	1,398		884,582	8,184	1,637		902,541
Bitartrate (cream of tartar)	25.0	(2)	(2)		69	(2)	(2)		8
Bromide	39.6	2	1		1,047	5	2		2,904
Carbonate, crude	61.0								
Carbonate, crude or black salts.	50.0	6,504	3,902		802,265	2,063	1,258		231,551
Carbonate, refined	67.0								
Caustic	80.0	2,008	1,606		259,237	1,713	1,370		226,165
Chlorate and perchlorate	36.0	5,401	1,944	8.0	594,243	7,159	2,577	5.4	752,007
Chromate and bichromate	40.0	(3)	(3)		5	-------	-------		-------
Cyanide	70.0	40	28		32,517	49	34		38,780
Ferricyanide (red prussiate)	42.0	51	21		26,132	81	34		38,610
Ferrocyanide (yellow prussiate)	44.0	4	2		1,496	17	7		4,763
Iodide	28.0	4	1		11,738	(2)	(2)		581
Nitrate (saltpeter), crude	40.0	10,108	4,043		495,663	13,626	5,450		554,586
Nitrate (saltpeter), refined	46.0	1,288	592		97,895	748	344		56,910
Permanganate	29.0	56	16		12,125	74	21		15,577
All other	50.0	154	77		35,988	238	119		42,756
	------	32,711	13,678	8.0	3,271,797	34,176	12,954	5.4	2,903,268
Grand total	------	486,167	171,955	100.0	11,616,918	603,595	241,510	100.0	12,512,711

[1] Chiefly wood ashes from Canada.
[2] Less than 1 ton.
[3] Quantity of bichromate imported in 1934, 22 pounds; approximate equivalent as K_2O, 9 pounds.

Approximate equivalent as potash (K_2O) of potash-bearing materials imported for consumption in the United States, 1931–35, in short tons

1931	214,785	1934	171,955
1932	113,505	1935	241,510
1933	171,854		

In the following table imports of the various salts from all countries making shipments to the United States are shown. Fertilizer salts imported from Belgium, Canada, and Netherlands represent transshipments of material originating largely in Germany or France. The Franco-German Syndicate supplied 84.7 percent, Spain 7 percent, and Russia slightly less than 2 percent of the total gross tonnage of imports.

Potash materials imported into the United States in 1935, in short tons

[The figures in parentheses in the column headings indicate in percent the approximate equivalent as potash (K_2O)]

Country	Muriate (chloride) (52)	Sulphate (50)	Potash-magnesia sulphate (27)	Manure salts (30)	Kainite		Bitartrate	
					(14)	(20)	Argols or wine lees (20)	Cream of tartar (25)
Algeria and Tunisia							1,273	
Argentina							1,439	
Austria								
Belgium	15,158	4,843		3,549		6,597		
Canada	5,660	3	85				22	
Chile							105	
China								
Czechoslovakia								
Finland								
France	2,953	255		3,145		4,267	2,280	(1)
Germany	130,587	48,096	25,590	43,526	1,399	43,351		
Greece							67	
Hong Kong								
Italy							1,944	
Japan								
Morocco							12	
Netherlands	70,044	15,241	201	34,716	446	23,818		
Portugal							467	
Spain	37,967	2,381				3,010	575	
Sweden	1							
Switzerland								
U. S. S. R. (Russia) in Europe				10,627				
United Kingdom								
	262,370	70,819	25,876	95,563	1,845	81,043	8,184	(1)
Approximate equivalent as potash (K_2O)	136,432	35,410	6,987	28,669	258	16,209	1,637	(1)

Country	Caustic (80)	Carbonate (61)	Cyanide (70)	Nitrate (saltpeter), crude (14 and 40)[2]	Chlorate and perchlorate (36)	All other (48)	Total	
							Short tons	Value
Algeria and Tunisia							1,273	$149,030
Argentina							1,439	73,010
Austria						15	15	7,152
Belgium	11				23		30,181	494,054
Canada				37	15	270	6,092	138,868
Chile				31,631	23		31,759	714,264
China		3				4	7	522
Czechoslovakia		194				60	254	31,678
Finland					1		1	117
France					602	2	13,504	469,703
Germany	1,534	1,633	49	13,589	5,981	1,273	316,608	6,725,046
Greece							67	6,998
Hong Kong		7					7	1,352
Italy							1,944	258,162
Japan					4	1	5	1,232
Morocco							12	1,390
Netherlands		195				19	144,680	2,336,224
Portugal							467	49,025
Spain							43,933	801,185
Sweden	167	9			178		355	66,177
Switzerland					332		332	42,234
U. S. S. R. (Russia) in Europe	1						10,628	138,325
United Kingdom		22				10	32	6,963
	1,713	2,063	49	45,257	7,159	1,654	603,595	12,512,711
Approximate equivalent as potash (K_2O)	1,370	1,258	34	9,878	2,577	791	241,510	

1 Less than 1 ton.
2 Nitrate from Chile calculated at 14 percen t K_2O; other countries 40 percent.

EXPORTS

Exports of fertilizer salts more than doubled, to reach a new high of 75,983 tons. No information is available regarding the origin or nature of exported fertilizer material. It is believed, however, that a substantial part of the increase resulted from sales of speculative holdings of foreign salts, although it is known that domestic producers, because of the exceptional purity of their product, were able to reach foreign markets hitherto inaccessible to them and thus increase their export business. It will be noted that Belgium, Germany, Italy, and Sweden were added to the list of customers.

Potash fertilizer material exported from the United States, 1934–35, by destinations

Destination	1934		1935	
	Short tons	Value	Short tons	Value
Argentina			38	$1,238
Belgium			2,794	74,051
Canada	4,753	$150,535	13,751	304,339
China			1,145	31,976
Colombia	1	155	3	100
Cuba	299	9,296	777	17,660
Dominican Republic	2	86	6	180
Finland			200	6,544
Germany			587	16,862
Guatemala			17	1,513
Haiti			1	41
Honduras	34	1,289	398	10,675
Italy			2,480	37,742
Jamaica	20	460	1	80
Japan	22,784	752,327	50,176	1,387,615
Netherlands			560	18,125
New Zealand			2	139
Nicaragua			2	65
Panama	1	36		
Philippine Islands	50	1,335	616	12,425
Salvador	6	400		
Sweden			2,369	68,466
Trinidad and Tobago	20	731		
Venezuela	18	1,513	13	723
Virgin Islands of United States	(1)	6		
West Indies ("other British")			47	1,503
	27,988	918,169	75,983	1,992,062

[1] Less than 1 ton.

Chemical salts exported included cream of tartar, potassium bromide, potassium chlorate, potassium citrate, potassium iodide, and saltpeter. They were valued for export at less than 2 cents to $3 a pound. It is not known how much of this material is of domestic origin.

Potassium salts (not fertilizer) exported from the United States, 1931–35

Year	Short tons	Value	Year	Short tons	Value
1931	1,158	$370,935	1934	2,121	$466,929
1932	887	241,179	1935	3,641	637,473
1933	1,275	301,596			

WORLD PRODUCTION

Complete official figures of production for 1935 are available only for France, Spain, Poland, and the United States. However, the following tabulation, based on information from various unofficial sources, is believed to give a fairly accurate picture of the world supply. The 1934 output of the principal producing countries is shown for comparison.

World production of potash in metric tons of K_2O, 1934 and 1935

	1934		1935	
	Metric tons K_2O	Percent of total	Metric tons K_2O	Percent of total
Germany	1,329,428	60.8	1,393,000	61.1
France	378,900	17.4	347,300	15.3
United States	130,944	6.0	174,897	7.7
U. S. S. R. (Russia)	139,197	6.4	150,000	6.6
Spain	129,687	5.9	121,372	5.3
Poland	61,854	2.8	71,539	3.1
Palestine	8,840	.4	12,000	.5
All other	7,000	.3	10,000	.4
	2,185,850	100.0	2,280,108	100.0

These figures indicate an increase of 5 to 6 percent in world output, whereas world consumption is estimated by informed sources to have increased 8 to 10 percent. Productive capacity far exceeds 1935 output, but potential overproduction is now checked in Europe by cartelized control that extends to Palestine through a "gentlemen's agreement" and apparently to Russia, as well, through acquiescence in the general program of price stabilization.

Available official figures of world production from 1931 to 1935 are shown in the following table.

World production of potash minerals and equivalent K_2O, 1931–35, in metric tons

[Compiled by R. B. Miller]

Country and mineral [1]	1931		1932		1933		1934		1935	
	Output	Equivalent K_2O	Output	Equivalent K_2O	Output	Equivalent K_2O	Output	Equivalent K_2O	Output	Equivalent K_2O
China, potassium carbonate [2]	(3)	(3)	15	(3)	22	(3)	57	(3)	(3)	(3)
Chosen, alunite	14,183	(3)	16,320	(3)	27,220	(3)	56,330	(3)	(3)	(3)
Egypt, crude potassium salts	1	(3)	8	(3)	4	(3)	----	----	----	----
France (Alsace), crude potassium salts	2,196,740	[4] 367,879	1,920,000	[4] 326,500	1,890,600	[4] 332,000	2,054,400	[4] 378,900	1,983,500	[4] 347,300
Germany, crude potassium salts:										
Carnallite [5]	1,059,278	100,985	635,940	61,245	642,445	65,285	829,669	81,020	(3)	(3)
Kainite, sylvinite, and hartsalz	6,992,122	976,657	5,779,591	810,109	6,720,326	960,829	8,787,010	1,248,408	(3)	(3)
India (British), nitrate of potash [6]	6,600	3,100	9,100	4,400	10,000	4,900	9,100	4,400	(3)	(3)
Italy:										
Alunite	990	102	700	84	534	64	1,605	193	4,000	(3)
Leucite rock	16,000	(3)	44,000	3,520	----	----	----	----	(3)	(3)
Palestine, crude potassium salts [7]	13,000	2,600	10,200	5,100	15,000	7,500	(3)	8,982	(3)	(3)
Poland, crude potassium salts:										
Kainite	59,120	7,165	44,692	4,759	62,537	6,979	86,172	10,217	81,593	8,159
Langbeinite	----	----	----	----	----	----	1,470	300	(3)	(3)
Sylvite	202,199	45,576	231,966	52,285	236,608	70,391	213,906	51,337	288,091	63,380
Spain:										
Alunite	23,985	(3)	----	----	----	----	----	----	(3)	(3)
Crude potassium salts	250,087	28,116	409,888	54,811	623,941	90,637	872,839	129,687	776,873	121,372
Potassic earth	1,100	(3)	750	(3)	500	(3)	500	(3)	(3)	(3)
U. S. S. R. (Russia), crude potassium salts [8]	120,031	(3)	78,532	(3)	303,094	42,122	1,001,602	139,197	1,300,000	(3)
United States, crude potassium salts	121,490	57,951	129,836	56,236	302,191	130,070	250,139	130,944	324,747	174,897

[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] Exports.
[3] Data not available.
[4] Content of merchantable products.
[5] Includes some natural kieserite.
[6] Estimated production (Imperial Institute, London).
[7] Extracted from waters of the Dead Sea.
[8] Produced at Solikamsk potash mines.

FOREIGN DEVELOPMENTS

Austria.—Commercial Attaché Gardner Richardson reports from Vienna that drilling at Hallein in the Province of Salzburg to develop rock salt deposits discovered at lower levels considerable beds of potash salts believed to be of economic importance.

Egypt.—Discovery of large potash deposits in the neighborhood of Mareotis Lakes near Alexandria has been reported. If experts assigned by the Ministry of Agriculture to examine the deposits report favorably, systematic exploitation will be undertaken.

France.—The output of crude potash salts from French mines declined from 2,054,400 metric tons in 1934 to 1,983,500 in 1935. Production of the State mines decreased more than 100,000 tons, but that of the Kali Sainte-Thérèse showed a small increase. Sales in the home market were less than in 1934. Exports increased slightly but not enough to offset domestic losses. Prices in France were lowered 5 percent in May following a reduction of 8 percent in May 1934. Export prices, however, improved following the entry of Spanish producers into the European cartel. One hundred and fifty thousand five hundred and twenty-five tons of K_2O were sold in France and 188,898 tons exported. Production exceeded sales by about 8,000 tons K_2O.

Germany.—Increased sales both at home and abroad combined with a considerable rise in export prices following the cartel agreement with Spanish producers in May to bring notable recovery and much improved earnings to the German potash industry. The full effects of price increases are not immediately reflected in average realization to sellers because of old contracts that remain to be fulfilled at low prices. Hence, a further improvement in profits may be expected as more transactions come to represent new business at going prices. The marked improvement in export prices is shown clearly by comparing average export values in the last quarter of 1934, when prices reached their lowest ebb, with the last quarter of 1935. In the fourth quarter of 1934 raw salts were valued for export at an average of 19.04 reichsmarks per metric ton bulk weight, and processed potash at 50.36 reichsmarks. In the corresponding period of 1935 the average valuations were 33.77 reichsmarks and 60.98 reichsmarks, respectively.

Potash in merchantable salts produced by the industry increased 4.7 percent—from 1,330,000 metric tons (K_2O) in 1934 to 1,393,000 in 1935—while sales increased 8 percent to 1,320,000 tons. Exports kept pace with expanding domestic consumption, and the ratio of domestic to export sales remained unchanged at 70 to 30. Of the 390,000 tons of K_2O shipped abroad, about 34 percent went to the United States, 15 percent to Netherlands, 14 percent to Japan, 11 percent to Belgium and Denmark, 9 percent to Great Britain, and 17 percent to all others. Taking into account reshipments to the United States from Netherlands and other countries, it is evident that well over 40 percent of Germany's exports of potash found their way into the American market. The export business showed a marked falling off in sales of raw salts that was more than compensated by a 50-percent increase in shipments of refined material of high purity. This shift from low- to high-grade salts reflects a trend that has been strongly in evidence as falling prices of the last 2 or 3 years have gradually reduced the profitable shipping radius of low-grade material. Technical improvements at the mines to increase the output per man underground have not been encouraged in order not to increase unemployment, and no special improvements in processing practice have occurred. Concentration of the salts by flotation has been considered, but doubt is expressed whether this method would prove satisfactory in Germany because the potash salt crystals are so intimately intergrown with other salts. The writer is indebted to Consul Sydney B. Redecker, Frankfurt-am-Main, and Vice Consul C. W. Wright, Berlin, for much of the data presented regarding the German industry.

Japan.—Exports to Japan in 1935 from Germany and the United States totaled 152,000 short tons of salts, equivalent to approximately 88,000 tons of K_2O. This is nearly double Japanese purchases from these two sources in 1934 and emphasizes the rapidly growing importance of this market for high-analysis salts.

Palestine.—Present capacity of Palestine Potash, Ltd., is reported to be 25,000 to 30,000 tons annually of muriate of potash ranging from 80 to 99 percent purity. One hundred thousand tons capacity is projected when the plant now being built to exploit the richer brines at the south end of the Dead Sea is completed. In the fall of 1935 Consul Joseph L. Brent, Jerusalem, reported that two pumps, powered by 175-horsepower Diesel engines, were already pumping brine to four evaporation pools of 73 acres each. The completed plant will consist of 12 evaporation pools, 6 pumps, and necessary incidental equipment. Solar evaporation in open pans precipitates carnallite by fractional crystalization. The carnallite is treated with cold water to remove magnesium chloride, leaving 80 to 99 percent potassium chloride. Bromine and some calcium chloride also are recovered. M. A. Novomeysky, in a paper read to the Institution of Chemical Engineers, London, on March 6, 1936, stated that magnesium chloride constitutes about one-half of the salts, sodium chloride little more than one-third, and potassium chloride more than one-twentieth. Calcium chloride, calcium sulphate, and magnesium bromide are other constituents. Negotiations between Palestine Potash, Ltd., and the Franco-German Cartel have been reported. It is understood that because of legal technicalities in Palestine the company may not join the international cartel but is not averse to "gentlemen's agreements" of short duration that can easily be renewed or canceled. Terms of the agreement under discussion have not been disclosed.

Poland.—The output of sylvite from the three Polish mines at Stebnik, Kalusz, and Holyn in eastern Galicia increased 34 percent, while that of kainite declined. In terms of pure potash, the total output was about 15 percent greater. More than half of the Polish production is exported.

Spain.—Definite confirmation of the agreement that brought Union Espanola de Explosivos and Potasas Ibericas, the two independent Spanish potash producers, into the International Potash Cartel did not come until late in the year, although negotiations to this end actually were consummated in April. Terms of the pact, not officially announced, have been variously stated by generally well-informed observers. The reported allotment of 9 percent of the total exports of all cartel members to Union Espanola de Explosivos and 6 percent to Potasas Ibericas is probably near the truth. Exports of Minas de Potasa de Suria, the third Spanish producer, have been handled by the export sales organization of the Franco-German Syndicate for a number of years. Perhaps because of long-term commitments, the nominally improved price situation resulting from termination of the price war was not reflected in 1935 business, measured by export valuations, but improvement is anticipated in the 1936 season. Exports fell off to 252,547 metric tons, valued at 14,267,562 gold pesetas, a reduction of 5.8 percent in quantity and 38 percent in value. Thirty-five percent of the total went to Netherlands, 16 percent to Belgium, 15 percent to United States, and 11 percent to Denmark. The mine output of crude salts dropped from 872,839 tons in 1934 to 776,873 in 1935. Marketable salts produced from this crude material in 1934 totaled 319,633 tons, equivalent to 129,687 tons K_2O, valued at 20,663,045 gold pesetas, and in 1935 amounted to 247,499 tons, equivalent to 121,372 tons K_2O, valued at 13,981,238 gold pesetas. About one-sixth was consumed locally and five-sixths was exported.

The 1935 recession in both output and export trade marks the first pause in rapid growth of the Spanish industry since production was begun in 1931. Reduced exports following entrance of the Spanish companies into the international cartel resulted from quota allotments that were below foreign business previously acquired by price concessions in competitive markets. Anticipated benefits of stabilization are expected to offset the relatively small tonnage loss that will soon be restored by expanding markets at more favorable price levels.

The following table of annual production since 1931, and much of the foregoing data, were abstracted from a special report by Consul Daniel M. Braddock, Barcelona, to the Bureau of Mines.

Production of potash salts in Spain, 1931–35

Year	Crude salts at mine mouth (metric tons)	Marketable salts (metric tons)	K_2O equivalent (metric tons)	Value (gold pesetas)
1931	250,087	85,825	27,394	8,749,937
1932	409,888	107,442	53,850	9,546,025
1933	623,941	242,940	91,026	15,500,438
1934	872,839	319,633	129,687	20,663,045
1935	776,873	247,499	121,372	13,981,238

U. S. S. R. (Russia).—The Solikamsk potash mine reached a daily output of 5,300 metric tons of sylvinite in December 1935. This was increased to a daily average of 5,480 tons in January 1936 and 6,400 tons in February. In 1935, 1,300,000 tons were produced, and it is planned to increase this to 2,000,000 tons in 1936 and 3,000,000 tons in 1937. The third 5-year plan contemplates the founding at Solikamsk of a Scientific Research Institute to direct the entire Soviet potash industry and arrange for sinking a number of new shafts at the various deposits. Many new discoveries have been reported during the year, but announcements as to quality and extent of deposits are vague. Potash obtained from a new mine at Tschurtan is said to be of such satisfactory grade that immediate exploitation is justified, and complete equipment to produce and treat 3,000,000 tons of sylvinite a year is planned. Other important discoveries were reported at Sagiz, Ozinki, and Akjar, in the Ural-Emba district, in the Southern Urals, and near the Yaiva River. The existence of an understanding for price control and stabilization between the Soviets and the International Potash Cartel is persistently rumored.

MAGNESIUM AND ITS COMPOUNDS

By Paul M. Tyler and A. E. Davis [1]

SUMMARY OUTLINE

Magnesium, eighth most abundant of Nature's elements, is recognized throughout the world as a useful metal, and its rapidly growing commercial importance is attested by the remarkable increase in tonnages sold for structural and metallurgical uses. These developments, nevertheless, are recent, and the element is still used most in chemical combination with other elements. Magnesite nominally heads the list of magnesian minerals, and it affords a ready source of magnesium for other compounds, besides being used largely in dead-burned form for refractory purposes. Far more dolomite is used than magnesite even for industrial purposes that depend chiefly upon magnesium content. Brucite is a third possible source of this element and its compounds, but magnesium salts also occur in more or less concentrated natural deposits and are recoverable from salt-works bitterns and even from raw sea water. The commercial sources of magnesium and its compounds are considered in this chapter, but dolomite is discussed only briefly, as the statistics are presented in the chapters on Stone and Lime. Talc, olivine, asbestos, and sundry other mineral products in which magnesium is a more or less essential constituent but which are not employed commercially as sources of the metal or its salts are discussed in other chapters of the Minerals Yearbook.

MAGNESITE

Owing to further recovery in the steel industry and minor expansion of other consuming industries, consumption of magnesite in the United States during 1935 increased 50 percent over 1934. As imports remained at approximately the same level in 1935 as in 1934, domestic producers enjoyed the full benefit of the increased demand, and shipments from California and Washington mines almost equaled those of 1929, exceeding by a wide margin those of any other year since the 1920 peak. Prices were virtually unchanged, and the status of magnesite compared with other high-grade refractories

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

tended to improve. Magnesite seems to be gaining ground for kiln linings in copper reverberatories and for several other types of high-temperature service outside of the steel industry, and in the steel industry it seems to be holding its own or even recapturing some of the business that had been taken by competitive materials. Increased demand for "periclase," the superquality of dead-burned magnesite, was reported, particularly in the manufacture of special-alloy steels.

Salient statistics of the magnesite industry in the United States, 1925–35

	1925–29 (average)	1930–34 (average)	1934	1935
Crude:				
Mined:				
Short tons	138,102	90,109	100,973	177,154
Value [1]	$1,264,526	$677,261	$730,630	$1,192,052
Sold by producers:				
Short tons	1,210	1,237	1,588	1,626
Value	$13,310	$14,779	$18,393	$22,345
Average per ton [2]	$11.00	$11.95	$11.58	$13.74
Imports for consumption:				
Short tons	603	282	50	49
Value	$6,191	$3,076	$706	$1,084
Apparent new supply short tons	1,813	1,519	1,638	1,675
Percent domestic	66.74	81.4	96.9	97.1
Caustic calcined:				
Sold by producers:				
Short tons	16,214	6,705	7,528	10,710
Value	$538,344	$203,147	$222,415	$317,276
Average per ton [2]	$33.20	$30.30	$29.55	$29.62
Imports for consumption:				
Short tons	10,675	2,396	1,553	1,441
Value	$249,182	$45,585	$36,031	$36,076
Apparent new supply short tons	26,889	9,101	9,081	12,151
Percent domestic	60.3	73.7	82.9	88.1
Dead-burned:				
Sold by producers:				
Short tons	47,158	34,935	38,535	67,777
Value	$1,124,618	$640,450	$670,343	$1,214,999
Average per ton [2]	$23.85	$18.33	$17.40	$17.93
Imports for consumption:				
Short tons	56,787	21,162	22,921	24,674
Value	$828,663	$324,857	$368,014	$429,830
Apparent new supply short tons	103,945	56,097	61,456	92,451
Percent domestic	45.37	62.3	62.7	73.3

[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.

Domestic production.—The production of crude magnesite from two mines in California and one in Washington was 177,154 short tons in 1935, an increase of 75.4 percent over 1934. Of this total, which was valued nominally at $1,192,050, only 1,626 tons were sold crude. Increases in sales of magnesite were reported as follows in 1935: Crude, 2.4 percent in quantity and 21.5 percent in value; calcined, 42.3 percent in quantity and 42.7 percent in value; and dead-burned, 75.9 and 81.3 percent, respectively. Sales of domestic caustic calcined magnesite increased moderately, but shipments of dead-burned magnesite increased considerably. Sales of magnesite for refractory and plastic material increased in 1935.

Figure 152 compares domestic sales and imports of dead-burned magnesite with the index of steel-ingot production (1923–25 average=100). The increasing importance of domestic supplies is shown clearly, also the correlation between apparent supply and steel production. The latter doubtless would be even closer if repairs to steel furnaces had not been postponed so generally during the depression with a correspondingly deferred demand for refractory materials in excess of normal replacements after 1932.

California.—During 1935 the California Chemical Co. (220 Bush Street, San Francisco, Calif.) absorbed the plants, assets, and activities of the Sierra Magnesite Co., its former subsidiary, and purchased the mines and plant in Stanislaus County about 30 miles above Patterson, heretofore owned by Robert Hays Smith. This company, the only remaining producer in the State, produced "periclase", ordinary dead-burned magnesite, and caustic calcined magnesite at its Bald Eagle properties and crude and dead-burned magnesite at its Santa Clara plant. The Bald Eagle mine is situated in Stanislaus

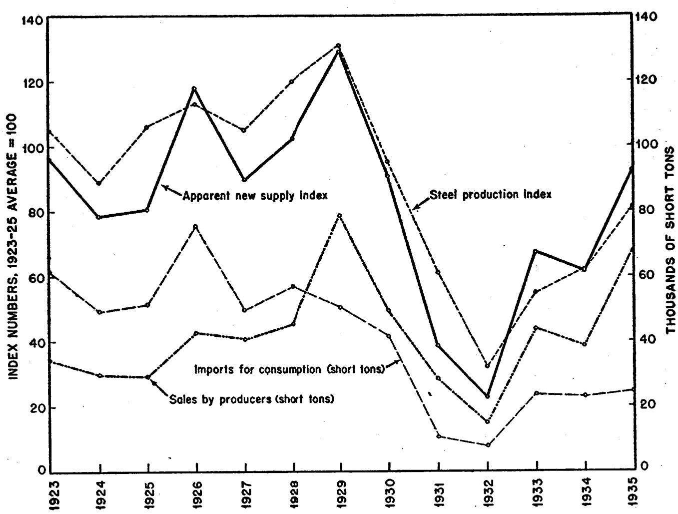

FIGURE 152.—Trends in sales by producers, imports for consumption, and apparent new supply of dead-burned magnesite compared with Federal Reserve Board index of production of steel ingots and castings in the United States, 1923-35.

County (above Ingomar) and is equipped with a rotary kiln of 40 tons daily capacity. The Apex mine, an adjacent property comprising six lode claims purchased in 1934, was operated in conjunction with the Bald Eagle mine. The California Chemical Co. also operated its Western mine in Santa Clara County (near Livermore), which was opened originally by C. S. Maltby and is served by a rotary kiln of 15 tons daily capacity. Both kilns are oil-fired.

Nevada.—No production of brucite or magnesite was reported from Nevada in 1935. Title litigation was rumored [2] as a possible cause for delaying the erection of a refining plant at Luning by the U. S. Brucite Co., which holds the option on the Springer claims.

New Mexico.[3]—Magnesite occurs in Dona Ana County, N. Mex., on both sides of a ridge in the Organ Mountains and adjacent to the township line between 23 and 24 S., R. 4 E. A third and probably smaller occurrence is north of the Organ Pass on the south-

[2] Denver Mining Record, Brucite Mine to Erect Refinery: Vol. 46, no. 27, July 6, 1935, p. 4.
[3] Taft, H. H., Magnesite in Dona Ana County, N. Mex.: Eng. Min. Jour., vol. 137, no. 3, March 1936, p. 137.

west side of San Andres Mountain. The magnesite may have been formed by metamorphic action in dolomite, brought about by intrusions of syenite and monzonite. Analyses show about 44 percent MgO, low iron (well under 1 percent), silica, and lime. None of the deposits have been worked commercially as yet, but they are all within 15 or 20 miles of main railway lines, and the foot of the mountain can be reached by automobile. Supplies of labor, oil, and natural gas are ample. Predazzite, presumably a mixture of calcite and brucite, occurs locally much more abundantly and may also afford a commercial source of magnesia. The extent of the deposits is not known.

Vermont.—Results of tests by the Bureau of Mines on material furnished by the Eastern Magnesia Talc Co. indicate that the tailing from beneficiating the talc by flotation may constitute salable magnesite. Laboratory results indicate a product carrying 85 to 90 percent magnesium carbonate, less than 10 percent insoluble (mostly talc), and 3 percent iron. Commercial development is planned during 1936, and an output of 6,000 to 10,000 tons annually is anticipated from this source.

Washington.—The Northwest Magnesite Co. (executive offices, Farmers Bank Building, Pittsburgh, Pa.) operated its Finch mine near Chewelah in Stevens County and reported that two to four of the six rotary kilns were in operation throughout the year except for a brief shut-down in July.

Imports.—As indicated in the table of salient statistics, imports for consumption of the three classes of magnesite registered no significant changes in 1935. Comparisons of imports by countries in 1934 and 1935 with imports for earlier years are distorted by the change made by the Bureau of Foreign and Domestic Commerce, beginning January 1934, in its system of reporting statistics. Stocks of dead-burned magnesite are kept in bonded warehouse and are not generally entered for consumption (duty paid) upon arrival in the United States. Figures for the last 2 years (which are comparable) show no substantial changes in source or quantities of imports, except perhaps for increased receipts from Russia. Italy was credited with shipment of 4,083 tons of dead-burned magnesite, the first since 1931 when only 14 tons were so recorded, but the 1935 tonnage from Italy may balance the decrease reported from Austria and Czechoslovakia and doubtless comprises merely transshipment from the latter countries as Italy is an insignificant producer of magnesite.

Possibly 30 percent of the imports of dead-burned magnesite are subsequently exported (generally with benefit of draw-back or refund of 99 percent of the duties) in the form of manufactured refractories.

The so-called "magnesitic dolomite" produced in Argenteuil County, Quebec (originally imported as "magnesite" but subsequently classified for customs purposes under paragraph 214 of the Tariff Act of 1930) was specifically provided for under the Reciprocal Trade Agreement with Canada, effective January 1, 1936, as "dead-burned basic refractory material containing 6 percent or more of lime and consisting chiefly of magnesia and lime." The duty was reduced from 30 to 27½ percent of the foreign market value.

Magnesite imported for consumption into the United States, 1934–35, by countries and classes

Country	Crude		Caustic calcined				Dead-burned and grain (not suitable for manufacture into oxychloride cements)	
			Lump		Ground			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1934								
Austria							15,381	$232,079
Canada							168	12,602
Czechoslovakia							5,548	93,901
Germany					3	$278		
Greece			55	$1,418	89	1,760	2	31
India, British	28	$287	529	8,071			22	287
Netherlands	22	419	23	669	374	10,151		
U. S. S. R. (Russia)							1,800	29,114
United Kingdom			11	542	67	2,956		
Yugoslavia					402	10,186		
	50	706	618	10,700	935	25,331	22,921	368,014
1935								
Austria							12,765	216,937
Canada							103	8,422
Czechoslovakia					55	1,417	3,516	65,129
Germany					5	672		
Greece			55	1,417	49	1,194		
India, British			381	6,207				
Italy							4,083	69,884
Netherlands	49	1,084	92	1,956	549	15,650		
U. S. S. R. (Russia)							4,207	69,458
United Kingdom			10	276	86	3,160		
Yugoslavia			15	390	144	3,737		
	49	1,084	553	10,246	888	25,830	24,674	429,830

Prices.—No price changes were reported for dead-burned or calcined magnesite after June 21, 1934; the following quotations per short ton were in effect throughout 1935:

Dead-burned magnesite:	
F. o. b. Chewelah, Wash	$22.00
F. o. b. California mines	25.00
Artificial periclase:	
F. o. b. California mines:	
No. 94	65.00
No. 90 (about 92 percent)	35.00
Caustic calcined magnesite:	
F. o. b. California mines:	
95 percent	40.00
85 percent	37.50

The prices quoted for caustic calcined magnesite are for kiln-run, unground (improperly referred to as "lump") material in bulk. An extra charge of $2 a ton is made for packing in bags, and for powdered calcined magnesite packed in bags the extra charge is $5 a ton.

Prices of magnesite brick were unaltered at $65 a ton, f. o. b. works in the eastern United States, for standard burned brick and $55 for unburned brick.

Dead-burned, grain magnesite delivered at Pittsburgh is worth about $35 a ton, including all-rail freight of $13 a ton on the domestic product. Austrian magnesite has European rail and ocean freight charges of about $7 a short ton, duty of $11.50, and American rail freight of $3.90 or more—a total of $22.50 over and above the f. o. b. mine price. The average declared valuation of all imports of dead-burned magnesite into the United States in 1935 was $17.42 f. o. b. foreign mine or port, compared with an average of $17.93 f. o. b. domestic mines as reported by American producers.

World production of magnesite, 1930–34, by countries, in metric tons [1]

[Compiled by M. T. Latus]

Country	1930	1931	1932	1933	1934
Australia:					
New South Wales	8,794	3,480	5,199	9,512	15,902
Queensland	----------	----------	132	152	42
South Australia	37	----------	117	205	208
Victoria	64	51	29	6	26
Austria	304,396	179,440	134,409	164,331	258,382
Canada [2]	25,073	24,345	2,833	27,158	(3)
China (Manchuria)	29,482	36,034	55,386	71,376	(3)
Czechoslovakia [4]	71,388	38,918	33,965	49,935	58,235
Germany	(3)	(3)	(3)	(3)	11,010
Greece	68,509	49,990	44,699	44,719	(3)
India, British	16,788	5,419	14,087	15,450	15,215
Italy	4,122	3,470	460	2,187	1,100
Norway	2,206	1,580	1,311	2,007	2,500
Southern Rhodesia	----------	----------	14	----------	----------
Turkey	357	2,197	310	951	628
Union of South Africa	1,910	1,357	1,418	1,495	1,667
U. S. S. R. (Russia)	[5] 152,000	[5] 246,000	334,454	380,300	482,000
United States	117,317	66,770	34,892	98,145	91,601
Yugoslavia [6]	32,036	32,209	33,317	14,602	25,086

[1] Unless otherwise stated quantities in this table represent crude magnesite mined.
[2] Magnesitic dolomite.
[3] Data not available.
[4] 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.
[5] Year ended Sept. 30.
[6] Serbia only.

Africa.—For several years magnesitic talc rock deposits in the Anglo-Egyptian Sudan have been investigated with a view to commercial utilization. They average nearly 50 percent of talc and more than 40 percent of ferruginous magnesite, and also contain chromite and magnetite. Two types of refractory bricks have been manufactured, and both are reported [4] to have withstood practical service in British steel works. The first type is a magnesite brick made from the rock after removal of the talc by flotation, and the second is a dolomite brick made by mixing the raw rock with dolomite. The leading dolomite concern in England has erected a plant capable of turning out 6,000 brick of the second type weekly and has arranged for a supply of 500 tons of rock for large-scale test of the market. According to an earlier report [5] this material should cost less than £4 a ton delivered at British ports.

Austria.[6]—In 1935, 300,312 metric tons of crude magnesite were produced in Austria, a 16-percent increase over 1934. Of the 1935 total, which includes both amorphous and crystalline varieties, the Veitscher-Magnisitwerke A. G. produced 118,495 tons and the Osterreichisch-Amerikanische Magnesit A. G., 111,253 tons; the remainder

[4] Mining World and Engineering Record (London), Sudan: Vol. 129, no. 3356, July 27, 1935, p. 93.
[5] Tyler, W. H., and Rees, W. J., An Investigation into the Commercial Utility of a Deposit of Magnesite-Bearing Rocks in the Anglo-Egyptian Sudan (Paper presented before Refractory Materials Sec., Ceramic Soc., London, Nov. 21–23, 1933): Chem. and Ind., vol. 52, no. 50, Dec. 15, 1933, p. 1017.
[6] Richardson, G., U. S. commercial attaché (Vienna), Foreign Metals and Minerals Circ. 3: Apr. 15, 1936, pp. 1–2.

was produced by the two smaller concerns. Exports of dead-burned magnesite increased to 55,121 tons valued at 9,251,000S., compared with 36,578 tons valued at 6,225,000S. in 1934; the increase was distributed proportionally among the leading consuming countries. Export prices ranged in 1935 from 144.05S. to 223.27S. per metric ton, the lowest being to the United States; these quotations are based partly upon volume of business and partly upon special agreements. Exports of caustic calcined magnesite, of which most go to Germany, increased only moderately (from 31,272 to 34,317 tons), and exports of raw magnesite (of which Germany is also the main buyer) decreased slightly (from 19,432 in 1934 to 7,169 tons in 1935).

The best gain was in exports of magnesite bricks and plates—from 26,276 tons valued at 10,706,000S. in 1934 to 35,960 tons valued at 14,387,000S. in 1935. The production of magnesite bricks and plates (38,785 tons) was 35 percent greater than in 1934. The raw material for these products is included in the production of dead-burned magnesite, which rose 46 percent to 94,522 tons. Production of caustic calcined magnesite during the year was 43,733 tons, a 22-percent increase over 1934, and reflected improved domestic consumption.

The report of the Veitscher company shows a gross profit of 3,206,000S. for 1935 compared with 2,791,000S. for 1934; a net profit of 1,316,000S. permitted a dividend of 65S. (13 percent) as against 40S. or 8 percent for 1934. Capital was reduced from 10 to 7.5 million S. during the year. (The average exchange rate for the Austrian schilling was $0.1883 in United States currency in 1935 and $0.1879 in 1934.)

Czechoslovakia.—Exports of crude magnesite from Czechoslovakia increased to 9,539 tons and those of dead-burned magnesite to 30,307 in 1935 compared with 8,848 and 24,236 tons, respectively, in 1934. Production from the mines in Kosice, Lovinobani, and Ochtina (all in the Province of Slovakia) likewise increased over the preceding year. Imports are unimportant; only 72 tons of crude and 1,114 tons of dead-burned magnesite were brought from Austria and Russia for use in frontier plants. Two companies, both members of the European cartel, constitute the Czechoslovak industry—Magnesitindustrie, A. G., Bratislava, and Western Bohemia Kaolin & Refractory Works, Prague.

Greece.—Exports from Greece of both crude and caustic calcined magnesite increased 50 percent in 1935 compared with 1934, but those of dead-burned magnesite declined slightly, according to preliminary figures furnished by Consul Henry A. W. Beck (Athens). The average export values of the respective grades were $6, $19, and $16 per metric ton. Virtually the entire Grecian output is exported, the business being dominated by a British company. In 1935, as in former years, crude magnesite was shipped to the Netherlands, Germany, Italy, Great Britain, and France; caustic calcined and dead-burned magnesite were exported chiefly to the Netherlands and Germany.

In 1913 Greece exported 23,376 metric tons of crude, 36,094 tons of caustic calcined, and 1,841 tons of dead-burned magnesite. Prior to the World War the item of principal value was caustic calcined material, which went to the Netherlands, whence it was reshipped to various countries. The crude ore was sent to Italy, France, and the Netherlands. Shipments of crude rose to a peak of 159,778 long tons in 1916, and there was a temporary increase in output of dead-burned magnesite. Subsequently, due to higher fuel costs, little material was treated locally, and even exports of crude dwindled greatly. After various ups and downs, exports rose in 1928 to 13,408 metric tons of crude and 16,489 tons of caustic magnesite, only to decline again due to competition from Russia, Yugoslavia, and Austria, and to the world-wide shrinkage in demand for plastic magnesite. Later figures indicate a sharp upturn as follows:

	1931	1932	1933	1934	1935
Magnesite; metric tons:					
Crude	1,222	13,002	10,928	20,297	33,502
Caustic calcined	8,149	10,563	13,901	14,963	22,502
Dead-burned	----------	----------	6,195	9,393	9,191

Mexico.—Presumably typical analyses of high-grade magnesite from Baja, California, were furnished the Bureau of Mines by R. R. Pollok, San Francisco. It is believed that large quantities of 98-percent material can be produced without excessive sorting, and a so-called average sample shows 93.69 percent $MgCO_3$, 5.08 percent $CaCO_3$, 0.14 percent Fe_2O_3, and 1.52 percent SiO_2.

Sweden.—An apparently large deposit of high-grade magnesite is reported from the northern slope of Mount Apart in Sareks National Park, a Government domain in Swedish Lapland. Analysis gave 0.6 percent silica, less than 1 percent iron, and 3 percent lime, but commercial production in this inhospitable region must await transportation facilities. Even airplane communication stops on a lake 20 miles away from the deposit.

U. S. S. R. (Russia).—In 1934 Russia became by far the largest magnesite-producing country. Until a few years ago, Russian needs were supplied to a large extent by imports, but recently a growing surplus has been exported although domestic requirements have increased greatly.

DOLOMITE

Dolomite (magnesium-calcium carbonate) competes with magnesite as a source of magnesium compounds for medicinal and technical use, furnishing most of the basic carbonate employed in "85-percent magnesia" pipe and boiler coverings. Most important of all is the use of dead-burned dolomite as a steel-works refractory, 7 to 10 times as much dolomite as magnesite being used for this purpose. In 1934, for example, when the apparent supply of dead-burned magnesite was 61,456 tons, sales of dead-burned dolomite were 309,000 tons, and doubtless much of the raw stone sold for refractory use (249,000 tons) was similarly employed. Dolomitic lime to the extent of 25,000 to 40,000 tons annually is used in the manufacture of sulphite pulp, an operation that formerly consumed substantial tonnages of magnesite.

Available statistics on dolomitic lime will be found in the Lime chapter of the Minerals Yearbook, and those for raw stone are given in the chapter on Stone. Raw dolomite, however, is used for patching linings for open-hearth furnaces and further quantities are used for making carbon dioxide, often with Epsom salts as a joint product.

MAGNESIUM

World-wide expansion in the use of magnesium is indicated by the number of new plants built or projected in 1935. As noted in the Minerals Yearbook 1935, output for 1934 was estimated at 30,000 to 35,000 tons, but this figure may be twice too high; actual figures as to European output are still carefully guarded. After being a German monopoly for many years, manufacture of magnesium was begun in the United States as a war measure, and in 1934 large quantities of American metal were exported to Europe. Reports in the British press indicated a great increase in this trade early in 1935, but final figures for 1935 show no increase in total shipments of American magnesium for domestic and foreign consumption, although the high record of 1934 was virtually duplicated. Rapidly growing demand in Great Britain, hitherto supplied mainly by imports, may soon be met by home production. Japan and Russia also are reported to be preparing to furnish large quantities of the metal. Increased supplies are promised likewise from France, Italy, Switzerland, and Germany. Austria, too, after considerable experimenting, is now producing the metal at Radenthein on a commercial scale; this enterprise is of special interest as it employs magnesite instead of magnesium chloride as raw material. According to report,[7] the calcined magnesia is reduced with coal in an electric furnace at a temperature (2,200° to 2,300° C.) above the vaporization temperature of the metal, which is later condensed. The product is 99.97 to 99.98 percent pure, energy consumption does not exceed 24 to 25 kw-hr. per kilogram of cast metal, and the total cost is low. Even in Tasmania, the Australian Magnesia Co. was reported to be operating an experimental plant for making magnesium from local magnesite.

Progress in the industry during 1935[8] was concerned largely with refinements in technology and commercializing existing knowledge, rather than with strictly new developments. Improved die-casting practice, perfection of chemical finishes (preparatory to painting) that produce no dimensional changes, and wide adoption of an improved magnesium-aluminum-manganese-zinc alloy for castings were high lights of the year. Whereas magnesium formerly was used almost exclusively as a deoxidizer or as an alloying metal, consumption of castings and wrought shapes is growing not only in the aircraft industry, the largest user of magnesium-alloy parts, but in many other industries that require a light metal having suitable physical properties.

Domestic production.—All the magnesium made in the United States is a product of the Dow Chemical Co. at Midland, Mich. Although sales of ingot remained about the same in 1935 as in 1934, sales of alloy ingot, castings, and forgings increased, and notwithstanding some decrease in other structural and nonstructural products the aggregate output of fabricated items increased to 673,956 pounds or 16 percent of the ingot sales (which include export sales and domestic consumption) compared with 15 percent in 1934. By far the bulk of the magnesium sold in the United States is still employed for deoxidiz-

[7] Hansgirg, F., Die elektrothermische Gewinnung von Magnesium-Metal: Berg-und Hüttenmännisches Jahrbuch, vol. 82, Sept. 28, 1934, pp. 109–112 (Metals and Alloys, vol. 6, no. 2, February 1935, p. MA 46).

[8] Gann, John A., Magnesium Products Improve in Quality and Size: Min. and Met., vol. 17, no. 349, January 1936, p. 49.

ing and desulphurizing other metals, as a minor addition in aluminum heat-treated alloys, and for other uses of ingot or stick metal.

New magnesium ingot and stick sold or used by the producer in the United States, 1931–35

Year	Pounds	Value	
		Total	Average price per pound [1]
1931	580,463	$199,633	$0.34
1932	791,699	228,653	.29
1933	1,434,893	377,181	.28
1934	4,249,838	(2)	.26
1935	4,241,218	(2)	(2)

[1] 1931–32: Represents average of total sales; 1933–34: Represents average of sales for domestic consumption only.
[2] Bureau of Mines not at liberty to publish figures.

Magnesium products (other than ingot and stick magnesium) manufactured in the United States and sold or used by the companies manufacturing the products, 1931–35

Product	1931		1932		1933		1934		1935	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Alloy ingot	65,314	$24,524	128,751	$48,563	165,729	$52,978	237,693	$69,696	307,470	(1)
Structural products:										
Castings	127,398	206,858	132,049	175,806	[2] 165,599	[2] 269,308	284,419	429,974	375,625	$591,480
Sheet	9,433	8,221	17,796	10,940	57,750	29,408	93,591	49,236	75,977	44,570
Structural shapes, rods, and tubing [3]	[4] 194	[4] 294	19,154	10,309	45,275	24,263	94,935	48,726	49,139	26,918
Forgings	[4] 22,588	[4] 14,179	13,159	10,192	41,575	25,968	68,936	44,159	72,626	45,400
Other structural [3,5]	4,357	2,025	6,964	6,489	[2] 15,507	[2] 11,507	4,137	1,374	672	264
Total structural products [6]	163,970	231,577	189,122	213,736	325,706	360,454	546,018	573,469	574,039	708,632
Nonstructural products:										
Wire and ribbon	2,906	9,026	4,650	10,806	8,464	14,684	10,348	16,989	20,171	33,084
Shavings [7]	768	445	1,863	827	15,500	7,771	55,469	27,643	57,181	28,511
Powder [7]	23,156	38,688	17,962	30,176	16,564	28,339	22,348	37,525	22,565	38,832
Other nonstructural [5]	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	----------	----------
Total nonstructural products [6]	26,830	48,159	24,475	41,809	40,528	50,794	88,165	82,157	99,917	100,427
Grand total (exclusive of alloy ingot)	190,800	279,736	213,597	255,545	366,234	411,248	634,183	655,626	673,956	809,059

[1] Bureau of Mines not at liberty to publish figures.
[2] An unknown quantity of die castings included under "Other structural."
[3] In 1931–33, inclusive, some structural shapes included under "Other structural"; separate figures not available.
[4] Some structural shapes, rods, and tubing included under "Forgings"; separate figures not available.
[5] In 1931–34, inclusive, small quantity of miscellaneous, unspecified, nonstructural products included under "Other structural"; separate figures not available.
[6] In 1931–34, inclusive, small unspecified quantity of miscellaneous nonstructural products included under "Total structural products."
[7] Minor quantities of shavings included under "Powder"; separate figures not available.

Imports and exports.—Little foreign magnesium has been consumed in the United States in recent years. In 1935 imports of magnesium powder were 882 pounds valued at $1,252 (an unimportant increase over the 1934 figures of 661 pounds valued at $962), and only 2 pounds of sheets, tubing, wire, and other manufactures, valued at $40, were imported compared with none in 1934. Exports of magnesium, mainly as ingot, are not separately recorded but have been relatively large since 1933, when a sharp reduction in the domestic price followed by the drop in the dollar (resulting from the departure from the gold standard) placed the American metal on a more favorable competitive basis with the German alloys that formerly had a virtual monopoly of international trade.

Prices.—The nominal prices quoted in Metal and Mineral Markets remained unchanged at 30 cents per pound for ingots (4- by 16-inch) in carloads and 32 cents in less-than-carload lots of 100 pounds or more, with a premium of 5 cents a pound for specified stick sizes (¼, ⅜, ½, 1, and 2 pounds each). London quotations declined slightly to 1s. 3d. in January 1935, advanced during the second quarter, and remained at 1s. 6d. during the latter half of the year with a slight tendency to rise in November.

Any consideration of the price of magnesium should take account of the fact that, on a volume basis, 1 pound of magnesium is equal to 1½ pounds of aluminum and about 5 pounds of copper. The manufacture of magnesium is not costly, as the consumption of electrical energy per pound does not exceed that for a corresponding quantity of aluminum. Moreover, the raw materials are as abundant as the bauxite from which aluminum is made and in most localities are cheaper.

MAGNESIUM SALTS

Commercial utilization of magnesium compounds other than magnesite formerly was confined mainly to magnesium chloride for magnesite stucco and cement mixtures (Sorel cement), Epsom salts for medicinal and sundry minor industrial uses, and technical (basic) carbonate for pipe coverings. World supplies of the chloride and sulphate came principally from Germany, as byproducts of the potash industry. Recently, the uses of magnesium salts have become more diversified, and many other countries have developed their own supplies, utilizing bitterns from salt making as well as magnesite or dolomite. The decline in use of Sorel cement has tended to reduce the gross consumption of these salts, but larger quantities are used for other purposes. The carbonate finds employment in rubber goods, paper, pharmaceutical preparations, dentifrices, face powder, and glass and metal polishes. Magnesium hydroxide is used more and more in petroleum refining. As the role of magnesium as a plant food is understood better, magnesium sulphate finds increasing use in fertilizers in New England and the South as well as in France and Germany; large quantities are still consumed for medicinal and bath purposes. Tanning, textile, ink, paint, cosmetic, dry cleaning, food, and miscellaneous chemical industries use magnesium compounds.

Domestic production.—The total production of natural magnesium salts (sulphate, chloride, and carbonate from sea-water bitterns) in the United States in 1935, as reported by producers, was 107,626,206 pounds; the quantity sold or used during the year was 109,601,855 pounds valued at $1,286,804. Magnesium sulphate represented 60,491,090 pounds or 56.2 percent of the total production. Of the total quantity and value of natural magnesium salts sold or used during 1935, 62,392,215 pounds (56.9 percent), valued at $828,424 was magnesium sulphate. Separate figures for magnesium chloride and magnesium carbonate may not be published, as there were less than three producers of each commodity.

Magnesium sulphate was produced from natural brines by the Dow Chemical Co. at Midland, Mich., and the Texaco Salt Products Co. at West Tulsa, Okla. (address, Houston, Tex.), and from natural deposits of epsomite near Oroville, Okanogan County, Wash., by C. A. Kearney (address, 1208 Post St., Seattle, Wash.), who leased the property of the Magnesia Co. (address, Portland, Oreg.). Commercial magnesium chloride made from natural brines and bittern waters was produced by the California Chemical Co. (address, 220 Bush St., San Francisco, Calif.) and by the Dow Chemical Co. Magnesium carbonate was produced from sea water by the Marine Chemicals Co., Ltd., South San Francisco, Calif., and the Plant Rubber & Asbestos Works (address, 537 Brannan St., San Francisco, Calif.).

Imports.—During the last 15 years Germany's shipments of magnesium chloride to the United States have dwindled to almost insignificant proportions and those of magnesium sulphate have shrunk greatly. On the other hand, imports of calcined magnesia and precipitated carbonate, mostly of British origin, have increased markedly, as shown in the following table:

Magnesium compounds imported for consumption in the United States, 1920–35 [1]

Year	Magnesium chloride (hydrated and anhydrous)		Magnesium sulphate (Epsom salts)		Calcined magnesia		Carbonate, precipitated		Magnesium silicofluoride or fluosilicate	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1920–24 (average)	11,495,360	$96,479	12,610,276	$96,889	80,441	$18,542	319,625	$16,486	(2)	(2)
1925–29 (average)	9,858,618	68,144	10,886,654	63,205	342,997	57,419	316,153	19,335	(2)	(2)
1930–34 (average) [3]	861,138	8,267	8,357,367	51,761	389,467	69,426	581,958	26,662	47,221	$2,654
1934	28,290	614	4,586,707	27,206	313,096	64,451	476,418	24,110	20,946	1,520
1935 [3]	50,094	1,095	3,060,883	18,495	196,264	36,297	601,459	27,935	98,037	6,500

[1] In addition to the items reported separately for previous years, 4,303,241 pounds of calcined magnesium sulphate or calcined Kieserite (not fertilizer) valued at $32,720 were imported in 1934, and 3,668,091 pounds valued at $30,291 in 1935.

[2] Data not available.

[3] Also "manufactures of carbonate of magnesia" imported as follows: In 1933, 314 pounds valued at $74; 1930–32 and 1934, none recorded; 1935, 11,200 pounds valued at $489.

MICA

By Oliver Bowles and B. H. Stoddard

SUMMARY OUTLINE

Sales of uncut sheet mica of domestic origin in 1935, amounting to 936,633 pounds valued at $161,150, exceeded sales in 1934 by 61 percent in quantity and 79 percent in value. As usual, North Carolina was the principal producer, accounting for about 55 percent of the total. New Hampshire was second, with 14 percent. Production in North Carolina was nearly double that of 1934, but production in New Hampshire decreased considerably.

Scrap-mica sales in 1935 were much larger than in 1934. Fine mica, recovered as a byproduct in washing kaolin, and the product obtained by grinding muscovite, chlorite, and sericite schists are logically part of the ground-mica industry and are included therewith. However, the tonnage of these products is added to that of scrap, so that it may properly be included with domestic production.

An important trend in the mica industry is the great increase in the quantity of finely divided mica obtained from sources other than scrap. Just a few years ago virtually all ground mica was manufactured from the scrap or waste that resulted from trimming sheet mica. In 1935 such true scrap provided only about 65 percent of the raw material from which the total output of finely divided mica was obtained. The remaining 35 percent was recovered from washing kaolin or was manufactured from mica schists.

Although the United States is the world's largest consumer of mica, it produces normally only 15 to 35 percent of its requirements of sheet mica larger than punch and circle and less than 5 percent of its requirements of splittings; however, it produces enough punch and scrap mica to satisfy nearly all domestic requirements. Foreign supplies of mica other than scrap are therefore of great importance to domestic consumers.

Imports of unmanufactured mica decreased about 14 percent in both quantity and value in 1935 compared with 1934, while imports of manufactured mica increased about 25 percent in quantity and 35 percent in value. Imports of splittings increased about 42 percent. There were no imports of ground mica in 1935. Exports of mica and mica products in 1935 amounted to 2,998,762 pounds valued at $165,385, a decrease of about 14 percent in quantity and 12 percent in value compared with 1934.

The following table summarizes the principal statistics of the mica industry in the United States from 1932 to 1935:

Salient statistics of the mica industry in the United States, 1932–35

	1932	1933	1934	1935
Domestic mica sold or used by producers:				
Uncut sheet:				
Punch and circle:				
Pounds	258,512	253,243	425,156	670,327
Value	$7,976	$10,199	$16,096	$28,387
Average per pound	$0.03	$0.04	$0.04	$0.04
Larger than punch and circle:				
Pounds	80,485	111,297	158,372	266,306
Value	$37,906	$42,980	$74,172	$132,763
Average per pound	$0.47	$0.39	$0.47	$0.50
Total uncut sheet:				
Pounds	338,997	364,540	583,528	936,633
Value	$45,882	$53,179	$90,268	$161,150
Average per pound	$0.14	$0.15	$0.15	$0.17
Scrap:				
Short tons	7,040	8,751	7,719	[1] 18,852
Value	$83,777	$98,159	$99,791	[1] $243,951
Average per ton	$11.90	$11.22	$12.93	$12.94
Total sheet and scrap:				
Short tons	7,209	8,933	8,011	[1] 19,320
Value	$129,659	$151,338	$190,059	[1] $405,101
Ground:				
Dry-ground: [2]				
Short tons	5,253	6,439	6,824	15,178
Value	$126,714	$135,178	$156,046	$341,825
Average per ton	$24.12	$20.99	$22.87	$22.52
Wet-ground:				
Short tons	2,452	3,392	2,723	3,145
Value	$184,126	$263,503	$247,284	$201,148
Average per ton	$75.09	$77.68	$90.81	$63.96
Total ground:				
Short tons	7,705	9,831	9,547	18,323
Value	$310,840	$398,681	$403,330	$542,973
Consumption of splittings: [3]				
Pounds	898,249	1,428,329	1,763,035	2,532,984
Value	$268,285	$343,161	$490,148	$631,065
Imports for consumption:				
Unmanufactured:				
Pounds	2,970,742	3,853,906	7,688,458	6,580,486
Value	$78,496	$178,953	$247,408	$211,556
Manufactured:				
Cut:				
Pounds	23,097	39,787	68,619	94,237
Value	$16,824	$25,609	$64,498	$83,382
Splittings:				
Pounds	944,628	1,343,329	2,145,950	3,041,408
Value	$184,920	$255,401	$442,949	$584,657
Built-up:				
Pounds	12,956	15,244	7,637	32,495
Value	$6,871	$10,795	$5,651	$25,383
Ground:				
Pounds	111,771	537,776	318,464	------------
Value	$383	$1,388	$907	------------
All other manufactured:				
Pounds	1,287	3,441	1,898	7,867
Value	$173	$1,611	$1,209	$3,406
Total manufactured:				
Pounds	1,093,739	1,939,577	2,542,568	3,176,007
Value	$209,171	$294,804	$515,214	$696,828
Total imports:				
Pounds	4,064,481	5,793,483	10,231,026	9,756,493
Value	$287,667	$473,757	$762,622	$908,384
Exports (all classes of mica):				
Pounds	3,098,737	3,125,873	3,502,498	2,998,762
Value	$132,755	$117,863	$188,525	$165,385

[1] Includes 6,667 tons valued at $111,345 recovered from kaolin and from schists.
[2] Includes fine unground mica recovered in washing kaolin and, in 1935, mica recovered by milling mica schist.
[3] Exclusive of a nominal quantity of splittings produced in South America and the United States.

PRODUCTION

Sheet and scrap.—The following tables show the quantity and value of the various classes of domestic mica sold or used by producers in the United States and in the two principal producing States—New Hampshire and North Carolina—from 1931 to 1935.

Domestic mica sold or used by producers in the United States, 1931–35

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
1931	757,647	$33,317	205,306	$78,513	962,953	$111,830	6,621	$99,415	7,102	$211,245
1932	258,512	7,976	80,485	37,906	338,997	45,882	7,040	83,777	7,209	129,659
1933	253,243	10,199	111,297	42,980	364,540	53,179	8,751	98,159	8,933	151,338
1934	425,156	16,096	158,372	74,172	583,528	90,268	7,719	99,791	8,011	190,059
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

[1] Includes 6,667 tons valued at $111,345 recovered from kaolin and from schists.

Mica sold or used by producers in chief producing States, 1931–35

State and 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
New Hampshire:										
1931	349,168	$17,342	91,996	$19,026	441,164	$36,368	295	$5,465	516	$41,833
1932	121,487	3,607	24,527	14,371	146,014	17,978	344	5,585	417	23,563
1933	117,333	3,940	50,131	18,068	167,464	22,008	532	9,563	616	31,571
1934	118,508	3,788	42,922	10,635	161,430	14,423	537	9,529	618	23,952
1935	95,112	3,869	36,474	9,858	131,586	13,727	394	5,335	460	19,062
North Carolina:										
1931	310,366	12,894	79,060	38,763	389,426	51,657	5,312	79,601	5,507	131,258
1932	85,803	2,906	41,893	15,416	127,696	18,322	4,837	56,842	4,901	75,164
1933	117,826	5,322	44,846	15,785	162,672	21,107	6,918	74,711	6,999	95,818
1934	225,967	9,080	67,414	29,594	293,381	38,674	4,757	59,496	4,904	98,170
1935	401,605	18,411	110,985	59,187	512,590	77,598	11,831	153,553	12,087	231,151

Ground mica.—The quantity of ground mica sold by domestic producers in 1935 was 18,323 tons valued at $542,973, an increase of 143 percent in quantity and 35 percent in value compared with 1934. However, the figures are not exactly comparable because ground muscovite, sericite, and chlorite schists are included with ground mica for the first time in 1935. The increase in sales of ground mica reflects growing use in roll roofing, wall-paper coating, rubber trade, and architectural plastic manufacture, which provide its chief markets. Following is a list of companies that reported ground mica to the Bureau of Mines in 1935, classified according to the method of grinding.

	Process
Asheville Mica Co., Biltmore, N. C	Dry.
Concord Mica Co., Concord, N. H	Wet.
Richmond Mica Corporation, 323 South 9th St., Richmond, Va	Do.
Franklin Mineral Products Co., Franklin, N. C	Do.
General Mica Co., Inc., Pueblo, Colo	Dry.
Marion Mica Mills, Marion, N. C	Wet.
Newdale Mica Co., Micaville, N. C	Dry.
Southern Mica Co., Franklin, N. C	Do.
Standard Oil Co., 910 South Michigan Ave., Chicago, Ill	Do.
U. S. Mica Manufacturing Co., 1521–1527 Circle Ave., Forest Park, Ill	Do.
D. T. Vance, Plumtree, N. C	Wet.
Vance-Barrett, Inc., Plumtree, N. C	Do.
Western Elaterite Roofing Co., 841 Equitable Bldg., Denver, Colo	Dry.

The following tables show the quantity and value of wet-ground and dry-ground mica sold by producers in the United States from 1931 to 1935 and the 1935 sales by uses. The figures for dry-ground mica include sales of byproduct mica recovered by the Harris Clay Co. and the General Mica Co. in the process of washing kaolin in Mitchell County, N. C., and for 1935 the product obtained by grinding muscovite, sericite, and chlorite schists as reported by the Pacific Minerals Co., Ltd., Richmond, Calif., L. E. Shepard, Buckeye, Ariz., Thompson Weinman & Co., Inc., Cartersville, Ga., and the Victor Mica Co., Spruce Pine, N. C.

Ground mica sold by producers in the United States, 1931–35, by methods of grinding

Year	Dry ground		Wet ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1931	5,363	$168,783	2,444	$267,653	7,807	$436,436
1932	5,253	126,714	2,452	184,126	7,705	310,840
1933	6,439	135,178	3,392	263,503	9,831	398,681
1934	6,824	156,046	2,723	247,284	9,547	403,330
1935	[1] 15,178	[1] 341,825	3,145	201,148	18,323	542,973

[1] Includes ground mica schist.

Ground mica sold to various industries in the United States in 1935

Industry	Quantity		Value
	Short tons	Percent of total	
Roofing [1]	14,403	79	$324,165
Wall paper	2,051	11	134,457
Rubber	768	4	46,456
Miscellaneous [2]	1,101	6	37,895
	18,323	100	542,973

[1] Includes ground mica schist.
[2] Figures cover mica used for molded electric insulation, paint manufacture, surfacing on asphalt shingles, Christmas-tree snow, manufacture of axle greases and oil, annealing, concrete and foundry facing, pipe-line enamel, plastic specialties, and other purposes.

CONSUMPTION AND STOCKS OF MICA SPLITTINGS

Thin flakes of mica known as splittings, used for the manufacture of built-up mica products, constitute an important raw material of the mica-products industry, but virtually all of them are prepared in India, Madagascar, and Canada. Approximately 85 percent of the imports of splittings in 1935 came from India.

The accompanying tables show the quantity, value, and source of mica splittings consumed in the United States from 1931 to 1935 and of stocks in the hands of consumers on December 31, 1934, and 1935. Stocks at the end of 1935 had increased 2.4 percent in quantity and decreased 1.3 percent in value compared with those at the close of 1934.

Mica splittings consumed in the United States, 1931–35, by sources, as reported by consumers [1]

Year	India		Canada		Madagascar	
	Pounds	Value	Pounds	Value	Pounds	Value
1931	1,713,954	$648,169	163,091	$52,258	162,545	$63,443
1932	666,911	193,309	73,810	13,655	157,528	61,321
1933	1,088,796	233,075	84,494	24,412	255,039	85,674
1934	1,422,635	350,561	94,422	37,903	244,978	101,684
1935	2,150,593	492,161	129,272	42,897	253,119	96,007

[1] Exclusive of a nominal quantity of splittings produced in South America and the United States.

Stocks of mica splittings in hands of consumers, Dec. 31, 1934–35

Source	1934		1935	
	Pounds	Value	Pounds	Value
Canada	200,018	$80,976	139,019	$57,286
India	924,028	240,792	1,011,864	259,201
Madagascar	208,354	82,809	213,421	82,908
	1,332,400	404,577	1,364,304	399,395

TRENDS IN PRODUCTION AND IMPORTS

Figure 153 shows the quantity and value of mica splittings and of the better grades of sheet mica imported into the United States for a 10-year period, also domestic production of sheet mica in sizes larger than punch during the same period. Imports of splittings show large gains both in quantity and value since 1933. Imported sheet gained moderately from 1932 to 1934 but declined both in quantity and value in 1935. Domestic production remained at a low level from 1930 to 1934 but registered a definite gain in 1935. This graph shows clearly that splittings are of major importance in the domestic market, also that domestic production of sheet mica lags far behind imports.

NEW DEVELOPMENTS

The recovery of mica from kaolin during recent years has encouraged wider activity in mica production from residual deposits. During 1935 new plants near Spruce Pine, Newdale, and Micaville, N. C., were built for recovering mica from semikaolinized pegmatites. Mica thus recovered competes with dry-ground mica and is used chiefly in the manufacture of roofing.

The claim has been made that the addition of mica to paints increases their durability and their protective and dielectric qualities, and, because the mica flakes are transparent, causes no alteration in the color.

After considerable experimentation a process has been developed to substitute mica for felt in making asphalt shingles.

MARKET AND PRICES

Domestic sheet mica.—Demand for most grades of sheet mica was strong in 1935. The accompanying table shows the range in prices for domestic uncut sheet mica f. o. b. North Carolina, as reported in Metal and Mineral Markets. These prices apply to both No. 1 and No. 2 clear; stained mica takes a 10- to 25-percent discount from the prices given. The bulk of the electrical mica used for heating appli-

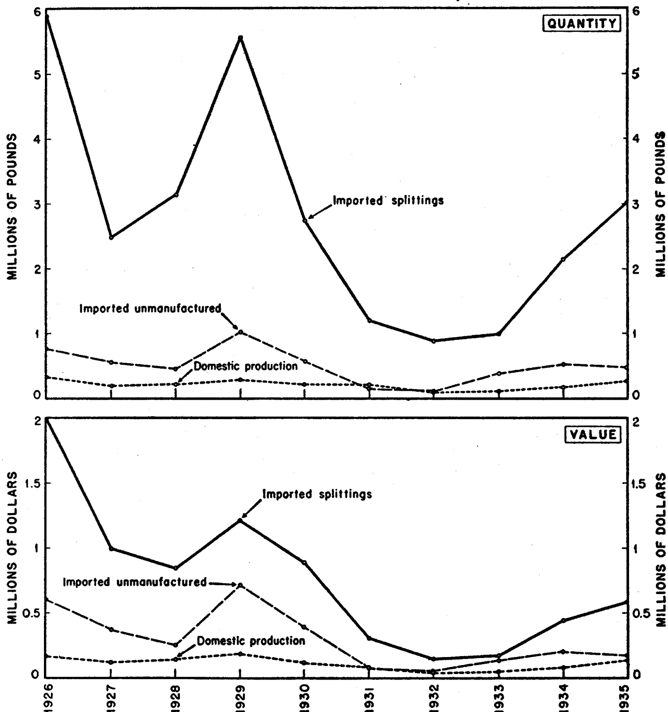

FIGURE 153.—Trends in imports of splittings and of both imports and domestic production of the better grades of sheet mica, 1926–35.

ances, washers, and similar products is of domestic origin and sells at prices consistently lower than that of India mica of the same quality. It is reported that the domestic supply of mica for such uses has not kept pace with the demand and had to be supplemented by imports of heavy stained ruby mica from India and Brazil.

Range in prices per pound for domestic uncut sheet mica in 1935

Size	Price per pound	Size	Price per pound
Punch	\$0.03–\$0.05	3 by 4 inches	\$0.90–\$1.25
½ by 2 inches	.15– .30	3 by 5 inches	1.25– 1.50
2 by 2 inches	.30– .50	4 by 6 inches	1.50– 2.50
2 by 3 inches	.50– .65	6 by 8 inches	2.50– 3.50
3 by 3 inches	.65– .85	8 by 10 inches	4.00– 5.00

Foreign sheet mica.—The demand for India mica was strong, and the price trend for almost every grade and size was upward. Most of the sheet mica imported from India consisted of No. 6 "good stained" for the manufacture of radio-tube supports; Nos. 5, 5½, and

6 "fair stained" condenser mica; large sizes No. 1 and upward of "fair stained" and "stained" qualities; and various standard specialties, such as 1 1/16-inch disks and certain regular sizes of cut mica.

Prices of electrical mica on the London market have been considerably higher than in New York; London, consequently, has had first call on supplies from India and Brazil.

There are no definite New York quotations for foreign mica, but the following table of prices is a close approximation based on actual sales during the year:

Approximate average prices per pound of uncut sheet mica in New York in 1935

Domestic			India (duty paid)[1]					
Size (inches)	Clear	Black spotted	Size (number)	Clear and slightly stained	Fair stained	Good stained	Stained	Black spotted
1½ by 2	$0.40	$0.15	6	$0.94	$0.64	$0.34		
2 by 2	.60	.25	5	2.14	1.69	1.46	$0.54	$0.33
2 by 3	.90	.40	4	3.04	1.84	1.69	1.09	.64
3 by 3	1.20	.55	3	3.35	2.59	2.14	1.69	.99
3 by 4	1.40	.75	2	3.79	3.04	2.74	2.29	1.47
3 by 5	1.60	.90	1	4.54	4.09	3.64	3.19	1.99
4 by 6	1.90	1.00	A-1	9.04	6.04	5.59	4.54	2.14
6 by 8	2.40	1.10	Special	12.04	8.44	6.04	5.44	2.22

[1] Prices of India mica calculated on basis of £1 equals $4.80.

Splittings.—There was no appreciable change in price of no. 6 second- and third-quality loose splittings, which comprise the bulk of the demand. The price of all high-quality splittings has been firm, and an upward trend is indicated for 1936. Supplies of splittings from Madagascar have barely kept pace with demand, and prices have increased somewhat.

Average prices for Indian splittings, duty paid, in New York were as follows: No. 4, book-packed, $0.93; loose $0.75. No. 5, book-packed, $0.80; loose, $0.50. No. 5½, book-packed, $0.75; loose, $0.30. No. 6, first-quality loose, $0.23; second-quality loose, $0.175; third-quality loose, $0.13; cheap loose, $0.10.

Scrap.—The average price of domestic scrap f. o. b. mill in 1935 was $12.94 a ton; in 1934 it was $12.93.

Ground mica.—The average price of dry-ground mica f. o. b. mill in 1935 was $22.52 a ton compared with $22.87 in 1934. Wet-ground mica sold at an average price of $63.96 a ton in 1935 compared with $90.81 in 1934.

FOREIGN TRADE [1]

Imports.—Imports of mica in 1935 amounted to 9,756,493 pounds valued at $908,384, a decrease of about 5 percent in quantity but an increase of nearly 19 percent in value compared with 1934. Imports of unmanufactured mica (6,580,486 pounds valued at $211,556) decreased about 14 percent in both quantity and value. Imports of splittings (3,041,408 pounds valued at $584,657) increased 42 percent in quantity and 32 percent in value compared with 1934. The accompanying table shows the classification, quantity, and value of mica imported for consumption in the United States in 1935 and the countries from which it was last shipped.

[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 1935, by kinds and by countries

Country	Unmanufactured								Manufactured							
					Other				Cut or stamped to dimensions, shape or form							
	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)		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)		Cut (duty, 40 percent)		Disks (duty, 40 percent)		Washers (duty, 40 percent)		Other (duty, 40 percent)	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Africa:																
Union of South							655	$183								
Madagascar							3,302	2,635								
Argentina					8,789	$1,110	25,591	8,808								
Brazil					31,285	3,313	36,546	14,997	21,310	$169	352	$126				
Canada	1,392,440	$6,191	30,606	$2,677	6,971	666	4,503	2,613	8	14	555	194				
Ceylon					600	67	600	155								
Colombia					300	35										
France							5,544	6,106								
Germany							1,823	609	34,562	31,269						
India, British	3,333,998	9,204			83,405	10,857	281,120	106,129	34,000	49,041	1,500	622	1,100	$302	500	$360
Japan							276	166								
Peru					712	74	885	157								
Rumania					147	19										
U. S. S. R. (Russia)	1,259,605	3,502														
United Kingdom					14,606	1,795	56,177	29,488	348	1,253					2	32
	5,986,043	18,897	30,606	2,677	146,815	17,936	417,022	172,046	90,228	81,746	2,407	942	1,100	302	502	392

Country	Manufactured									
	Films and splittings									
	Not cut or stamped to dimensions				Cut or stamped to dimensions (duty, 45 percent)		Mica plates and built-up mica (duty, 40 percent)		All manufactures of which mica is the component material of chief value (duty, 40 percent)	
	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	Pounds	Value
Africa: Madagascar	126,793	$33,250								
Canada	38,470	16,734	20,628	$4,658	50	$21				
France	135,254	32,820								
Germany					363	2,434	12,228	$12,776		
India, British	2,363,206	362,632	252,604	124,453	160	253	116	274	7,136	$2,974
Japan	4,360	550								
Rumania	567	102								
U. S. S. R. (Russia)	74,826	201								
United Kingdom	20,674	3,927	3,203	2,544	250	78	20,151	12,333	731	432
	2,764,150	450,216	276,435	131,655	823	2,786	32,495	25,383	7,867	3,406

Exports.—Exports of mica and manufactures thereof in 1935 amounted to 2,998,762 pounds valued at $165,385, a decrease of about 14 percent in quantity and 12 percent in value compared with 1934. The accompanying table shows quantity, value, and destination of mica and mica products exported from the United States in 1935. Data in sufficient detail to classify exports by kinds are not available.

Mica and manufactures of mica exported from the United States in 1935, by countries

Country	Pounds	Value
North America:		
Canada	1,273,016	$87,645
Central America:		
Guatemala	36	30
Honduras	11	39
Nicaragua	5	10
Panama	349	432
Salvador	12	37
Mexico	5,840	2,293
Newfoundland and Labrador	1,030	66
West Indies:		
British:		
Barbados	2	8
Jamaica	27	36
Trinidad and Tobago	7	16
Other British	5	15
Cuba	980	827
Dominican Republic	29	22
Netherland	45	577
South America:		
Argentina	8,382	409
Bolivia	211	302
Brazil	2,286	2,021
Chile	1,424	1,983
Colombia	145	185
Costa Rica	1	5
Ecuador	376	133
Guiana, British	6	16
Peru	25	144
Uruguay	51	120
Venezuela	122	208
Europe:		
Belgium	301,528	$12,316
Czechoslovakia	8,477	301
Denmark	3,000	177
France	49,267	1,610
Germany	509,046	15,034
Italy	2,547	1,603
Netherlands	16,856	2,202
Spain	6,078	219
Sweden	11,000	445
Switzerland	4,535	113
U. S. S. R.	960	552
United Kingdom	773,123	30,230
Asia:		
China	2,398	1,065
East India (British):		
India	122	189
Japan	4,511	248
Netherland India	7,026	364
Palestine	273	248
Philippine Islands	350	644
Other Asia	5	21
Africa:		
Madagascar	500	18
Union of South Africa	8	9
Oceania:		
Australia	2,724	186
New Zealand	5	12
	2,998,762	165,385

WORLD PRODUCTION

The following table shows world production of mica from 1931 to 1935 insofar as figures are available:

World production of mica, 1931–35, in metric tons

[Compiled by M. T. Latus]

Country	1931	1932	1933	1934	1935
North America:					
Canada (sales)	1,214	280	857	905	570
United States (sold or used by producers)	6,443	6,540	8,104	7,267	17,527
South America:					
Argentina [1]	51	55	75	175	(2)
Bolivia [2]	1	8	23	4	(2)
Brazil [3]	54	42	23	59	(2)
Europe:					
Italy	12	9	3	5	(2)
Norway [3]	48	103	105	170	(2)
Sweden	65	61	68	16	(2)
U. S. S. R. (Russia)	(2)	(4)	(4)	(2)	(2)
Asia:					
Ceylon	2	2	(5)	20	(2)
Chosen	18	20	23	103	(2)
India, British [6]	2,691	2,389	2,878	4,716	(2)
U. S. S. R. (Russia)	(2)	[4] 7,790	[4] 5,778	(2)	(2)
Africa:					
Eritrea	18	20	(5)	(2)	(2)
Madagascar [7]	235	140	173	294	(2)
Rhodesia:					
Northern	1	----------	2	1	2
Southern	37	13	4	2	4
Tanganyika Territory	9	12	11	31	(2)
Union of South Africa (Transvaal) (sales)	477	250	549	278	193
Oceania:					
Australia:					
New South Wales	----------	----------	41	91	(2)
Northern Territory (Central Australia)	28	30	43	49	(2)
South Australia	2	----------	----------	----------	(2)

[1] Rail and river shipments.
[2] Data not available.
[3] Exports.
[4] Output of U. S. S. R. in Europe included under U. S. S. R. in Asia.
[5] Less than 1 ton.
[6] Exports. The figures for output are incomplete, and a more accurate idea of the size of the industry is to be obtained from the export figures. (Rec. Geol. Surv. of India, vol. 59, pt. 3, p. 273, Calcutta, 1926.) Output is reported as follows: 1931, 1,979 tons; 1932, 1,662 tons; 1933, 2,087 tons; 1934, 2,830 tons.
[7] Exports reported as follows: 1931, 120 tons; 1932, 130 tons; 1933, 246 tons; 1934, 369 tons; 1935, 408 tons.

NATURAL SODIUM COMPOUNDS AND BORON MINERALS

By A. T. Coons

SUMMARY OUTLINE

The natural sodium compounds industry, with an output of 404,903 short tons in 1935, continued the steady growth that has been its outstanding feature since 1920 when only 42,683 tons were produced. Although production has been maintained on a relatively stable plane for several years, prices declined. Returns to producers were particularly low in 1932 and 1933 but increased in 1934 and 1935.

The output of sodium compounds (not including common salt) from natural salines and brines in the United States was 404,903 short tons valued at $6,930,506 in 1935, an increase of 17 percent in quantity and 11 percent in value compared with the output of 347,475 tons valued at $6,224,352 in 1934. These totals cover the output of sodium carbonate (soda ash and trona), sodium bicarbonate, sodium sulphate (salt cake and Glauber's salt), and sodium borate (borax and kernite).

The output of sodium carbonates, which declined 39 percent from 1930 to 1932, then increased in 1933 and 1934, increased 6 percent in quantity but decreased 6 percent in value in 1935 compared with 1934; it has not yet reached the peak of 102,930 tons attained in 1929. The output of sulphates, which varied only a few hundred tons from 1930 to 1932, increased 45 percent in 1933, declined 64 percent in 1934, and more than doubled in 1935 compared with 1934. The output of borates has increased each year since 1926, reaching a peak of 272,967 tons in 1935, or 13 percent more than in 1934.

Figure 154 gives the quantity and value of natural sodium compounds produced in the United States, 1926–35.

Production of natural sodium compounds (exclusive of common salt), 1931–35, is given in the following table.

Natural sodium compounds sold or used by producers in the United States, 1931–35

Year	Carbonates [1]		Sulphates [2]		Borates [3]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1931	78,530	$1,223,544	32,510	$198,132	178,550	$4,931,295	289,590	$6,352,971
1932	55,377	888,052	32,204	210,342	181,915	3,023,844	269,496	4,122,238
1933	70,461	918,295	46,539	245,240	188,047	3,436,377	305,047	4,599,912
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	375,943	272,967	5,381,560	404,903	6,930,506

[1] Soda ash, bicarbonate, and trona.
[2] Salt cake and Glauber's salt.
[3] 1931–33: Borax, kernite, and boric acid (calculated as borax); 1934–35, includes a small quantity of colemanite.

Boron minerals.—The output of boron minerals in 1935, as reported to the Bureau of Mines by producers, totaled 272,967 short tons valued at $5,381,560, increases of 13 percent in quantity and 12 percent in value over 1934.

In 1934 and 1935 a small quantity of mixed colemanite and ulexite is included with the sodium borates (borax and kernite) under boron minerals. Before 1927 the source of all the borax except that made at Searles Lake and Owens Lake was colemanite (calcium borate) mined in California and Nevada. In 1927 kernite mined in Kern County, Calif., replaced colemanite, production of which virtually ceased after 1927, although small shipments were made through 1930.

Review of operations.—In 1935 most of the material included in the sales of sodium carbonate was soda ash—normal sodium carbonate (Na_2CO_3)—produced in California from the waters of Owens Lake

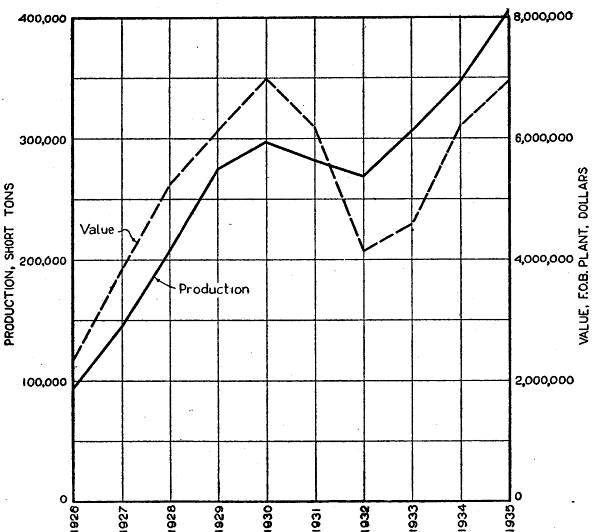

FIGURE 154.—Quantity and value of natural sodium compounds produced in the United States, 1926–35.

in Inyo County, by the Natural Soda Products Co. at Keeler and the Pacific Alakli Co. at Bartlett, and from the waters of Searles Lake in San Bernardino County, by the American Potash & Chemical Co. at Trona and the West End Chemical Co. at Westend. Sodium bicarbonate ($NaHCO_3$) and trona, a mixture of soda ash and bicarbonate, were produced by the Natural Soda Products Co.

Sodium sulphate, as salt cake (Na_2SO_4), was produced at Trona on Searles Lake, San Bernardino County, Calif., by the American Potash & Chemical Co. in 1935 for the second year. Production at this plant largely accounts for the increased output of the salt in 1935. A considerable quantity was also produced near Monahans, Ward County, Tex., by the Ozark Chemical Co. of Tulsa, Okla., and sales were made from stock on hand at the deposit of the Rhodes Alkali & Chemical Corporation near Mina, Mineral County, Nev. A small quantity for medicinal purposes was produced by the Spokanogan Chemical Co. at Okanogan, Okanogan County, Wash. Hydrated sodium sulphate ($Na_2SO_4.10H_2O$) (Glauber's salt) was produced near Casper, Natrona County, Wyo., by W. E. Pratt. The Iowa Soda

Products Co. mined Glauber's salt near Rawlins, Carbon County, Wyo., and shipped it to Council Bluffs, Iowa, for refining. Considerable interest was aroused in 1934 and 1935 by the discovery of several large deposits of natural sodium sulphate (Glauber's salt) in northwestern North Dakota, and a survey of the deposits was made as a North Dakota F. E. R. A. Work Project under the supervision of the University of North Dakota. The results of the survey are given in a paper of the American Institute of Mining and Metallurgical Engineers.[1]

The sodium borate produced in 1935 includes borax ($Na_2B_4O_7.10H_2O$) obtained in California from Searles Lake brines in San Bernardino County, by the American Potash & Chemical Co. at Trona and the West End Chemical Co. at Westend, and from Owens Lake brines in Inyo County, by the Pacific Alkali Co. at Bartlett. Sodium borate, as kernite ($Na_2B_4O_7.4H_2O$), was produced in Kern County, Calif., by the Pacific Coast Borax Co. from the Baker deposit near Barstow. Boric acid also was produced by the American Potash & Chemical Co.; this product, calculated as borax, is included with sodium borate in the figures for sales from 1931 to 1935. A small quantity of colemanite (calcium borate) was reported sold from stock.

Foreign trade.[2]—Exports and imports of sodium sulphate and borax are given in the following tables; figures for sodium carbonates are not given, as they would include largely manufactured sodium salts and therefore would not be comparable with the figures for natural salts contained in this report.

Exports of sodium sulphate were small in 1933–35 and were not recorded separately. Total imports of sodium sulphate in 1935 increased 18 percent in quantity and 13 percent in value compared with 1934; increases were shown for salt cake and Glauber's salt, and a decrease was shown for the anhydrous sodium sulphate. Exports of sodium borate (borax) in 1935 increased 10 percent in quantity and 12 percent in value over 1934. No crude sodium borates were imported in 1935; imports of the refined product were small but more than doubled in quantity and value compared with 1934.

Sodium sulphate exported from the United States, 1930–35

Year	Short tons	Value	Year	Short tons	Value
1930	4,436	$113,253	1933	(1)	(1)
1931	4,652	75,784	1934	(1)	(1)
1932	1,435	24,155	1935	(1)	(1)

1 Not separately classified in 1933, 1934, and 1935.

Sodium sulphate imported for consumption in the United States, 1931–35

Year	Crude (salt cake)		Crystallized (Glauber's salt)		Anhydrous		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1931	72,746	$803,509	924	$9,615	10,315	$193,041	83,985	$1,006,165
1932	61,124	644,074	304	2,848	8,855	153,612	70,283	800,534
1933	99,269	885,306	629	8,677	10,371	179,529	110,269	1,073,512
1934	89,701	799,141	533	4,116	8,409	151,490	98,643	954,747
1935	110,379	959,441	551	4,479	5,788	113,771	116,718	1,077,691

1 Lavine, Irvin, and Feinstein, Herman, Natural Deposits of Sodium Sulphate in North Dakota: Am. Inst. Min. and Met. Eng., Contribution 97, February 1936.

2 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.

Crude sodium sulphate (salt cake) imported into the United States, 1934–35, by countries

Country	1934		1935	
	Short tons	Value	Short tons	Value
Belgium	17,794	$152,256	23,433	$181,820
Canada	3,647	34,198	906	8,305
Chile	1,091	4,566	1,353	9,912
Germany	63,270	565,887	83,061	739,314
Netherlands	3,634	39,656	1,122	10,190
U. S. S. R. (Russia)	265	2,578	504	9,900
	89,701	799,141	110,379	959,441

Imports of crude sodium sulphate (salt cake) in 1934 and 1935 were distributed by customs districts as follows:

Crude sodium sulphate (salt cake) imported into the United States, 1934–35, by customs districts, in short tons

Customs district	1934	1935	Customs district	1934	1935
Atlantic ports:			Pacific ports and Canadian border:		
Maryland	3,696	4,872	Dakota	2,410	906
New York	743	1,297	Duluth and Superior	797	
South Carolina	54		Montana and Idaho	439	
Gulf ports:			Oregon	6,130	2,601
Florida	17,007	18,773	Washington	5,098	4,592
Galveston	1,873				
Mobile	22,789	47,952		89,701	110,379
New Orleans	28,665	22,803			
Sabine		6,583			

Imports of salt cake from Canada and the Netherlands decreased noticeably, whereas imports from Belgium, Chile, Germany, and U. S. S. R. (Russia) increased 32, 24, 31, and 90 percent, respectively. Most of the product entered through southeastern ports.

All crystallized sodium sulphate imported in 1935 was from Germany. The imports of anhydrous sodium sulphate included 5,760 short tons valued at $113,108 from Germany, 28 tons valued at $599 from the Netherlands, and less than 1 ton valued at $64 from Sweden.

Sodium borate (borax) exported from the United States, 1931–35

Year	Short tons	Value	Year	Short tons	Value
1931	86,938	$3,358,609	1934	103,643	$2,907,276
1932	89,641	2,677,626	1935	114,447	3,242,350
1933	87,677	2,498,035			

Sodium borates imported for consumption in the United States, 1931–35

Year	Crude		Refined		Year	Crude		Refined	
	Short tons	Value	Pounds	Value		Short tons	Value	Pounds	Value
1931	570	$16,507	1,516	$251	1934			335	$74
1932			610	128	1935			748	181
1933	1,069	30,742	1,061	259					

GEM STONES

By Sydney H. Ball

SUMMARY OUTLINE

The retail jewelry industry was one of the "hardest hit" during the depression, reaching a low point in 1933, when its sales were but 33 percent of those in 1929 ($536,000,000). Sales increased about 15 percent in 1934 (from $175,000,000 to $201,000,000), and in 1935 a further improvement of about 15 percent was noted. Christmas sales in 1935 were "spotty;" some States showed no improvement over 1934, sales in Florida doubled, and the average increase was 16 percent. A promising feature was the greater interest in fine jewels.

Although the increased sales are encouraging, the jewelry dollar is being spent more and more in the department store and, during the depression, in the pawnshop. Bankruptcy sales and distress sales by banks also cut into the jewelers' sales. Under present conditions, the jeweler must look more and more for his customers among the well-to-do, as the number of possessors of great fortunes has decreased markedly in the past 6 years. In 1935 manufacturing jewelers had the best year since 1929.

Fashions in jewels.—The tendency in 1935 to use richer fabrics in women's gowns naturally has led to a greater demand for genuine rather than imitation jewelry. Bracelets, clips, jeweled hair ornaments, and earrings have been popular, as have multiple rings, each ring being set with either diamonds, rubies, or sapphires. Late in the year, necklaces made their bid for popularity. The use of fine jewelry that may be separated into sections to be used for different purposes increased. Besides the four noble gems—diamonds, emeralds, rubies, and sapphires—aquamarines, topazes, and amethysts have been in vogue. Baguettes and other fancy shaped diamonds are losing popularity compared with brilliants. Gold in mountings gained at the expense of platinum.

Jewelry for men appears to be returning to favor, rings in the middle price range having sold particularly well.

Imports.—According to the Bureau of Foreign and Domestic Commerce, imports of precious and imitation stones into the United States in 1935 totaled $27,612,390, an increase of 54 percent from 1934. Details are shown in the following tabulation:

	Carats	Value
Diamonds:		
Rough, uncut	79, 695	$4, 261, 921
Cut, but not set	330, 617	15, 538, 902
Glaziers', engravers', and miners', not set	954, 589	4, 293, 611
Pearls and parts, not strung or set		652, 219

	Value
Other precious stones:	
Rough, uncut	$50, 444
Cut, but not set	1, 282, 348
Imitation precious stones, except opaque	1, 480, 937
Imitation precious and semiprecious stones, opaque, including imitation pearls	30, 032
Marcasites	21, 976

Domestic production.—As in recent years, the gem production of the United States in 1935 was small and presumably did not exceed $5,000 in value. Turquoise valued at almost $2,000 was produced in Nevada from the Blue Jay claim in the Lone Mountain district, Esmeralda County and from the Snow Storm claim near Camp Royston. Rose quartz in South Dakota, kunzite in California, sapphire, ruby, amethyst, rhodolite, and aquamarine in North Carolina, moss agate in Montana, and topaz and pink beryl in the Thomas Range, Utah, were also produced on a small scale. An increasing number of mineral collectors and amateur lapidaries pay annual visits to well-known mineral localities to obtain material to further their hobbies.

DIAMOND

Recovery in the diamond industry, first noted in the summer of 1932, continued at an accelerated rate in 1935, but the industry cannot be prosperous until the United States, its best customer, enjoys good times. The trade, however, is confident of the future, and virtually every index of the industry improved, in comparison with 1934, by 15 to 75 percent.

The reorganized method of marketing by a single sales unit, the Diamond Trading Co., which first functioned early in 1934, worked smoothly and satisfactorily. The cooperation displayed by producers was excellent, and while production exceeded that of 1934, the increase was due to the operations of the larger mining companies, who are responsible for the stability of the industry. De Beers is so confident of the future that the Dutoitspan mine was reopened in March 1936, and a second pipe mine may be operated later in the year.

Stocks of rough diamonds decreased somewhat during the year, the sale of all sorts of industrial stones being especially large. Stocks in the hands of retailers are low and will have to be increased markedly if business continues to improve.

Prices of rough, firm throughout the year, were raised 7½ percent in September. The price of large cut stones advanced. Due to destructive competition between the cutting centers, however, small polished goods were less firm in price but toward the end of the year began to follow upward the price of rough.

Share dealings.—Trading in shares of diamond-mining companies was rather active, and during the year the shares of the ten principal companies gained 26 percent in price. They were at year end about 45 percent of the all-time high (1927) and over four times the all-time low (1932). Of the 17 principal companies, 11 paid dividends in 1935.

Market.—Sales of rough by the Diamond Trading Co. exceeded £6,000,000, a 55-percent increase over those of 1934. The market was broad as to the number of buyers and varieties of diamonds purchased and the sale of fine-quality stones increased markedly.

The market for cut or polished diamonds was the best since 1929, but the cutters made little money as the market was oversupplied, particularly with small sizes.

India has been, perhaps, the most important buyer of diamonds in late years and, when the price of gold was raised, converted much of its store into fine gems. The United States increased its diamond imports by about 57 percent, and Hungary and Austria increased their purchases markedly.

Fine cut stones of 1 carat or more were in demand throughout the year, indicating investment buying, in which, at one time or another in 1935, Americans, British, Hungarians, French, and Belgians participated.

Imports.—The source of diamonds imported into the United States in 1935 follows:

Diamonds imported into the United States in 1935, by countries [1]

Country	Rough, or uncut			Cut, but not set		
	Carats	Value		Carats	Value	
		Total	Per carat		Total	Per carat
Albania				33	$1,547	$46.88
Australia				3	92	30.66
Belgium	36,383	$1,926,697	$52.96	234,429	11,032,946	47.06
British Guiana	505	7,015	13.89			
Canada	1,019	29,832	29.37	58	4,019	69.29
Ecuador				7	3,500	500.00
France	1,485	465,248	313.30	1,634	110,800	67.81
Germany				147	6,545	44.52
Mexico				4	200	50.00
Netherlands	19,058	789,383	41.42	93,656	4,319,912	46.13
Switzerland				1	158	158.00
Union of South Africa	8,269	417,727	50.52	156	12,886	82.60
United Kingdom	12,976	626,019	48.24	489	46,297	94.67
	79,695	4,261,921	53.48	330,617	15,538,902	47.00

[1] Compiled from records of the Bureau of Foreign and Domestic Commerce.

Tariffs.—On April 5, 1935, Japan reduced the tariff on diamonds from 100 percent ad valorem to 5 percent ad valorem on industrial stones and 10 percent on gem stones. In February 1936, Indian duties on diamonds were reduced from 25 to 10 percent. Italy, on the other hand, on February 16, 1935, increased the duty on precious stones from 3 to 6 percent and imports are strictly controlled.

Cutting.—The struggle between Belgium, Holland, and Germany for supremacy in diamond cutting continued in 1935, but, of the three countries, only Germany improved its position. The master cutters made little profit, but there was more work in 1935 for the artisans and their wages were increased in the last half of the year. The cutting industry in the United States improved by perhaps 20 percent, but that of France suffered greatly.

Comparative hardness.—Charles E. Wooddell, research engineer of the Carborundum Co., presented a most valuable paper on the relative hardness of electric furnace products and natural abrasives before the October 1935 meeting of the Electrochemical Society. He found considerable difference in hardness between gem diamonds from different fields—carbonado softer than most diamonds and diamonds immeasurably harder than any artificial substance. As is well-known, he found the diamond much harder, compared with ruby, than the single number in Mohs' scale would indicate. His table of comparative hardnesses by the abrading method follows:

	Scale: Corundum = 9, Diamond = 10	Scale: Quartz = 7, Corundum = 9
South American brown bort	10.00	42.4
South American Ballas	9.99	42.0
Belgian Congo yellow (cubic crystals)	9.96	41.0
Belgian Congo clear white (cubic crystals)	9.95	40.7
Belgian Congo gray opaque (cubic crystals)	9.89	38.7
South American carbonados	9.82	36.4
Boron carbide	9.32	19.7
Black silicon carbide	9.15	14.0
Green silicon carbide	9.13	13.4
Tungsten carbide (13 percent cobalt)	9.09	12.0
Fused alumina (3.14 percent TiO_2)	9.06	11.0
Fused alumina "A"	9.03	10.0
African crystal corundum	9.00	9.0
Rock-crystal quartz	8.94	7.0

World production.—World production of diamonds in 1935 was approximately 7,300,000 carats, worth about $30,000,000. Compared to 1934 this is an increase of about 32 percent in carats and 45 percent in value. The South African pipe mines washed only a little blue ground, and in consequence the alluvial mines of the world accounted for some 96 percent of the carats and 93 percent of the value.

The following table gives, with the accuracy available statistics permit, world diamond production for the past 5 years:

Production of diamonds by countries, 1931–35, in carats

Country	1931	1932	1933	1934	1935
South Africa:					
Mines	1,470,376	307,431	14,149	9,414	274,316
Alluvial	647,044	488,096	492,404	430,898	402,404
	[1] 2,119,155	[1] 798,382	[1] 506,553	[1] 440,312	[1] 676,720
Angola	351,495	367,334	373,623	452,963	482,000
Brazil	80,000	34,000	[2] 30,000	[2] 30,000	50,000
British Guiana	63,479	61,780	48,569	44,569	45,000
Congo	3,528,200	3,990,069	1,975,450	3,331,360	[2] 3,500,000
Gold Coast [3]	880,479	842,297	863,722	1,142,268	2,172,563
Sierra Leone	----------	749	32,017	68,633	[2] 250,000
South-West Africa	71,532	17,944	2,674	4,126	[2] 125,000
Tanganyika	7,790	1,391	[2] 1,432	1,414	[2] 1,714
Miscellaneous [4]	3,600	3,725	1,825	4,000	[2] 3,500
Grand total	7,105,730	6,117,671	3,835,865	5,519,645	7,306,497

[1] Includes a small quantity of diamonds recovered from re-treatment of tailings.
[2] Estimated.
[3] Exports year ended Mar. 31.
[4] 1931–34 includes India, Borneo, New South Wales, and, in cetrain years, Rhodesia, Venezuela, French Equatorial Africa, and the United States (Arkansas and California); 1935, India, Borneo, Australia, French Equatorial Africa, and Nigeria.

The increased production over that of 1934 came largely from the pipe mines of South Africa and from the alluvial mines of Sierra Leone, Gold Coast, South-West Africa, and Congo. Of the total production, about 60 percent was bort and only 40 percent suitable for the jewelry trade, and an unusually high percentage of this was too small to cut into stones of appreciable value.

In addition to newly mined diamonds, a varying number of diamonds appears on the market annually for resale. In 1935 the quantity was relatively small, and these were sold at firm prices. In January a few Russian seconds were marketed.

Industrial diamonds.—Sales of industrial diamonds exceeded those of 1934 by about 40 percent, partly due to the increased demand for war equipment. This brought about a shortage of good industrial diamonds, especially in 1-carat sizes, as the South African pipe mines, normally responsible for much of the supply, are shut down and the Brazilian carbonado production remains small.

Imports of industrial diamonds into the United States during the past 8 years are given in the following table:

Industrial diamonds imported into the United States, 1928–35 [1]

Year	Carats	Value	Value per carat	Year	Carats	Value	Value per carat
1928	38,342	$2,756,895	$71.90	1932	163,704	$1,061,823	$6.48
1929	46,901	4,060,577	86.58	1933	263,484	1,263,156	4.79
1930	145,958	2,756,630	18.89	1934	526,007	2,862,349	5.44
1931	224,970	2,400,879	10.67	1935	954,589	4,293,611	4.50

[1] Includes glaziers', engravers', and miners' diamonds; compiled from records of the Bureau of Foreign and Domestic Commerce.

The dollar value of 1935 imports was 50 percent greater than those of 1934 and over 5 percent greater than those of the boom year—1929. The price per carat fell markedly from 1929 to 1935 due to the increased use of bort for drilling and in the past 3 years to larger imports of diamond dust for abrasive wheels.

Perhaps a third more diamond drilling was done during 1935 than in 1934. Prospecting for gold, the chief use of the diamond drill for the past 5 years, was supplemented by search for deposits of base metals, due to the better market outlook for these metals. During the year further successful experiments were made in diamond drilling with "common industrial goods", a grade still cheaper than borts. In certain mines drifting is being done with light, portable diamond drills rather than with percussion drills. The use of bonded diamond wheels, described in this review last year, increased, as is indicated by the larger imports of crushing bort.

OTHER GEM STONES

The 1935 production of emerald, particularly that of good quality, was small because the Colombian mines were shut down. Cobra Emeralds, Ltd., Leydsdorp District, South Africa, apparently operated during 1935, and a Swiss company is reported to have reopened the Habachthal mine in Austria.

In 1934 the Mogok ruby district in Burma showed renewed activity and produced 21,622 carats in addition to returns by local miners.

In 1934 Kashmir produced 1,071,869 carats of sapphire, and the Anakie field in Queensland sold stones valued at £3,055. Many of the sapphires exported from Siam are produced in Cambodia; normal production is about 3,500 carats.

In 1934 New South Wales produced opal valued at £3,283, largely from Lightning Ridge. Three districts in South Australia also produced opal.

Czechoslovakia exported 110 kilos of garnet-decorated articles in 1934, valued at 710,000 crowns.

Burma's 1934 jadeite production was normal—105 tons, worth presumably, about 3,500 rupees per ton. Jordansmuhl Nephrite Gesellschaft M. B. H., formed in 1933, quarries nephrite at Jordansmuhl, Silesia, which is sent to Idar to be cut.

Government amber mines in Samland, Prussia, produce about 1,350 troy pounds yearly. As export demand has diminished since the war German chemists are seeking commercial uses for substances derived from amber. In 1934 Burma produced 414 pounds of amber. Fifty tons of labradorite were quarried from Tabori Island, Labrador, last year. Brazil and Madagascar each produce annually somewhat over 400 pounds of rock crystal. In 1934 Brazil exported 307 contos worth of declared precious stones and in 1933 Madagascar exported stones valued at 300,000 francs. About 7 tons of tiger-eye (worth about £350) were shipped from Prieska, South Africa, in 1935.

SYNTHETIC STONES

"Igmerald", produced in 1935 by Doctor Jager and Doctor Espig, chemists of the I. G. Farbenindustrie at Bitterfeld, Germany, is, without doubt, a synthetic emerald but to date, at least, the product is made only in small hexagonal crystals, the value of which does not approach the cost of production. The specimens so far produced are reported to lack transparency and can be differentiated readily from the gem. Synthetic beryl is said to have been made in France as early as 1884. The Bitterfeld plant makes a number of other synthetic gems used both as ornaments and as bearings for watches and meters.

No striking developments in the synthetic production of ruby, sapphire, and spinel were announced during the year. They are produced in a wide suite of colors. In the spring of 1935 some "sharpshooters" in London attempted to pass a synthetic spinel as a synthetic diamond.

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MINOR NONMETALS: GRAPHITE, GREENSAND, KYANITE, LITHIUM MINERALS, MINERAL WOOL, MONAZITE, STRONTIUM MINERALS, VERMICULITE, AND WOLLASTONITE

By Paul M. Tyler [1]

SUMMARY OUTLINE

GRAPHITE

Quickening activity in the machinery and metal trades throughout the world stimulated graphite production in most countries in 1935, following substantial increases in 1934. This improvement, however, did not result in extensive resumption of mining in the United States. Amorphous graphite continued to be mined for paint by the Carson Black Lead Co., Ormsby County, Nev., and in a small way, perhaps, by several other companies. A small quantity of graphite from the unusual deposit of the Crystal Graphite Co., Dillon, Mont., was marketed locally, and there was evidence of possible awakening of interest in properties in other States, although the only other known producer of natural graphite in the United States during the year was the Western Graphite Co., Los Angeles County, Calif., which reported a small output of crystalline graphite and very little in the way of sales. Operations were resumed in Texas by the Southwestern Consolidated Graphite Co., with a prospect of commercial production in 1936.

For Alabama quarries, State Geologist Walter B. Jones estimated reserves in sight as around 5,600 million pounds of graphite, exclusive of large areas of graphite-bearing schists not yet explored. The unweathered schists, he says, run up to 8 percent, and the weathered schists such as formerly were worked averaged about 2½ percent. Now that milling methods have been improved by experimental work and a really high-grade product can be produced, he believes that with some temporary stimulation domestic producers could compete with foreign suppliers and accordingly in a memorandum enclosed in a letter to the Bureau of Mines, dated June 1, 1935, he urged an allotment of Federal relief funds to assist the industry to a fresh start.

[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.

Austria, Chosen, Czechoslovakia, Italy, Mexico, and Russia are the leading sources of natural amorphous graphite, and crystalline graphite is obtained mainly from Ceylon, Germany, Madagascar, and Norway. Manufactured graphite, an electric-furnace product, is produced in several industrialized countries where power is relatively cheap. Graphitized electrodes constitute its principal use, but it is employed extensively in graphite lubricants (many of them trade-marked preparations) and in dry batteries; to an increasing extent it competes with the best grades of natural amorphous graphite.

Domestic consumption of natural graphite, which probably parallels world conditions, is roughly 20 percent in crucibles, 40 percent for general foundry work, 15 percent in pencils or crayons, 15 percent in lubricants, and 10 percent in paints, stove polishes, and miscellaneous uses. Crucible making, which requires the more costly varieties of graphite, was formerly the most important outlet, but crucible melting has been abandoned at many foundries and steel works in favor of electric furnaces or other processes; modern crucibles do not have to be replaced so often as their predecessors, because they are better made; and even for the manufacture of crucibles other materials, especially corundum or alumina in some form, are being substituted for graphite. At present the consumption of natural graphite is about evenly divided between crystalline and amorphous varieties.

PRICES

American trade journal quotations for various kinds of graphite are more or less nominal, and most of the business is done on a private contractual basis. During 1935 prices remained virtually unchanged in New York, except perhaps for Madagascar flake, which showed a slight upward tendency. Ceylon lump averaged a little over 5 cents a pound, with chip and dust around 3 and 4 cents a pound, respectively. Madagascar flake seems to have sold at a trifle under 5 cents a pound, while amorphous graphite ranged from a minimum of $10 to perhaps $20 a ton. Prices of the several prepared varieties of graphite probably differed little from the 1934 figures given in the chapter of this series in Minerals Yearbook 1935 (pages 1216–1217).

The London market quotations for Ceylon lump, 90 percent, c. i. f., ranged mostly around £15 to £17 a long ton throughout the first half of 1935, whereas Madagascar flake, 85 to 90 percent, duty paid, fluctuated between £20 and about £25 a ton. In July the price of Madagascar flake was lowered somewhat, and that of Ceylon lump was advanced, but in October the Ceylon material was cut to £11 to £12, where it subsequently remained, whereas the Madagascar competitor continued to hover within £1 above or below £20 a ton. Converted into American currency, the latter price was equivalent to approximately 4.5 cents a pound, whereas Ceylon lump was worth only about 2.5 cents compared with nearly 3.5 cents earlier in the year.

FOREIGN TRADE

Imports.—In 1935 imports of all kinds of graphite for consumption in the United States increased to 18,361 tons, virtually equaling the predepression average, but the foreign market value was only $526,133 compared with $869,468 in the 1925–29 period. The tonnages received from both Ceylon and Madagascar now are substantially less, but more significant is the drastic reduction in the average value of the imports from Ceylon. It is interesting to note, on the other hand, that receipts from both Mexico and Canada have increased. Some reduction occurred in shipments of amorphous graphite from Chosen, but the full effect of an increase in freight rates did not become apparent until the latter part of the year; Seoul merchants reported that after September they could no longer compete with Mexican graphite in the American market. It will be noted that the total imports of amorphous graphite increased 40 percent in 1935 but that those of crystalline varieties were less than in 1934.

Graphite (all kinds) imported into the United States, 1925–35, by countries

Country	1925–29 (average)		1931	1932	1933	1934	1935	
	Short tons	*Value*	*Short tons*	*Short tons*	*Short tons*	*Short tons*	*Short tons*	*Value*
Canada	1,876	$108,599	956	828	946	1,814	3,331	$131,464
Ceylon, including British India	6,261	415,051	2,825	1,756	2,050	3,741	4,438	179,596
Chosen, including Japan	1,270	22,144	624	1,314	1,542	1,950	1,141	11,632
Germany	46	4,710	69	94	121	368	229	15,268
Italy	203	5,439		25	135		59	1,336
Madagascar, including France	2,484	240,840	1,093	788	885	2,014	1,473	112,474
Mexico	6,290	51,694	3,523	2,203	2,332	4,162	7,684	74,056
Norway	3	459				72		
U. S. S. R. (Russia)	(1)	9			41		6	50
United Kingdom	136	15,260	(1)	7	1	(1)	(1)	257
Other	72	5,263						
	18,641	869,468	9,090	7,015	8,053	14,121	18,361	526,133

1 Less than 1 ton.

Graphite imported for consumption in the United States, 1932–35, by kinds

	1932		1933		1934		1935	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Amorphous:								
Artificial	656	$23,315	711	$27,107	579	$22,591	1,916	$74,679
Natural	5,275	71,970	5,999	90,786	10,469	235,592	14,477	302,646
Crystalline:								
Lump and chip	187	6,227	294	9,532	384	18,878	215	11,606
Dust	107	4,042	90	3,072	302	12,109	84	4,444
Flake	790	45,237	959	80,569	2,387	200,314	1,669	132,758
	7,015	150,791	8,053	211,066	14,121	489,484	18,361	526,133

Exports.—Notwithstanding a 19 percent increase in tonnage, the value of the exports of graphite and manufactures thereof declined somewhat in 1935 compared with the previous year. In addition to products of natural graphite, the exports include graphitized products, notably electric furnace and battery electrodes.

Graphite exported from the United States, 1931–35

Year	Short tons	Value	Year	Short tons	Value
1931 [1]	1,188	$248,998	1934 [2]	1,245	$250,332
1932 [2]	790	173,486	1935 [2]	1,480	234,334
1933 [2]	914	182,671			

1 Graphite and manufactures, except crucibles.
2 Graphite, crude, refined, and manufactures (including crucibles).

World production of natural graphite, 1926–34, in metric tons

[Compiled by M. T. Latus]

Country	1926–30 (average)	1931	1932	1933	1934
Australia:					
New South Wales	12	61	---	30	---
South Australia	---	---	71	---	6
Austria	20,005	12,060	10,598	14,771	18,145
Brazil [1]	7	9	---	1	---
Canada	1,569	497	314	367	1,377
Ceylon [1]	12,262	6,828	6,198	9,711	11,755
Chosen	22,439	14,050	16,733	22,677	31,294
Czechoslovakia	28,495	1,830	922	122	3,503
France	753	---	---	(2)	(2)
Germany (Bavaria)	19,177	23,571	20,808	19,755	17,535
India, British	8	7	5	---	342
Indo-China [3]	245	---	---	---	---
Italy	7,676	4,050	2,945	3,200	3,908
Japan	422	295	495	869	969
Madagascar [1]	12,986	6,300	2,100	3,600	9,400
Mexico	5,617	3,122	2,045	2,685	3,898
Morocco, French [1]	50	50	100	66	183
Norway	---	882	672	1,983	2,281
Spain	191	---	---	---	---
Union of South Africa	52	44	49	59	64
U. S. S. R. (Russia)	[4] 4,666	(2)	(2)	(2)	(2)
United States:					
Amorphous	2,551	(5)	(5)	(5)	(5)
Crystalline	[4] 2,410	(5)	(5)	(5)	(5)

[1] Exports.
[2] Data not available.
[3] Concentrates.
[4] Data for 4 years only (1926–29).
[5] Bureau of Mines not at liberty to publish figures.

THE INDUSTRY IN FOREIGN COUNTRIES

Austria.[2]—The production of washed and purified graphite in Austria rose to 19,500 metric tons in 1935, and exports increased to 14,196 tons; in addition, exports of graphite crucibles jumped to 1,762 tons. More than half the graphite exported went to Germany, whereas Italy was the main customer for graphite products.

Ceylon.—Graphite exports from Ceylon during 1935 rose to 15,577 short tons compared with 12,958 tons in 1934; accompanying this increase in volume was a 25-percent rise in value. The United States once more became the principal buyer, displacing Japan from this position. The United Kingdom was third and Germany fourth. Increased duties on imports of competitive graphite into the United Kingdom early in 1935 undoubtedly helped Ceylon shippers. According to a report from United States Vice Consul George W. Renchard, Colombo, the Ceylon industry was more active in 1935 than for many years, and an even greater volume of business is in prospect for 1936. A recent official report, quoted in London,[3] shows that Ceylon has more than held its own in competition with Madgascar in international trade. In 1931 the total exports of Ceylon plumbago were 6,721 long tons as against 6,254.5 from Madagascar. Whereas Ceylon's exports, after dropping to 6,100 long tons in 1932, rose to 9,559 tons in 1933, 11,569 tons in 1934, and 6,143 tons for the first 6 months of 1935, Madagascar exports were 2,146 long tons in 1932, 6,796 tons in 1933, and 9,205 tons in 1934.

[2] Chemistry and Industry (London), Chemical Notes from Abroad: Vol. 55, no. 16, Apr. 17, 1936, p. 310.
[3] Mining Journal (London), Ceylon's Plumbago Industry: Vol. 191, no. 5230, Nov. 16, 1935, p. 855.

The prices of Ceylon plumbago in mid-1935 ranged, according to grade, from Rs. 170 to Rs. 225 (United States $63.50 to $84) compared with a Madagascar range of Rs. 154 to Rs. 164 (United States $57.50 to $61.25) per long ton. Three principal reasons were given for prices not being higher: (1) That Madagascar graphite was cheaper to produce than Ceylon graphite; (2) that English manufacturers have altered their plants to suit the Madagascar product; and (3) that in the United States the electric furnace tends to oust the crucible and thus decrease the demand for high-grade graphite. The change that principally affects Ceylon was said to be the transfer of British custom to Madagascar and closing down in Ceylon of the Morgan Crucible Plumbago factories. Prices during 1935 ranged from $20.30 per long ton (United States currency) for flying dust to $83.03 for ordinary lump graphite.

Chosen.—Exports of graphite from Chosen rose to 50,096 short tons in 1935, an increase of 52 percent over the 32,941 tons exported in 1934 and largely in excess of any previous record. The product is mainly amorphous worth under $10 a ton but in 1935 included 5,218 tons of flake worth around $45 a ton, which was shipped almost entirely to Japan.

Czechoslovakia.[4]—Two enterprises in Moravia and one in Bohemia are responsible for Czechoslovakia's graphite production, the southern Bohemian deposits supplying the important pencil industry. Production rose from 122 tons in 1933 to 3,503 tons in 1934. Exports—chiefly to Germany, Poland, and Austria—totaled 4,108 tons in 1934 but dropped to 1,868 tons in 1935; imports also declined from 2,637 tons in 1934 to 1,684 tons in 1935.

Germany.[5]—Crystalline graphite is mined in Germany only in eastern Bavaria. The mining centers are Pfaffenreuth, Kropfmühl, Oberotzdorf, Wilersdorf, Reichartsreuth, Pelzöd, Diendorf, Schaibing, and Haar, all near the Austrian frontier. The Graphitwerk Kropfmühl A. G., Kropfmühl near Passau, is the leading producer. In 1920 this company absorbed the Passauer Graphitwerke A. G., and in 1933 it took over the business of three more companies—Vereinigte Graphit und Tiegelwerke, Obernzall Untergriesbach A. G. in Obernzell Untergriesbach; Deutsche Graphitwerke G. m. b. H. in Dohna (Saxony); and the Deutsch Graphitgesellschaft m. b. H. in Munich. In 1934 this concern employed 270 persons and in 1935 probably about 300. Other Bavarian deposits are owned by peasants who work them in only a small way and who sell their meager output to the Kropfmühl company or to a few minor firms engaged in grinding and refining the product.

The German industry made much improvement in 1934; this was carried on into 1935 as further efforts were made to displace imported graphite, especially amorphous grades, with a domestic product. In recent years the Bavarian output has been greater than it was before the World War, but it could be greatly expanded; in 1918, for example, it rose to 41,000 tons. Recent reorganization of the industry seems

[4] Commercial Attaché Sam E. Woods, Prague, Bureau of For. and Dom. Commerce, Foreign Metals and Minerals Circ. 3, Apr. 15, 1936, p. 10.
[5] American Consul Hugh F. Ramsey and Clerk Sidney Model, Munich, Dec. 19, 1935.

to have resulted in increased efficiency of labor, as the following figures show:

Graphite industry of Eastern Bavaria

Year	Number of works	Number of workers	Output, tons	Value per ton, marks	Year	Number of works	Number of workers	Output, tons	Value per ton, marks
1934	10	295	17,535	15.75	1931	9	283	23,571	17.72
1933	9	263	19,755	13.61	1913	53	418	12,059	22.04
1932	11	279	20,808	13.13					

Refined Bavarian graphite carries 82 to 92 percent carbon, but the raw product runs only about 20 percent, and no data are furnished on the average carbon content of the output as officially reported. However, the value of refined graphite produced in 1934 was 1,112,000 marks; of the total amount mined and refined, 6,357 metric tons were described as of specially good quality, and of this 2,666 tons (42 percent) were exported.

Total exports, as reported by Consul Sydney B. Redecker, Frankfurt-am-Main, were 3,811 tons in 1934 compared with 5,431 tons in 1929. There was some increase in 1935, but the average price slumped to 222 marks compared with 405 marks in 1930. Great Britain is the principal buyer, although Czechoslovakia, Denmark, Poland, Sweden, and the United States also purchase Bavarian graphite. Germany's imports of graphite rose from 7,201 metric tons in 1932 to 13,451 tons in 1934 but dropped to 12,155 tons in 1935, of which Austria furnished 7,340 tons. Czechoslovakia, Madagascar, and Ceylon also have been important sources of imports into Germany.

Madagascar.—Whereas Ceylon's exports of graphite increased in 1935, those of Madagascar flake declined, according to preliminary figures for the first 9 months. Late in the year a committee was organized under the governor's auspices, comprising representatives of the administrative and technical government agencies, six members of the industry, and two representatives of shipping companies. The leading producers already had formed an association earlier in the year, and the declared objective of the new committee was "to find means of remedying the depressed state of this commodity, notably by way of organizing production."

Mexico.[6]—In 1935, shipments of amorphous graphite from Sonora to the United States—presumably the entire Mexican output—rose to 7,961 short tons compared with 3,918 tons in 1934 and a depression low of 1,990 tons in 1932. The average declared value in 1935, $9.88 a ton, was the highest for many years.

GREENSAND

Expanding demand for water softening was reflected in a slightly increased production of New Jersey greensand. The patent literature, however, discloses new processes for making artificial zeolites, and in England and the U. S. S. R. (Russia) determined efforts seem to have been made to find ways and means to produce those products from local materials. From Russia comes the report that a factory in the central Volga region already is manufacturing water-softening

[6] American Vice Consul A. F. Yepis, Guaymas.

material of suitable quality from local shales, at a cost comparing favorably with that of imported glauconites.[7] In Europe some publicity has been given to a method of desalting sea water by simple filtration through base exchangers so as to make a palatable water for drinking purposes (about 0.4 gram NaCl per liter).[8]

Since 1929 the best grade of greensand, screened and bagged, has been quoted in Metal and Mineral Markets at $20 per short ton, f. o. b. cars in New Jersey, in carload lots. A typical analysis of this material, which is used for soil beneficiation, is reported by this journal (Sept. 17, 1931) as follows: 51 percent silica, 21 percent iron, 6 to 7 percent alumina, 7.5 percent potash, 3 percent lime, 3.5 to 4 percent magnesia, and 1.8 percent phosphoric acid, with minor amounts of soda and sulphates.

Greensand produced in New Jersey, 1925–35

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average per ton			Total	Average per ton
1925–29 (average)	12,515	$195,393	$15.61	1932	9,231	$201,173	$21.79
1930–34 (average)	8,858	207,005	23.37	1933	6,713	206,985	30.83
1930	12,761	221,211	17.33	1934	7,335	209,278	28.53
1931	8,252	196,327	23.79	1935	7,589	219,749	28.96

KYANITE

Production and sales of kyanite from North Carolina and Georgia were substantially greater in 1935 than in 1934 or earlier years, and imports likewise increased. The concentrating plant of Celo Mines, Inc., Burnsville, N. C., was enlarged. Electrostatic separators, formerly used for cleaning the concentrates, have been replaced by dry tables, and a swing hammer mill has been substituted for the rod mill. The Georgia-Carolina Minerals Corporation (Franklin, N. C.) and B. S. Lockmund (Blacksburg, S. C.) continued to ship lump and dornick ore from the Carolinas. The sluicing operation of the former company in Georgia was resumed, and Philip S. Hoyt of that company also reports having worked on mica kyanite schists of Georgia and producing therefrom a good roofing-mica byproduct at a low price. Kyanite was likewise mined at the Blue Bird mine of the Vitrefrax Co. near Ogleby in California, and the Champion Spark Plug Co. used andalusite and dumortierite from its own mines, processing the ores at Detroit, Mich. The andalusite operations of this company were described by C. D. Woodhouse in a paper entitled "The Andalusite Deposits in the White Mountains of California", presented orally at the San Francisco meeting of the Industrial Minerals Division of the American Institute of Mining and Metallurgical Engineers, October 3, 1935. On account of the altitude and climatic conditions it is more profitable to work the deposits only from March to December. This company has also produced andalusite or dumortierite in Nevada from the vicinity of Oreana, Pershing County. In 1935 the Donnelly mine and the Petervitch and Ray property near Hawthorne, Mineral

[7] Chemical Age (London), vol. 33, no. 844, Aug. 31, 1935, p. 1991.
[8] Austerweil, G., Removal of Salt from Sea Water: Chem. and Ind. (London), vol. 54, no. 22, May 31, 1935, p. 535.

County, began shipments to the Tillotson Clay Products Co., Los Angeles. No reports have been received as to possible developments in Wyoming, and the Virginia situation seems to have remained virtually dormant. Research was reported as in progress with a view to utilizing kyanite deposits near Mount Pleasant, Tenn.

Massive slide boulders of kyanite have recently been found near Death Rapids north of Revelstoke, B. C., and further prospecting may locate the source of this float.[9] Andalusite occurs in some sands of the Zeerust and Marico districts of the Transvaal, and recent tests by the Department of Mines indicate that material suitable for refractory purposes can be obtained therefrom; the andalusite is confined mainly to certain sizes, the best being between one-eighth inch and 40-mesh standard sieve. The samples treated are said to compare favorably with the material used in the United States for making spark plugs and contain 88 to 90 percent theoretical Al_2SiO_5, all in the form of andalusite. Samples of andalusite from the Gold Coast were submitted to the Imperial Institute,[10] which reported that a concentrate was readily obtained by washing, crushing, and screening the andalusite earth; owing to the complex mineral nature of the crystals, however, they were not sufficiently freed from alkalies and iron.

There are no figures for either domestic production or imports of kyanite and allied minerals, but there is no doubt that at least 4,000 tons and possibly double this quantity were shipped from American mines in 1935 and that imports exceeded 1,000 tons.

Prices range from under $10 a ton for impure dornick ores to $25 to $36 for high-grade concentrates f. o. b. mines. Delivered at Ohio points Indian kyanite costs $30 to $35, but at Atlantic seaboard points the imported material is said to be cheaper than domestic—under $20 a ton. Prices of kyanite brick range from about 45 cents to $1 a piece. One manufacturer adds about 25 percent kyanite to a good fireclay brick and thereby enhances its value by about $10 per thousand.

Concentration tests on kyanite ores at the Southern Experiment Station of the Bureau of Mines have been described in a recent paper.[11] In general, classification and tabling can be made to yield a fair recovery of a 90-percent concentrate, but a higher grade—95 percent or better—calls for flotation. Flotation likewise increases the total recovery. The problem of utilizing domestic schist ores is not simply to free the kyanite and separate it from adhering impurities. For most refractory uses the final product must have a suitable size ratio, containing grains as coarse as 4-mesh. It appears further that different types of kyanite crystals behave differently when heated; certain bladed varieties change to a weak, chalky form when converted into mullite, whereas certain fibrous or more massive types do not. Consideration has been given the possibility of sintering or nodulizing the finer concentrates. On the other hand it seems that for certain ceramic uses fine grinding may obviate the need for preliminary calcining. Mattson has found that the puffing of kyanite grains on inversion into mullite is a function of grain size and is much less noticeable with the fines.

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[9] Richmond, A. M., British Columbia's Industrial Minerals: Canadian Min. and Met. Bull. 280, Trans., August 1935, p. 385.

[10] Bulletin of the Imperial Institute (London), vol. 33, no. 1, April 1935, p. 78.

[11] O'Meara, R. G., and Gandrud, B. W., Concentration of Georgia Kyanite Ore: Am. Inst. Min. and Met. Eng. Contrib. 98, February 1936.

The Laclede Christy Clay Products Co. in St. Louis has begun manufacture of a cellular brick of about 50-percent kyanite content, which combines the functions of a refractory, a heat insulator, and a light weight building unit. Its principal use will be for furnace roofs.

LITHIUM MINERALS

Lithium and its compounds are increasing rapidly in commercial importance. For a number of years there has been a steady output of lithium-hardened bearing-metal alloys, and due to the profound influence of rather minute amounts of this ultralight metal in such alloys its sponsors envisage rapid expansion in its metallurgical uses.

Developments in nonmetallic fields, however, seem destined to be even more important, and the new use for the element that appeals most to the average man's imagination, and consequently may be most important in the way of tonnage, is in the form of its compounds for air conditioning. Lithium salts afford an extraordinarily efficient vehicle for dehumidifying air and thus making indoor atmospheres more comfortable in hot weather. Sprays of concentrated lithium chloride solution (50 to 60 percent LiCl), for example, will extract a large proportion of the moisture content of the air (down to 11 percent relative humidity at ordinary temperatures), and the moisture so extracted can be removed and the solution regenerated simply by boiling it out again. This system, pioneered by Bichowsky,[12] also has outstanding advantages for industrial drying. Already it has created a fairly large demand for lithium minerals.

The therapeutic properties of lithium salts were utilized many generations ago. Even now "lithiated" mineral waters consume a substantial quantity of lithium chloride, and the citrate and salicylate are employed as remedies for rheumatism and gout. Lithium hydroxide is employed in alkali storage batteries, and a small amount of a soluble lithium salt may be added to the acid of ordinary storage batteries (to remove absorbed carbon dioxide). Welding fluxes, principally those used for welding aluminum, utilize either the chloride or fluoride. Lithium compounds have minor industrial uses; among many suggested applications may be mentioned the employment of lithium hydride as a carrier of hydrogen, provided it can be made somewhat more cheaply, replacing compressed gas in steel cylinders. Unlike the corresponding salts of other alkali metals, lithium carbonate and lithium fluoride are only slightly soluble in water; crystals of the latter salt have unique optical properties and now can be grown artificially. In the ceramic industries artificial lithium compounds, as well as lepidolite, have been used to some extent, mostly as opacifiers for certain kinds of glass. Lithium oxide is considered an excellent flux for glass melts, and lithium glass is said to have a low melting point, low annealing temperature, and characteristic optical properties. Additions of lepidolite to white and opalescent glasses and enamels tend to prevent crazing of zincless glazes, and in porcelain the use of lepidolite instead of feldspar improves appearance as well as resistance to sudden temperature changes. Processes are available for recovering not only lithium salts but also cesium and rubidium compounds from California lepidolite.

[12] Bichowsky, F. R., The Use of Lithium Chloride for Air Conditioning: Foote-Prints, vol. 8, no. 2, December 1935, 7 pp.

Prior to 1916 the domestic output of lithium minerals fluctuated around 501 tons annually, with an average value of nearly $20 a ton. In 1917 the quantity jumped to 2,062 tons valued at $42,912, and a peak of 11,696 tons valued at $173,002 was reached in 1920. In 1921 there was a drop to 1,833 tons valued at $33,508, and a gradual recovery of 4,600 tons valued at $94,750 in 1928 was followed by another slump to 1,797 tons valued at $56,327 in 1930. In 1933 the output was back below the pre-war average tonnage, and the gross value was only $12,997. Subsequently there was some improvement, but figures cannot be published.

Fluctuations in the domestic output are largely attributable to the erratic demand for lepidolite. This lithia-bearing mica has been mined more or less continuously in San Diego, Calif., since 1899, but in widely varying quantities. The peak of output in 1920 was 10,046 tons valued at $153,502, but no more than a very few hundred tons have been reported in any subsequent year. The California lepidolite, largely from the Stewart mine in a pegmatite about 1½ miles northeast of Pala, has ranged from 2 to 6 percent lithia, and has been shipped almost exclusively to glass works in the eastern United States. Lepidolite was mined for a number of years from a pegmatite deposit 9 miles east of Dixon, Rio Arriba County, N. Mex., and 12 miles from Embudo, the nearest railroad station; it has also been produced more or less experimentally in South Dakota, Maine, and perhaps other States, although never in substantial amounts. South Dakota is the main source of amblygonite, the mineral in most demand as a source of lithium salts, and also of spodumene. During 1935, Frank L. Hess and Oliver C. Ralston of the Bureau of Mines investigated disseminated spodumene deposits in the vicinity of Kings Mountain, N. C., and as a result of this work an eastern source of lithium minerals may be developed as soon as the concentrating problems are solved.

Foreign trade statistics are not separately reported, but it is known that there has been a substantial exportation of lithium minerals, principally South Dakota amblygonite, to Germany in recent years following a reduction in output from the Spanish peninsula. On the other hand, trial shipments of South African lepidolite have been made with a view to creating a market for this material in the United States. Offerings have also been made from Canada. Deposits of lepidolite, spodumene, amblygonite, and lithiophilite in the Pointe du Bois region of southeastern Manitoba are believed to have commercial possibilities, but outside of a little further prospecting at Bernie Lake no work was done there in 1935. On the other hand, production of lepidolite seems to have been launched on a fairly substantial scale in France, probably for local consumption in the glass and ceramic industries.

The price of amblygonite has remained around $35 f. o. b. South Dakota mines for several years. Lepidolite is nominally around $20 a ton f. o. b. mines or $35 to $40 c. i. f. eastern industrial points.

MINERAL WOOL

In 1931, American Builder and Building Age forecast an annual market for 11,700 million square feet of insulating materials of which market it was thought mineral wool could capture about one-half, thereby becoming a $100,000,000 industry. Since 1933 the mineral wool industry has witnessed great activity and has expanded beyond its predepression record. The present annual business is estimated [13] conservatively at over $3,000,000, and with a revival of housing construction the expectation of $100,000,000 annual sales does not seem unwarranted. Already there are about 30 producers of rock or slag wool and at least 2 producers of glass wool in the United States. The manufacture of rock wool was begun in Canada in 1935 at two plants, one at Brantford, Ontario, and the other at Asbestos, Quebec. Previously, in September 1934, a third company had started to operate at Thorold, Ontario, using an electric furnace and making an exceptionally long-fibered, light-weight wool (3 to 6 pounds per cubic foot).

Under the N. R. A. code a uniform retail price of about $50 a ton for mineral wool in bulk was maintained throughout the United States, and the price of the refined material for blowing into houses was approximately $70. Freight rates are high because only about 12 tons of this bulky material can be loaded in a boxcar. The industry has long been centered largely around Alexandria, Ind., but the freight rate from there to Chicago is $4.80 per ton, to Cleveland $5.80, to Baltimore $9, to Philadelphia $9.40, to New York $10, to Birmingham $19.40, and to San Francisco $52.80. Already three or four plants are operating near Los Angeles, and plants are either operating or being established in Illinois, Ohio, New Jersey, Vermont, Virginia, and Texas. Further decentralization may be facilitated by improved processes whereby local materials other than so-called wool rock can be utilized more economically. The Bureau of Mines, for example, has been asked regarding the suitability not only of various qualities of limestone or cement rock, but even as to slate and granite waste as raw material.

The patent situation may be a deterrent to rapid spread of the industry, but figures compiled by the Illinois State Geological Survey place the estimated cost of a two-cupola plant with a rated capacity of 1,000 pounds of wool per hour at only $38,000 and indicate that a new enterprise might not require an investment of more than $50,000 or $75,000. With coke at $4 or $5 a ton it should be possible in most localities to produce wool at a figure under $20 a ton, figuring all costs.[14] Mineral-wool products supplied by an Ohio firm include rock-wool insulating cement, rock-wool industrial blankets, rock-wool stove pads, loose commercial rock wool in bags, granulated commercial rock wool in bags, roll rock wool for home and oven insulation, and wall-thickness rock-wool batts for home insulation.

Tests by the National Research Laboratories, Ottawa, indicate [15] that the thermal conductivity of rock wool depends more upon the quality of the material than upon the density of packing. According to these tests, rock wool is a better insulator than many organic materials used for this purpose, but not so good as asbestos or even 200-mesh serpentine (moistened, applied by hand, and dried).

Glass wool came in for much publicity in 1935. This product looks and feels like cotton fiber. It is caught on a conveyor as it leaves the

[13] Fryling, C. F., and White, O., Considerations in Developing a Mineral-Wool Industry: Chem. and Met. Eng., vol. 42, no. 10, October 1935, pp. 550-553.
[14] Fryling, C. F., and White, O., work cited, p. 553.
[15] Niven, C. D., The Thermal Conductivity of Sundry Materials: Canadian Jour. Research, vol. 13, no. 1, sec. A, July 1935, pp. 16-18.

furnaces in a continuous blanket about 3 feet wide and 4 inches thick which can be cut into mattresses or pillows of suitable length for placing between walls or wrapping around steam pipes. The cut packs can also be crushed into pellets that can be conveyed into old walls by means of a blower and hose. Glass wool may be used to fill life preservers. It is used on battleships and made into ropes that are strong and durable as well as waterproof; moreover, a band of glass wool around a tree trunk affords protection from crawling insects and caterpillars. Glass-wool filters used in air conditioning are cheaper and last longer than those made of metal. Spun-glass wool may be woven or knitted into garments, theater curtains, and innumerable fireproof fabrics. This thread is already used for insulating electric wires and cable. The fibers of spun glass before being twisted into yarn are so fine that 100 are needed to form a no. 50 thread. A single pound of glass can be drawn into a strand 31 million feet long and of almost unbelievable strength and great flexibility.

Glass silk or glass wool was first developed in Germany but was pioneered in America by the Owens-Illinois Glass Co. The Corning Glass Works likewise has carried on experiments and in December 1935 broke ground for a factory with a furnace for melting 24 tons a day, with the expectation of beginning to produce before the summer of 1936.

MONAZITE

The Bureau of Mines has no record of any domestic production of monazite since 1925; in fact, world supplies in recent years have been derived almost exclusively from British India. The movement into the United States is quite irregular, but a general uptrend seems in progress, following the heavy decline that accompanied the rapid displacement of gas mantles by other forms of lighting equipment. For the 1920–29 decade the recorded imports of monazite into the United States averaged 499 short tons annually. In 1930 none was imported, but the average for the next 5 years, detailed figures for which are given in the accompanying table, is 947 tons.

Of the 1935 importations, 1,064 tons came direct from India, and 235 tons were credited to England, although this doubtless also originated in India. Virtually all of it was landed at Baltimore; and the average declared value, $39.60 per short ton f. o. b. foreign port, compares with a nominal trade-journal quotation, c. i. f. New York, of $60.

Monazite occurs in India on the seacoast of Travancore. Ilmenite and zircon occur in the same beach sands but in variable proportions. Of 28 samples of sand from different localities, the Imperial Institute[16] found that five samples contained less than 0.2 percent monazite and only nine contained more than 5 percent, although one sample carried 33.7 percent. Some of the sand contained appreciable amounts of enstatite; in one sample the nonmagnetic portion, which formed 25.5 percent of the sand, consisted of about 40 percent quartz, 30 percent enstatite, and 30 percent zircon and rutile. Ordinarily the monazite is the most finely grained constituent, whereas the garnet and quartz (and sometimes zircon) are the coarsest. According to a letter to the Bureau of Mines from Joseph L. Gillson of the E. I. du Pont de Nemours & Co., Inc., monazite is produced now only from the ilmenite

[16] Bulletin of the Imperial Inst. (London), vol. 33, no. 3, October 1935, pp. 355–6.

sands at Manavalakurichi, a little town generally known as "M. K." about 4 miles south of Colachel (which appears on most maps). The average sand currently treated at this plant carries 2 to 5 percent monazite, which is saved as a byproduct, but before the market developed for ilmenite thin layers carrying as much as 15 to 25 percent were selected, being scooped up by the natives with a hoelike tool called a momati. This operation has continued with little interruption since 1906. Monazite has been produced also from the vicinity of Quilon near the mouth of the Neendakara estuary, but the sands now worked in that vicinity carry very little monazite. In preliminary tabling of the sand monazite is concentrated with the finer ilmenite, which is largely removed by running the product through magnetic separators. The nonmagnetic product from the separators is rerun in magnetic separators at a higher intensity, which picks out the monazite from the other minerals, including zircon and rutile, which are even less magnetic. Final cleaning is done on dry tables. The Travancore Government collects a substantial royalty on the export of monazite.

Monazite sand imported for consumption in the United States, 1931–35

Year	Short tons	Value	Year	Short tons	Value
1931	1,698	$65,080	1934	112	$4,867
1932	1,569	48,639	1935	1,299	51,495
1933	56	1,935			

STRONTIUM MINERALS

No domestic production of strontium ore has been reported since 1918, and the canvass has been discontinued. Extensive deposits of celestite occur in the southwestern United States but are not exploited. Imports of strontium ores in 1935 were a trifle larger than in most former years, but imports of leading strontium chemicals were substantially lower than the 1925–29 average, indicating reduced consumption.

Strontium minerals and chemicals imported for consumption in the United States, 1925–35

Year	Minerals		Nitrate		Carbonate		Oxide	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1925–29 (average)	2,567,658	$43,123	1,868,113	$105,412	52,346	$3,249	2,335	$245
1930	440,924	10,459	1,678,886	92,166	33,978	2,182		
1931	260	123	1,701,750	80,889	29,452	2,022	11,252	520
1932	11,685	276	438,931	18,699	30,550	2,211		
1933	2,426,493	8,457	532,835	23,744	10,073	850	595	115
1934	2,500,411	9,218	237,105	13,796	28,416	3,284	2,204	469
1935	2,674,094	11,595	277,548	15,716	21,828	2,641		

VERMICULITE

It is becoming increasingly evident that deposits of high-grade vermiculite are not even as abundant as was generally supposed a year or two ago. Experience seems to indicate that no vermiculite product weighing, after exfoliation, more than about 6 pounds per cubic foot can be marketed successfully, and although there are many deposits of material that will show a considerable expansion upon heating, few yield material that expands sufficiently to meet this requirement. Moreover, many vermiculites decrepitate when expanded and fail to yield a blocky, corklike product such as the trade demands for many purposes. Some of the large automobile manufacturers, however, do buy screenings (under 60-mesh) for making plastic insulator for their cars, and there are other industrial uses which eventually may afford a larger outlet for fine material. In view of the importance of size classification, the following list of uses for calcined vermiculite, based upon a tabulation prepared for the Tennessee Valley Authority, is particularly interesting:

¼-inch to 20-mesh

House insulation.	Safe and vault linings.	Smelter ladles.
Home refrigerators.	Pipe covering.	Refractory brick.
Auto mufflers.	Boiler lagging.	Insulation cement.
Acoustic plaster.		

20- to 40-mesh

Auto insulation.	Passenger car insulation.	Fire extinguishers.
Airplane insulation.	Wall board.	Filters.
Refrigerator car insulation.	Water coolers.	Cold storage.
	Annealing steel.	

40- to 120-mesh

Linoleum.	Cornice boards.	Dielectric switch boards.
Shingles.		

120- to 200-mesh

Grease lubricant.	Bakelite products.	Tires and rubber goods.

200- to 270-mesh

Wallpaper printing.	Building up viscosity in oil.	Fireproof cartons for films.
Outdoor advertising paints.		

270-mesh

Extender for gold and bronze printing ink or for paint.

For the present, at least, the domestic field—house insulation—is the main outlet but industrial sales opportunities are by no means unimportant. In addition to the foregoing list of uses, special mention should be made of the newly created business for insulating open-hearth steel furnaces. According to a recent review:[17]

Under the trade name "Therm-O-Flake", the Illinois Clay Products Co., Joliet, Ill., produces three different products for furnace installation: Granules, coating, and brick. The granules, which weigh about 5¼ pounds per cubic foot and fuse around 2,500° F., are usually spread on the silica brick of the roof 3 inches deep and covered with a 1-inch layer of "coating." The latter—a fluffy aggregate of vermiculite granules, mineral fiber, and bond—is used alone for vertical walls; mixed with water, and plastered on a furnace it weighs 15 pounds per cubic foot and melts around 2,300° F. The bricks of this same trade name are quite light, a standard straight, 9 by 4½ by 2½ inches, weighing only 18 ounces; they are a blend of vermiculite granules with refractory fibers and bond and undergo no volume change up to 2,000° F. Over 200 open-hearth furnaces have been supplied with these products, according to the manufacturer. The Johns-Manville Corporation, New York, supplies J. M. vermiculite granules that can be simply raked upon the roof of a furnace in a layer of about 2 inches thick. This company also furnishes a cement, J-M No. 500, comprising granules mixed with asbestos fiber and a binder that coats and seals the pores of the granules.

[17] Cone, E. F., Insulation of Open-Hearth Furnaces: Metals and Alloys, vol. 7, no. 4, April 1936, pp. 109-118.

A wide variety of vermiculite plasters and concrete for both sound and heat insulation is available, using various binders, such as gypsum, bentonite, goulac (paper-making waste liquor), casein, etc. Foundry partings of raw dust and a foundry-sand binder of exfoliated fines are being tried out. Freshly expanded vermiculite is a powerful desiccant; nevertheless, it has been proposed as a fruit-packing material, and it has found actual employment for packing bottles and other fragile articles. The mineral is mentioned as an insecticide carrier, battery-box filler, thermal jug insulation, roofing filler (tends to raise the melting point of asphalt), sealing compounds (due to its expansive properties), and to prevent "squeaking" shoes. Preliminary tests indicate a large use in oil refining as decolorizing agent, for which purpose it seems to be greatly superior to fuller's earth. One company has launched a Nation-wide advertising campaign claiming that the expansive properties of raw vermiculite can be utilized to prevent power leakage past the rings of worn automobile and other internal-combustion engines, restoring compression; the Bureau of Mines has made no tests of this procedure, but the use of both raw and exfoliated vermiculite for this purpose is covered by United States Patents 2012951–2012952 issued September 3, 1935, to Harold S. Brinker and William B. Thomas.

The Associated Minerals, Inc. (Ralph J. Hole, president, J. W. Mann, Austin, Minn., secretary) superseded the Allied Minerals Co. (H. O. Aaberg, president). The new company, after abandoning its options on several properties in Colorado, Wyoming, and Montana, has concentrated its efforts on a new deposit at Gunnison, Colo., which it expects to open up and exploit actively in 1936.

A number of companies and individuals were mining vermiculite or doing development work in North Carolina in 1935, production being reported by Philip S. Hoyt, Franklin, N. C., and others. Shipments were made also from Encampment, Wyo.

Production figures for vermiculite are not available, but consumption in the United States, almost exclusively from domestic sources except for some experiments with Russian material, doubtless approached 15,000 tons in 1935.

Prices vary; standard-grade raw material, suitable (after being expanded) for house insulation purposes, is sold at $12 to $20 a ton according to locality, the average probably being between $14 and $16 per ton in wholesale quantities. North Carolina raw vermiculite is nominally quoted in trade journals at $7 per ton, f. o. b. mines. In Omaha expanded material is offered at 14 cents per cubic foot in bulk or 15.5 cents in bags, the bulk price corresponding to around $46.60 per ton. In Washington, D. C., single bags containing enough material to cover 18 square feet 3 inches deep have been offered at 99 cents per bag delivered, equivalent to $74.50 per ton.

The history of the vermiculite industry, in common with that of other newly developed industries, is largely a record of the growth of individual companies. The leading developments to date seem to have been based upon extensive deposits about 7 miles from Libby, Mont., a mineralized zone about 2 miles long striking about N. 15° W. and about 1,800 feet wide. The east end of this deposit is owned and operated by the Zonolite Corporation of America and the west end by the Universal Insulation Co. The former concern was founded by Edgar M. Alley, a pioneer in the industry who died on May 30, 1935; a controlling interest therein has been acquired by Fisher Bros., Detroit, Mich., through William B. Mayo and associates. In addition to operating the mine and mill at Libby, this company licenses under its patents or has sales agreements with the F. E. Schundler Co. (plants at Joliet, Ill., and Long Island City, N. Y.), Zonolite Insulation Co. (plants at St. Louis, Mo.; Tulsa, Okla.; Kansas City, Mo.; and Denver, Colo.), Western Mineral Products Co. (Omaha, Nebr.), Micolite Co. (Kansas City, Mo.), and two small Canadian plants (Winnipeg, Man., and Paris, Ont.). A total of about 25 plants is planned, each to be situated at a large consuming center for expanding vermiculite to avoid excessive freight due to the bulky nature of exfoliated material.

The Universal Insulation Co. succeeds the National Vermiculite Products Corporation of Chicago, Ill., which in 1934 acquired the property and assets of the Vermiculite & Asbestos Co., Libby, Mont. This concern, which is reputed to be financed jointly by the Armour interests and J. N. Camden of Kentucky, has built several expanding plants in the East and in March 1936 was building a new mill at Libby, Mont., for cleaning 75 tons a day of raw vermiculite. The freight rate from Libby to Chicago is $8 and to Detroit $10 per ton.

The economic mineralogy of the west end of this deposit is thus described in a recent memorandum furnished the author by Oliver C. Ralston of the Bureau of Mines, who visited the property in April 1936:

> The vermiculized pyroxenite, consisting of something less than 50 percent vermiculite, also carried fluorapatite amounting normally to 2 to 3 percent, but in places up to 10 percent. Later, after standardized methods are adopted for milling the ore, the possibilities of segregating the fluorapatite will be considered. The main vermiculized-pyroxenite zone in this mine shows very few accumulations of biotitic material difficult to exfoliate. This material seems associated more with enriched zones, rare in this mine. Instead, a series of syenite dikes blocks off the ore zone, following about the same strike as the ore zone, and mining is carried on by steam shovel in 30-foot benches between the syenite dikes. Periodically the dikes are toppled over and trucked to a separate dump. Spacing of the dikes varies from 10 to 50 feet apart. They are thought to have been the source of the solutions that altered the pyroxenite in part or in whole into vermiculite in this end of the ore zone. Probably they were the last intrusions of the area, as they cut all other formation. Another series of dikes or zones intersect the ore body consisting of material high in amphibole asbestos, together with less altered pyroxenite, and striking about N. 40° E. While some vermiculite occurs in these zones, it is a minor constituent. These asbestos dikes are up to 10 feet thick, whereas the syenite dikes are generally only a few feet thick. Evidently the amphibolization of the pyroxenite in this earlier series of dikes left the material less susceptible to alteration into vermiculite when the syenite dikes cut all other formations. The amphibole can be fluffed into rather poor asbestos fiber, but suitable for making up vermiculite-asbestos-bentonite insulating pastes. This will likely be undertaken after the milling problem of the vermiculite is satisfactorily solved.

The east end of the deposit is richer than the west end and probably has fewer dikes. Quarrying has followed only the enriched zones, and inasmuch as the deposit also contains material that expands poorly or even is quite inert (resembling biotite) the workings are highly irregular and are operated by hand shoveling into trucks.

In Colorado a number of operations are reported, mostly in the vicinity of Westcliffe or around Canon City. Hillside, Bone Yard Park (Sparling mine), Dead Mule Gulch, and Salida are among the leading localities from which shipments have been made to Omaha and Kansas City. The freight rate to Omaha is $4 a ton from Colorado compared with $7 a ton from Montana.

WOLLASTONITE

The first commercial production of wollastonite was made in 1933 from a deposit operated by John T. Thorndyke in the Radamacher district near Code Siding, Kern County, Calif. This natural calcium metasilicate ($CaSiO_3$) is shipped to Los Angeles, where it is used to manufacture mineral wool by a new process in an electric furnace. This unusual operation has been described in a recent paper.[18]

[18] Thorndyke, J. T., Mineral Wool from Wollastonite: Mining and Metallurgy, vol. 17, no. 351, March 1936, pp. 133–135.

PART IV. MINE SAFETY

EMPLOYMENT AND ACCIDENTS IN THE MINERAL INDUSTRIES

By W. W. Adams

SUMMARY OUTLINE

An increasing output per unit of work and a decreasing accident rate accompanied production of minerals in the United States from 1911 to 1934. These trends have been strikingly evident in the combined record for all mineral industries since 1930 and have been apparent in certain classes of mines over even longer periods. The increased productivity per unit of labor has been accompanied by a reduction in the total number of employees.

Through voluntary cooperation of the producing companies with the Federal Government, records have been made available annually stating the number of men employed and the number and causes of accidents that have injured workers in mines, quarries, and other mineral establishments. These records are complete as to employment and as to fatal accidents since 1911 for mines, quarries, and stone-products operations, such as those engaged in making cement or lime, or in crushing or dressing stone; the records as to coke ovens, ore-dressing plants, and smelters are complete since 1913. Records of nonfatal injuries are available for the same periods, except for coal mines; these were canvassed on a uniform scale for all States for the first time in 1930. Although petroleum wells and refineries, natural-gas wells, and steel plants are important branches of the mineral industry, they are not covered by the present report because annual records of employment and accidents for such establishments are not available.

EMPLOYMENT AND ACCIDENTS

A true picture of the scope and trend of employment in the mineral industry can be obtained only by consideration of two factors, the number of men working and the number of man-shifts of labor performed. Curves representing these two factors do not necessarily parallel each other, however, because the mines and quarries of the country are not operated a uniform number of days each year. The yearly averages of the number of workdays for the industry as a whole since 1911 have ranged from 272 days per man in 1918, the last year of the World War, to 165 days per man in 1932. The

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number of workers in any given year represents, therefore, the average number of men employed on the days the plants were active in that year; it does not indicate the volume of employment or the amount of labor performed unless considered in connection with the number of days on which the plants were in operation.

The mineral industry began the 24-year period in 1911 with a million employees and ended it in 1934 with approximately three-fourths of that number. Employment reached a peak in 1917 and dropped to its lowest level in 1932. Moreover, the volume of employment, as measured by the number of man-shifts worked by all employees, was largest in 1917 and smallest in 1932.

In a number of years the volume of employment has changed more, proportionately, than the number of workers. For example, in 1917, the year of peak employment, the number of workers was only 15 percent above that of the base year 1911, whereas the number of man-shifts worked was 32 percent above the base. The amount of labor performed was conspicuously low in 1921 and 1922, standing at 84 and 82 percent, respectively, of the base year compared with 104 and 109 percent, respectively, for the number of men employed. Beginning with 1930 and continuing through 1934 the number of man-shifts of labor was relatively at a much lower level than the number of men working.

The yearly changes in the number of men employed and in the number of man-shifts worked since 1911 are shown by the index numbers in the following table. The record for each year since 1911 is compared with that year as a base, the year 1911 being represented by an index number of 100.

Indexes of employment and accidents for all mineral industries, and in all metal and nonmetal mines, 1911–34

[1911=100]

Year	All mineral industries [1]			All metal and nonmetal mines (except coal mines)			
	Men employed	Aggregate man-shifts	Fatality rate per 1,000 300-day workers	Men employed	Aggregate man-shifts	Fatality rate per 1,000 300-day workers	Injury rate per 1,000 300-day workers
1911	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1912	99.9	102.9	90.4	101.9	103.6	91.8	111.6
1913	109.9	119.8	88.6	115.2	117.6	83.5	105.5
1914	106.7	103.9	89.5	95.3	91.4	88.0	124.4
1915	106.2	106.2	81.9	91.6	91.0	87.4	146.0
1916	112.2	123.6	73.8	123.3	123.3	81.3	147.2
1917	115.1	132.4	82.5	120.8	123.1	99.7	141.5
1918	112.0	131.5	75.5	110.0	116.0	80.2	139.2
1919	108.1	107.5	79.4	87.5	87.3	77.0	135.8
1920	108.9	117.3	71.8	82.3	86.2	71.0	142.1
1921	103.9	84.4	79.7	56.6	47.7	69.4	146.6
1922	108.7	82.0	87.1	63.7	62.2	79.5	157.7
1923	114.8	110.0	78.8	74.3	78.1	67.6	161.8
1924	106.8	101.6	84.3	74.2	76.3	78.8	163.3
1925	104.4	100.4	79.4	76.3	79.4	67.1	166.5
1926	105.3	110.5	81.9	77.0	79.4	77.9	143.9
1927	103.9	101.0	78.1	72.1	72.7	69.6	130.1
1928	94.6	94.7	78.4	68.6	70.1	56.1	120.8
1929	92.4	97.2	79.2	71.5	73.9	68.0	117.5
1930	88.4	82.8	84.9	62.2	59.5	65.6	98.6
1931	78.0	63.5	92.6	48.8	40.0	56.8	82.0
1932	66.8	47.6	99.8	32.1	23.7	64.9	79.6
1933	67.4	52.8	82.7	34.4	24.9	55.0	89.7
1934	73.6	62.2	86.7	35.2	27.3	57.0	98.0

[1] Excludes petroleum and natural gas.

By far the largest part of the mining population of the United States is employed at coal mines. During the earlier years of the 24-year period, about three-fourths of the men—and within the past few years an even larger proportion—have been employed in coal production. American metal mines, at which nearly 200,000 men worked during the early part of the period, now employ less than a third of that number. The quarrying industry, which formerly employed more than 100,000 men, now employs about 60,000. Ore-dressing plants, smelters and refineries, and coke ovens likewise operate with fewer workers.

These declines in the number of employees are comparable, to some extent, with the reduction in the total value of minerals produced. The value of the mineral production of the United States was 1.9 billion dollars in 1911; it attained a maximum of nearly 7 billion dollars in 1920. Following 1920 the lowest point in value was 2.5 billion dollars in 1932, and the 24-year period ended in 1934 with a mineral production valued at 3.3 billion dollars. These figures included the value of petroleum and natural gas, for which no employment data are available. They show, however, a spread of 65 percent between maximum and minimum output compared with a spread of 42 percent in the number of workers and 64 percent in aggregate man-shifts of employment for the mineral industries for which employment figures are available.

Indexes of value of mineral production, 1911–34

[1911=100]

Year	Metals	Non-metals [1]	Total [1]	Year	Metals	Non-metals [1]	Total [1]
1911	100.0	100.0	100.0	1923	221.9	360.0	311.1
1912	126.6	110.7	116.3	1924	181.0	327.3	275.8
1913	129.1	125.0	126.5	1925	207.7	345.2	295.1
1914	100.8	114.6	109.7	1926	206.0	386.4	322.9
1915	145.6	112.7	124.5	1927	178.8	346.3	287.4
1916	238.0	151.6	182.3	1928	188.7	329.2	279.9
1917	306.4	233.4	259.5	1929	216.8	354.1	306.0
1918	316.2	272.0	288.0	1930	144.3	303.6	247.6
1919	199.7	260.1	238.9	1931	83.3	208.5	164.6
1920	258.8	419.5	362.8	1932	41.7	174.7	127.9
1921	96.1	280.1	215.1	1933	60.4	171.6	132.8
1922	145.0	294.2	241.5	1934	79.8	222.9	173.0

[1] Includes petroleum and natural gas.

The coal-mining accident record may be cited as representative of the entire American mineral industry, because its employment and accident records comprise such a large part of the total.

The only accidents for which virtually complete figures are available for the entire industry before 1930 are those that resulted in the death of the injured workers. The record of fatal accidents is complete for all years back to 1911, except that in 1911 and 1912 the figures do not cover ore-dressing plants, smelters, and coke ovens, relatively small branches of the industry; data on these became available for the first time in 1913.

Fatalities comprise only about 2 percent of the total number of lost-time injuries among employees of mineral establishments, but they obviously represent the most serious accident losses to the mining companies and to the families of the men injured. It is, therefore, significant that while the fatality rate in 1934 was much lower than in the base year 1911 the rates for some of the most recent years do not reveal any marked reduction from those in certain years immediately following 1911. In fact, the most favorable rate, based upon the number of man-shifts worked in the industry as a whole, was attained in 1920, when the fatality rate was 28 percent lower than for the base year. There has been marked reduction in the death rates for certain branches of the mineral industry, such as the lead and zinc mines of the Mississippi Valley States, iron-ore mines and copper mines. Less progress has been made in coal mining, the largest branch of the industry; hence the combined rates for the industry do not fully reflect the progress in safety made by some branches of the industry. The following discussion covers separate records of the principal branches of the mineral industry on fatal accidents in the industry as a whole and on nonfatal injuries in those branches for which such figures are available.

All figures on nonfatal injuries were derived from yearly reports by the operating companies to the United States Bureau of Mines. The operators' reports are also the source of all data relating to fatal accidents, except those on coal mines for 1911 to 1929; the figures for those years were obtained from monthly reports to the Bureau by mining departments of the important coal-producing States and from yearly reports of operating companies in several States that do not have mining departments.

All data relating to accidents and employment are summarized in the accompanying table for 1911 and 1934, the first and last years of the 24-year period under consideration.

Employment and accident data for the mineral industry, 1911 and 1934 [1]

	Men employed	Aggregate man-shifts worked	Number of men killed	Number of men injured	Fatality rate per 1,000 300-day workers	Nonfatal injury rate per 1,000 300-day workers	Production per man-hour (short tons)
1911							
Coal mines:							
Bituminous	554,408	117,322,181	1,957	(2)	5.02		0.40
Anthracite	173,940	42,914,379	699	(2)	1.82		.23
Total coal	728,348	160,236,560	2,656	(2)	4.97		.36
Coke ovens [3]	24,345	7,000,862	46	2,514	1.97	107.73	
Metal mines:							
Copper	44,693	13,774,325	238	10,342	5.18	225.25	
Iron	45,953	12,749,121	197	10,722	4.64	252.30	
Lead and zinc (Mississippi Valley)	12,521	3,202,339	43	1,488	4.03	139.40	
Gold, silver, and miscellaneous metals	48,919	13,512,633	193	3,618	4.29	80.33	
Total metal	152,086	43,238,418	671	26,170	4.66	181.57	
Metallurgical plants: [3]							
Ore-dressing	14,985	4,846,338	16	1,977	.99	122.38	
Smelters and refineries	20,564	7,292,766	47	4,247	1.93	174.71	
Auxiliary works [4]	14,007	4,729,010	14	2,240	.89	142.10	
Total metallurgical	49,556	16,868,114	77	8,464	1.37	150.53	
Nonmetal mines	13,893	3,588,155	24	407	2.01	34.03	
Quarry and stone-products plants	110,954	25,325,094	188	5,390	2.23	63.85	
Total mining industries [5]	1,005,281	232,388,227	3,539		4.57		

[1] Value of minerals in 1911—Metal $680,907,000, nonmetal (including fuels) $1,242,942,000, total $1,924,081,000; 1934—Metal $542,100,000, nonmetal (including fuels) $2,793,300,000, total $3,335,400,000.
[2] No record of number of men injured until 1930.
[3] Figures for 1913, first year available.
[4] Figures for 1915, first year available.
[5] Excludes coke ovens and metallurgical plants.

Employment and accident data for the mineral industry, 1911 and 1934—Continued

	Men employed	Aggregate man-shifts worked	Number of men killed	Number of men injured	Fatality rate per 1,000 300-day workers	Nonfatal injury rate per 1,000 300-day workers	Production per man-hour (short tons)
1934							
Coal mines:							
Bituminous	458, 044	81, 647, 939	958	46, 982	3. 52	172. 63	0. 61
Anthracite	108, 382	22, 292, 281	268	21, 026	3. 61	28. 30	. 32
Total coal	566, 426	103, 940, 220	1, 226	68, 008	3. 54	196. 29	. 54
Coke ovens	15, 483	5, 428, 694	14	516	. 77	28. 51	--------
Metal mines:							
Copper	8, 084	1, 840, 798	12	669	1. 96	109. 03	--------
Iron	15, 477	3, 013, 352	16	485	1. 59	48. 28	--------
Lead and zinc (Mississippi Valley)	5, 069	985, 013	3	644	. 91	196. 16	--------
Gold, silver, and miscellaneous metals	29, 781	6, 936, 991	77	5, 307	3. 33	229. 51	--------
Total metal	58, 411	12, 776, 154	108	7, 105	2. 54	166. 83	--------
Metallurgical plants:							
Ore-dressing plants	7, 713	1, 801, 884	5	460	. 83	76. 59	--------
Smelters and refineries	11, 361	3, 368, 910	4	560	. 36	49. 87	--------
Auxiliary works	7, 858	2, 194, 936	4	300	. 55	41. 01	--------
Total metallurgical	26, 932	7, 365, 730	13	1, 320	. 53	53. 76	--------
Nonmetal mines	8, 234	1, 947, 061	8	787	1. 23	121. 26	--------
Quarry and stone-products plants	64, 331	13, 108, 274	60	3, 924	1. 37	89. 81	--------
Total mining industries	739, 817	144, 566, 133	1, 429	81, 660	2. 97	169. 46	--------

Copper mines.—In this report copper mines include all mines whose production was valuable chiefly for the copper content of the ore. Employment at mines of this class reached a maximum in number of workers in 1917 and in number of man-shifts of labor a year later. Substantially the same high level of employment prevailed during the 3-year period 1916 to 1918. The number of employees and the number of shifts were lowest in 1933, the latter being proportionately less than the former. Michigan copper mines had the greatest number of employees in 1911, but Arizona had gained first place by 1934, and Michigan dropped to third. Montana was in third place at the beginning of the period but passed Michigan and gained second position in 1934.

The fatal-accident rate for copper mines was at its most favorable level in 1934, when it was only 38 percent as high as in 1911. Only once since 1911 has the rate reached a higher figure than in the base year; this was in 1917, when 163 men lost their lives in a mine fire at Butte, Mont. Until 1928, the copper industry's efforts in accident prevention had not been attended with much success as far as nonfatal injuries were concerned. The highest nonfatal-injury rate was in 1923, and every year from 1912 to 1927 was marked by a less favorable rate than that for 1911, the base year. Apparently, however, the situation has been brought under control, as the injury rate has been lower than the 1911 level in every year since 1927.

The record for nonfatal injuries covers all cases of disability of an employee that extended beyond the day on which the accident occurred.

Iron-ore mines.—Operations at iron-ore mines were at a maximum in 1917, both as to employees and shifts, and at a minimum in 1932.

The index of the number of workers was 124.5 in 1917 compared with 100 in the base year 1911, and the index for man-shifts worked stood at 127. When employment fell to its lowest level in 1932 the index for employees was only 26, and that for man-shifts was even lower, being 12.9 compared with 100 for the base year. Michigan and Minnesota led all other States in employment by a wide margin both at the beginning and end of the 24-year period, with Minnesota holding a larger lead over Michigan in 1934 than in 1911.

The iron-mining industry has been successful to a marked degree in safeguarding its workers from accidental injury or death. At no time since 1911 has the death rate from accidents been as high as it was that year, nor was it unusually high in 1911. The fatality rate has been consistently lowered until, in 1932, it was only 25 percent as high as in 1911, and the index for nonfatal injuries was lowered to less than 18 percent of the base year. The downward course of the yearly fatality rates has been seriously interrupted only in 1926, when 51 men were killed in a single disaster due to flooding of a mine. The rates for nonfatal injuries have declined even more, proportionately, than the fatal-accident rates.

Indexes of employment and accidents in copper and iron-ore mines, 1911–34

[1911=100]

Year	Copper mines				Iron-ore mines			
	Men employed	Aggregate man-shifts	Fatality rate per 1,000 300-day workers	Injury rate per 1,000 300-day workers	Men employed	Aggregate man-shifts	Fatality rate per 1,000 300-day workers	Injury rate per 1,000 300-day workers
1911	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1912	115.8	114.9	87.4	114.7	99.5	102.2	85.4	95.8
1913	125.6	126.1	78.7	102.5	111.3	118.2	71.0	106.3
1914	100.0	93.3	74.3	138.6	97.5	92.1	81.5	88.8
1915	105.6	103.2	71.8	143.0	85.7	84.0	62.1	92.6
1916	137.0	137.4	70.2	141.9	116.4	116.6	73.6	95.2
1917	137.1	138.6	113.4	139.1	124.5	127.0	76.4	90.2
1918	133.0	138.7	66.6	143.0	116.8	122.1	74.4	73.5
1919	88.0	86.1	68.3	137.4	103.7	109.1	64.7	77.8
1920	78.9	81.2	66.2	143.5	100.1	106.5	50.5	79.5
1921	41.0	32.4	71.4	141.0	66.5	50.3	65.6	83.6
1922	57.6	54.5	57.9	142.4	70.2	65.0	64.7	70.3
1923	72.7	74.8	60.0	155.0	83.6	88.0	51.3	59.5
1924	72.7	74.3	68.5	154.4	79.7	77.3	63.6	59.9
1925	74.4	75.7	56.7	155.7	74.7	74.0	54.8	63.2
1926	73.2	76.3	66.6	128.0	72.2	71.7	91.2	53.1
1927	68.7	69.9	66.7	115.9	72.7	70.0	52.8	45.4
1928	68.4	71.9	58.4	98.1	63.4	61.1	46.6	38.9
1929	83.1	87.0	58.4	99.4	61.4	63.1	64.3	35.5
1930	62.0	59.9	53.2	85.9	64.0	60.6	57.8	32.3
1931	44.0	36.9	58.1	67.7	47.4	34.6	41.2	20.9
1932	21.4	16.6	58.1	49.9	26.0	13.9	25.5	17.7
1933	15.6	12.3	48.0	57.8	30.4	15.5	39.3	20.0
1934	18.1	13.4	37.8	48.4	33.7	23.6	34.3	19.1

Lead and zinc mines (Mississippi Valley States).—Although lead and zinc are produced in various parts of the country, especially in the far West, they are often associated with gold or silver in the ore as it comes from the mines, making difficult segregation of lead and zinc mines as a separate group except in the Mississippi Valley States, where such mines constitute a distinct class. The lead and zinc mines in the Mississippi Valley region reached a maximum number of employees and shifts in 1916, with an almost equally large number in 1917. Minimum employment was in 1932. Missouri led all other States in the number of men employed in 1911, with about three-fourths of the total number of workers, but dropped to second position in 1934, with only one-fifth of the total number of employees; Oklahoma meanwhile gained the leadership, with about one-third of the total number.

The lead and zinc mines have experienced some large increases in the rates for nonfatal injuries during certain years. The rate was highest in 1923, when it was more than three and one-half times that for the base year 1911. Ten years of improvement followed, but even in 1933, when the record was better than in any other recent year, the injury rate was 6 percent higher than in 1911. A larger measure of success has been made in the prevention of fatal accidents, as is indicated by the fact that the fatality rate has been kept under that of the base year during the entire period since 1919. Moreover, when the fatality rate was at its most favorable level in 1933 it was only 21 percent as high as in 1911.

Gold, silver, and miscellaneous metal mines.—In addition to gold and silver mines in all sections of the country, this group includes lead and zinc mines in States outside of the Mississippi Valley; it also includes all miscellaneous metal mines, such as those producing manganese, quicksilver, or any other kind of ore whose chief value lies in metals other than iron or copper. Considering the group as a whole, the number of employees was largest in 1916, with an index of 122.9, slightly above the index of 121.6 for 1913. The number of man-shifts was highest in 1913. The smallest volume of employment was in 1932, when the index for the number of workers was 43.1 and that for man-shifts 37. It should be stated that these figures are based upon reports from mines normally in operation from year to year; they do not cover the large number of prospects and small mines that are active only occasionally and for short periods, as reports from such operations can be obtained only with great difficulty and expense.

Accident reports for mines of the gold, silver, and miscellaneous metal group are complete as to fatal accidents since 1911, but reliable figures covering nonfatal injuries are not available before 1916. Reports of injuries had been furnished to the Bureau of Mines by operating companies since 1911, but they were manifestly incomplete in the number of nonfatal injuries reported. For this reason 1916 instead of 1911 has been chosen as the base year for comparing the nonfatal-injury rates for mines of this class. As the reports of fatalities have been complete since 1911, that year has been chosen as a satisfactory base for comparing the fatality rates for the various years.

The fatal-accident rate for mines in this group was highest in 1922, when 47 men died in the Argonaut (Calif.) gold-mine fire. The rate reached its second highest level in 1924, when 41 men were killed in a manganiferous iron-ore mine in Minnesota. The lowest death rate was reported in 1928. On the other hand, nonfatal injuries reached their highest rate in 1925 and declined to the lowest and most favorable level in 1917, although the injury rate in 1932 was almost equally low.

This group of mines includes a much larger proportion of small properties than other classes of mines whose accident records have been mentioned. As safety engineers have often observed, accident frequency at small mines as a class is characteristically higher than at large mines, as large operations have an advantage in more modern operation methods and better safety organization. These facts probably are largely responsible for the failure of the group as a whole to reduce its accident rate as much as iron-ore, copper, and other classes of mines.

Indexes of employment and accidents in lead and zinc mines, and in gold, silver, and miscellaneous metal mines, 1911–34

[1911=100]

Year	Lead and zinc mines (Mississippi Valley)				Gold, silver, and miscellaneous metal mines			
	Men employed	Aggregate man-shifts	Fatality rate per 1,000 300-day workers	Injury rate per 1,000 300-day workers	Men employed	Aggregate man shifts	Fatality rate per 1,000 300-day workers	Injury rate per 1,000 300-day workers
1911	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
1912	114.5	118.1	106.2	113.6	90.2	90.5	100.9	
1913	101.4	100.8	96.8	95.8	121.6	121.6	89.5	
1914	87.3	86.8	107.2	135.6	99.0	98.0	94.9	
1915	103.6	104.6	133.3	170.9	92.6	92.3	111.9	
1916	164.6	170.0	78.0	188.7	122.9	119.1	94.6	[1] 100.0
1917	161.9	155.9	101.5	195.8	106.1	107.9	94.2	90.4
1918	111.8	109.8	89.0	229.2	89.2	94.1	99.8	97.1
1919	103.6	102.1	102.5	209.7	65.7	63.5	103.0	100.3
1920	92.9	103.0	81.2	235.3	61.2	61.8	98.1	107.4
1921	55.5	50.9	64.0	272.4	54.2	52.7	76.9	118.2
1922	71.8	78.1	65.5	333.0	56.5	58.0	125.0	136.4
1923	81.7	92.5	67.7	355.6	62.4	64.4	91.8	156.7
1924	101.7	115.4	68.5	333.0	60.7	64.5	116.6	156.1
1925	103.1	112.8	82.4	335.8	67.9	74.2	89.5	161.1
1926	115.6	119.6	75.7	218.2	69.4	73.2	76.4	157.0
1927	99.8	99.2	65.5	213.5	62.3	64.8	91.4	146.6
1928	82.5	81.1	40.2	212.1	64.6	67.6	60.8	140.9
1929	89.3	85.4	51.6	170.9	63.1	64.4	85.5	141.2
1930	68.1	57.4	40.4	126.6	55.3	53.8	104.9	125.6
1931	49.3	36.5	64.5	126.7	49.8	44.7	67.3	99.6
1932	31.9	21.3	99.3	118.2	43.1	37.0	85.5	94.0
1933	37.0	22.0	21.1	105.9	48.6	41.0	74.8	105.4
1934	40.5	30.8	22.6	140.7	60.9	51.3	77.8	120.3

[1] 1916=100; records for earlier years incomplete.

Ore-dressing plants.—Plants that concentrate metallic ores have had an employment roll ranging from 24,111 men in 1917 to 5,925 in 1932. The earliest year for which employment figures are available is 1913. Using that year as a base for comparative purposes and representing the number of workers by an index number of 100, the number of employees may be represented by an index of 160.9 in 1917 and 39.5 in 1932. The same years were marked by the maximum and minimum man-shifts worked, the former reflecting an index of 150.9 and the latter, 26.3. Montana, Utah, and Missouri were the leading States in 1911 and California, Colorado, and Utah in 1934. The entrance of California and Colorado among the leading States reflects the revival of activity in gold mining within the past few years.

The fatal-accident rate for ore-dressing plants was almost twice as high in 1917, when employment was at a maximum, as it was in 1913, the first year for which figures are available. From this high point the rate dropped to zero in 1932, a year in which no fatalities marred the industry's record but plant activity was at its lowest ebb. The nonfatal-injury record was at its worst in 1922 but reached a very favorable low level in 1931.

Smelters and refineries.—The smelting and refining industry, not including iron blast furnaces (for which the Bureau of Mines has not collected employment statistics), employed its maximum number of workers (44,376) in 1918 and its minimum of 8,920 in 1932. Both minimum and maximum number of man-shifts worked coincided, in point of time, with corresponding levels of number of workers. In this industry 1916 and 1917 were years of marked activity, when employment indexes were above 200 compared with an index of 100 for 1913, the earliest year for which annual records are available. From an employment viewpoint the leading States in 1911 were Arizona, Illinois, and Utah. In 1934, New Jersey led all other States, followed by Pennsylvania, Illinois, and Utah.

This branch of the metallurgical industry has been successful to a marked degree in preventing accidents. Immediately following the base year the fatality rate was reduced by 46 percent, and in only 4 years has it been as much as half of that for 1913. The nonfatal-injury rate also has been greatly reduced. The best record was for 1932, when the rate was only 23 percent as high as in 1913. The record for the intervening years reveals a consistently downward trend in the rate for nonfatal injuries.

Employment and accidents in ore-dressing plants and in smelters and refineries 1913–34 [1]

[1913=100]

Year	Ore-dressing plants				Smelters and refineries			
	Men employed	Aggregate man-shifts	Fatality rate per 1,000 300-day workers	Injury rate per 1,000 300-day workers	Men employed	Aggregate man-shifts	Fatality rate per 1,000 300-day workers	Injury rate per 1,000 300-day workers
1913	100.0	100.0	100.0	----------	100.0	100.0	100.0	100.0
1914	96.8	90.2	159.6	----------	131.1	129.1	54.4	103.5
1915	123.9	118.3	158.6	----------	152.3	149.2	54.4	90.3
1916	149.2	145.3	142.4	[2] 100.0	213.1	203.1	37.8	119.9
1917	160.9	150.9	194.9	89.3	215.8	208.4	54.4	87.5
1918	145.5	139.4	156.6	102.9	194.0	186.9	47.7	84.9
1919	114.3	103.4	151.5	90.5	138.2	127.2	53.9	81.3
1920	106.5	98.9	132.3	121.1	121.3	119.9	35.8	81.5
1921	67.0	49.8	50.5	111.3	90.7	78.6	37.8	63.8
1922	77.9	68.4	110.1	132.3	94.8	85.9	39.9	82.3
1923	103.1	95.6	156.6	124.2	109.1	109.7	33.2	74.8
1924	105.0	99.6	125.3	115.0	121.3	120.2	28.5	64.5
1925	113.1	105.7	101.0	96.3	122.3	122.0	33.2	65.2
1926	111.3	107.6	75.8	97.3	118.6	119.5	35.8	62.7
1927	102.3	96.8	109.1	84.9	110.4	109.8	42.5	49.0
1928	78.5	76.5	122.2	85.7	99.2	100.0	38.3	44.9
1929	91.6	88.3	120.2	75.4	90.5	91.4	44.6	43.2
1930	77.7	68.9	54.5	58.3	83.5	82.4	18.1	30.3
1931	59.2	47.7	78.8	42.0	58.3	51.8	24.9	27.3
1932	39.5	26.3	----------	44.9	43.4	33.7	44.0	23.0
1933	42.7	27.7	113.1	48.7	44.2	37.9	39.4	33.6
1934	51.5	37.2	83.8	56.5	55.2	46.2	18.7	28.5

1 No records available before 1913.
2 1916=100; records for earlier years incomplete.

Anthracite mines.—All anthracite mines covered by the present discussion are in the eastern part of Pennsylvania. The number of men engaged in producing anthracite, which is used almost entirely as a domestic rather than an industrial fuel, has ranged from 179,679 men in 1914 to 104,430 in 1933. The employee index for 1914 was 104.1 compared with 100 for the base year 1911; that for minimum employment in 1933 was 60.5. The maximum number of workers followed by 1 year the maximum number of man-shifts of labor performed, the index for the latter being 105.6 in 1913 and 102.9 in 1914. Although the man-shift index in 1934 was only 45.2, production of coal per man-hour of labor reached its highest level in that year, being 0.321 short ton per man-hour of work performed by the underground and surface employees. Minimum productivity per man-hour was 0.225 ton, in 1913. Productivity of labor has increased without interruption since 1927.

The number of men killed by accidents at the mines was higher in 1911 than in any other year of the 24-year period 1911 to 1934. Accidents during 1911 killed 699 men. The smallest number killed was 231 in 1934. Considering the number of fatalities in connection with the total number of men employed and the number of days on which the mines were active, the record shows that 1919 was marked by the highest fatality rate. In this year 92 men were killed by an explosion of powder. The lowest fatality rate was reported for 1933, when the death rate from accidents was 82 percent of that for the base year 1911. The fatality rate for 1934 was a fraction less favorable than for 1933.

Employment, accidents, and production per man-hour in all coal mines and in anthracite mines, 1911–34

[1911=100]

Year	All coal mines				Anthracite mines			
	Men employed	Aggregate man-shifts	Fatality rate per 1,000 300-day workers	Production per man-hour (short tons)	Men employed	Aggregate man-shifts	Fatality rate per 1,000 300-day workers	Production per man-hour (short tons)
1911	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1912	99.2	101.5	89.7	106.5	100.8	94.0	91.5	99.2
1913	102.6	111.0	94.5	104.2	101.8	105.6	83.7	95.8
1914	104.8	98.6	93.7	105.4	104.1	102.9	82.8	97.5
1915	100.8	95.8	89.3	112.2	102.3	94.8	88.3	103.9
1916	99.0	105.9	79.0	115.3	92.6	94.6	91.6	111.5
1917	104.0	118.8	85.5	117.0	89.3	102.6	91.2	120.5
1918	104.7	122.6	79.2	120.4	85.2	100.8	88.0	122.2
1919	106.6	101.5	86.1	119.8	89.6	96.0	106.4	114.1
1920	107.7	112.6	76.0	128.9	84.1	92.0	86.0	121.3
1921	113.0	88.8	84.5	125.5	92.4	100.8	87.2	111.5
1922	116.0	75.8	98.5	138.2	90.9	55.2	87.2	123.0
1923	118.4	105.0	88.3	137.4	91.4	98.6	82.9	117.5
1924	107.0	93.6	96.5	134.0	92.7	102.6	77.9	106.9
1925	102.8	89.9	93.5	141.9	92.9	68.0	94.4	112.8
1926	104.2	104.7	90.5	137.7	95.8	94.2	77.3	111.5
1927	104.2	94.2	89.1	139.4	95.8	87.0	90.6	114.5
1928	93.8	87.7	93.3	143.6	93.1	81.3	88.3	114.9
1929	89.9	90.2	91.3	147.9	87.8	79.7	97.4	115.4
1930	88.4	77.3	100.5	151.6	87.4	73.8	96.9	117.1
1931	81.0	61.9	88.9	155.5	80.8	60.6	101.3	121.8
1932	72.4	49.1	92.5	160.1	70.3	45.5	87.4	135.4
1933	71.8	55.7	72.0	151.0	60.5	45.2	82.3	136.2
1934	77.8	64.9	71.2	153.3	62.8	52.1	82.8	136.7

Bituminous-coal mines.—An outstanding feature of the employment record for bituminous-coal mining from 1911 to 1934 is the marked increase in the number of men employed at West Virginia and Kentucky coal mines. Between the first and last years of the period the number of workers increased 59 percent in West Virginia and more than doubled in Kentucky. The increases in these two States occurred when employment had declined in virtually all other States.

Bituminous coal is primarily an industrial fuel and therefore differs fundamentally from anthracite from the viewpoint of employment and continuity of operation of the mines. The total number of men employed at the mines reached a maximum of 704,793 in 1923, when the tonnage of coal produced was larger than in any other year. That number of workers represented an employment index of 128.2 compared with 100 for the base year 1911. It was in 1918, however, that the number of man-shifts of labor reached a maximum; the labor index for that year was 131.1, whereas it was 107.7 in 1923 when the number of workers was at a maximum. The minimum number of employees and man-shifts was reached in 1932, the employee index being 73.9 and the man-shift index 50.7. It is interesting to note that in 1932, when employment was lowest, productivity of labor was greater than at any other time during the 24-year period; the output of coal per man-hour during that year was 0.645 short ton, 60 percent more than in 1911. Due to the growing use of machinery for cutting and loading coal, less human labor is now required to produce a given tonnage. As the following table indicates, productivity per man-hour has trended upward strongly between 1911 and 1934, notwithstanding a slight set-back during the last 2 years of that period.

The leading States in number of men employed at bituminous mines in 1911 were Pennsylvania, Illinois, West Virginia, Ohio, and Kentucky. In 1934 Pennsylvania's leadership was still unquestioned, but West Virginia had displaced Illinois for second position, and the latter State had dropped to third place. Kentucky, which was not among the five leading States in 1911, had climbed to fourth place in 1934, displacing Ohio, which ranked fifth.

The fatal-accident record for bituminous-coal mines is complete for all years since 1911, but the record on nonfatal injuries extends back only to 1930. The fatality rates have at times been increased suddenly by heavy loss of life in explosions of gas and coal dust. Intensive safety work by the industry has, however, decreased the frequency of such explosions in recent years encouragingly, especially during the past decade, until in 1933 there was only one explosion in which five or more lives were lost.

In 1911, 1,957 men were killed by accidents out of a total of 3,539 men killed in all mineral industries in that year. In 1934, accidents at bituminous mines killed only 958 men out of a total of 1,429 at all mineral establishments. The smallest loss of life in any single year at bituminous mines was 833 in 1933. These figures show only the actual loss of life without reference to the number of men working. When the number of deaths is related to the number of men employed, the record shows that the highest fatality rate was that for 1924 and the lowest that for 1934.

As the largest loss of life in the mineral industry is at bituminous-coal mines, it is highly significant that the general trend of the yearly fatality rates has been downward since 1924, although the course has not been without interruption. The chief hazard to which the bituminous-coal miners are exposed is falls of roof and coal. Although accidents of this kind have been reduced since 1930, that year was preceded by a period of definitely increasing death rates from falling roof and coal. Haulage accidents, which rank second as a coal-mining hazard, have been reduced since 1929, but conspicuously high rates prevailed for most of the years from 1917 to 1929. Explosions of gas and coal dust, at least those of major size, have been almost eliminated, but constant precaution against the explosion hazard is essential to avoid recurrence of the disasters of earlier years. Accidents from explosives have trended downward since 1911, in spite of a temporary rise in the death rate from 1920 to 1922. The reduction in the rate for accidents of this class is attributed largely to the increasing use of permissible explosives instead of black powder for blasting coal. Electricity has been responsible for an increasing death rate, although an improvement has marked the last 3 years. Miscellaneous hazards, including those due to machinery, have trended upward since 1911. While the increasing use of machinery in coal mines has greatly increased the production of coal per man employed, machines have introduced new hazards into the mines and have also modified the methods of extracting the coal and loading it on mine cars. The introduction of machine hazards does not necessarily mean an increased accident rate, as is proved by the experience of many individual companies whose mines have been completely mechanized and whose accident rates have been lowered rather than increased.

Coke ovens.—The employment situation in the coking industry has changed radically since 1913, the earliest year for which data are available. Coke was formerly made principally in beehive ovens, and the majority of employees in the coking industry worked at ovens of this type. Byproduct ovens employed a much smaller number of men. Separate records for the two kinds of ovens became available for the first time in 1915; in that year 57 percent of the employees worked at beehive ovens and 43 percent at byproduct ovens. In 1919 the number of employees at byproduct ovens exceeded that at beehive ovens for the first time, and the margin between the two sets of workers has widened in subsequent years, giving a greater leadership to ovens of the byproduct type. In 1934, for example, byproduct ovens employed more than 92 percent of the total number of workers, and beehive ovens employed less than 8 percent.

Considering both classes of ovens as forming a single group as far as employment is concerned, the record shows that maximum employment was reached in 1917. The index number representing the number of employees in 1917 was 133.2, with 1913 representing an index of 100. The index for number of man-shifts worked in 1917 was 152.5. Minimum employment was in 1932, when the indexes were 49.3 for number of employees and 59.4 for number of man-shifts of labor. Pennsylvania led all other States both in 1915 and 1934 in the number of employees at each of the two classes of ovens.

The accident record for coke ovens is a record of progress in the promotion of safety. The highest fatality rate since 1913 was that for 1917. By 1930 the rate had been reduced 64 percent below the 1913 level. Nonfatal injuries occurred most frequently in 1918, when the rate doubled that for 1913. A period of declining injury rates followed, the best record being for 1932, when the rate was only 21 percent as high as in 1913. The records for 1933 and 1934 were almost as favorable as that for 1932.

Employment, accidents, and production per man-hour in bituminous mines, 1911–34, and employment and accidents in coke ovens, 1913–34

[Bituminous mines, 1911=100; coke ovens, 1913=100]

Year	Bituminous-coal mines				Coke ovens			
	Men employed	Aggregate man-shifts	Fatality rate per 1,000 300-day workers	Production per man-hour (short tons)	Men employed	Aggregate man-shifts	Fatality rate per 1,000 300-day workers	Injury rate per 1,000 300-day workers
1911	100.0	100.0	100.0	100.0				
1912	99.8	104.6	88.9	104.9				
1913	104.0	113.4	97.6	103.6	[1] 100.0	[1] 100.0	[1] 100.0	[1] 100.0
1914	98.0	97.3	97.6	106.4	91.7	91.0	107.6	95.7
1915	101.4	96.5	89.1	112.0	127.6	134.6	61.4	84.3
1916	102.1	110.5	77.3	111.3	129.8	146.2	67.0	142.5
1917	109.7	125.2	86.3	111.3	133.2	152.5	108.6	175.1
1918	119.9	131.1	79.1	114.5	133.0	152.0	104.5	203.9
1919	113.1	103.9	82.7	117.5	118.1	118.6	97.4	135.2
1920	116.3	120.6	75.5	124.2	115.6	128.2	83.2	105.9
1921	120.7	84.8	87.3	129.1	66.6	59.4	62.4	124.0
1922	125.1	83.7	102.8	132.6	79.2	78.1	80.7	87.0
1923	128.2	107.7	92.7	137.0	97.5	109.8	89.3	93.9
1924	112.7	90.7	107.4	139.7	84.0	88.6	58.9	73.8
1925	107.0	98.3	95.5	138.5	95.5	103.1	58.9	65.5
1926	108.0	109.0	96.9	137.5	94.9	104.1	106.5	73.5
1927	108.0	97.2	91.7	139.5	84.9	99.5	54.8	51.4
1928	95.0	90.5	97.6	144.4	79.6	93.0	39.6	43.3
1929	78.9	94.3	92.3	148.2	92.3	110.2	43.6	48.0
1930	89.7	78.9	104.8	154.1	81.6	98.3	61.9	41.4
1931	81.9	62.7	88.1	158.5	63.9	77.8	25.4	27.3
1932	73.9	50.7	96.7	159.9	49.3	59.4	51.2	21.4
1933	76.2	59.7	71.3	146.2	55.9	66.9	35.5	23.1
1934	83.3	69.8	70.1	150.4	63.6	77.5	39.1	26.5

[1] 1913=100; no records available for earlier years.

Quarries and stone-products plants.—The record for this group includes quarrying operations proper and the preparation of stone products, such as crushed stone, dressed stone, cement, and lime, when conducted at or near the quarrying plants. In 1912 employment for the group was at a maximum. In 1917, when some classes of metal mining were experiencing their greatest activity, the index for number of workers in the quarry group was 74.2 compared with 100 for the base year 1911, and the index for man-shifts was 84.7. The employee index dropped to 61.6 and the man-shift index to 70.2 in 1918. The post-war peak for number of workers at quarries came in 1924, when the index was 84.9, and that for man-shifts in 1923, with an index of 100.9. Both 1923 and 1924 were good years for the quarrying industry, as far as the number of employees and days of operation are concerned.

The quarrying of stone is perhaps more widely distributed over the United States than any other branch of the mineral industry, chiefly due to the relatively low unit value of the material, which tends to locate the quarry plants near the points where the finished products are to be used. There are, of course, many exceptions to the general rule, as in the case of special limestone or marble, for which demand and price warrant shipment for long distances. Among the many quarrying States, however, a few are outstanding leaders in the number of men employed. In 1911 Pennsylvania, Ohio, New York, and Indiana, in the order of the number of workers, each employed more than 5,000 men in quarrying. In 1934, the four leading States were Pennsylvania, Ohio, California, and New York. Indiana employed 5,059 in 1911 and only 2,501 in 1934; California employed 3,845 in 1911 and 4,092 in 1934. The changes in the various States since 1911 are indicated by the index numbers in the following table.

Employment and accidents in quarries and stone-products plants, 1911–34

[1911=100]

Year	Men employed	Aggregate man-shifts	Fatality rate per 1,000 300-day workers	Injury rate per 1,000 300-day workers	Year	Men employed	Aggregate man-shifts	Fatality rate per 1,000 300-day workers	Injury rate per 1,000 300-day workers
1911	100.0	100.0	100.0		1923	83.3	100.9	75.3	100.2
1912	101.9	111.2	101.8		1924	84.9	100.0	73.1	99.7
1913	95.8	103.2	94.2		1925	82.8	98.8	79.8	96.6
1914	79.3	80.8	118.4		1926	82.1	97.6	83.9	91.3
1915	90.8	97.7	80.7		1927	82.5	97.9	73.1	92.8
1916	81.8	90.6	101.3	[1] 100.0	1928	80.8	96.3	65.5	74.0
1917	74.2	84.7	82.1	105.4	1929	77.1	90.7	74.0	73.0
1918	61.6	70.2	94.6	83.7	1930	72.7	81.2	68.6	61.6
1919	68.1	75.6	86.5	82.1	1931	62.4	61.3	52.9	59.7
1920	77.9	91.3	103.6	82.9	1932	51.3	43.9	38.6	54.9
1921	69.6	71.0	89.7	99.4	1933	55.8	44.9	70.0	54.7
1922	71.3	81.6	86.1	97.9	1934	58.0	51.8	61.4	51.1

[1] 1916=100; records for earlier years incomplete.

Reliable accident records for quarries and stone-products plants begin with 1911 for fatal accidents and with 1916 for nonfatal injuries. The fatality rate has been reduced materially. Throughout the 24-year period, the rate has been as high as it was in 1911 on only four occasions. The lowest death rate was reported in 1932, when it was only 39 percent as high as that for 1911. Nonfatal injuries have been reduced to a smaller extent, although the record is favorable. The best record was made in 1933, when the rate was only 51 percent as high as in 1916.

CONCLUSION

If the last predepression year, 1929, which was by no means a year of maximum labor force, is accepted as representing the number of workers required to produce the Nation's minerals, the mineral industry may look forward to reemployment of approximately 258,000 more men than in 1932, the year in which the number of employees reached its lowest level. Progress toward normal industrial conditions added 7,000 men to the employment roll in 1933 and an additional 61,000 in 1934. The number of men working in 1934 must be increased by approximately 190,000 before all of the men who worked in 1929 shall have been returned to their jobs.

The return of these men to their former jobs, or the employment of an equivalent number of men, will not necessarily mean that each man will again average 243 days of work annually as he did in 1929. Methods of production have changed somewhat since then; the mines are using machinery to a greater extent than before; and the average worker can now produce a larger quantity of coal or other mineral in a given unit of time than was possible when less machinery was used. For the near future we may expect that, should production again reach the level of 1929, the same number of men employed in that year would not hereafter require 243 days each to produce an equal tonnage. For the more distant future, as the richer and more readily accessible ore bodies and mineral beds are depleted, the outlook is for a declining productivity per man-hour of labor unless the increasing difficulties of mining and preparation of minerals can be offset by further improvements in mining methods and metallurgical processes. The prevention of waste and an increased efficiency in utilizing minerals are influences that should render less imperative the maintenance of as high a productivity per man-hour of labor for so large a working force as that employed in 1929.

The accident record of the mineral industries is not as favorable as that of most other industries, because of the fundamental difference between mining and other kinds of work. Mining is essentially an underground industry, whereas most other kinds of work are performed above ground, usually with adequate light. The dim and artificial light in which underground mining work is done has often been a contributing factor in the occurrence of accidents. The outlook, however, is favorable. Progress in the prevention of accidents has been rapid in recent years, being more notable in the prevention of nonfatal injuries than in the elimination of fatal accidents. The improvement is undoubtedly a result of the cumulative influence of the safety campaigns that have been conducted for many years by the operating companies and by the mining bureaus of State and Federal Governments. The increasing number of operating companies that have become active in accident-prevention work suggests that the progress already made in reducing mining hazards will continue, although occasional set-backs may be expected from time to time. The course of safety does not run smooth. The accident rates will assuredly increase occasionally, yet such increases can only retard, but cannot prevent the downward trend of the mineral industry's accident rates over any long period of time. The numerous forces for safety that have been set in motion can hardly have any other result.

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