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UNITED STATES DEPARTMENT OF THE INTERIOR
HAROLD L. ICKES, Secretary
BUREAU OF MINES
R. R. SAYERS, Director

MINERALS YEARBOOK

REVIEW OF 1940

Prepared under the direction of
E. W. PEHRSON, Chief
Economics and Statistics Branch

H. D. KEISER, Editor

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1941

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FOREWORD

Events in 1940 have demonstrated again that in this age of mechanization minerals are indeed the sinews of war. The British have shown that valor can offset, to a remarkable extent, the advantages of superior armament and munitions; but the experience of Finland, Belgium, Greece, and others has revealed the ineffectiveness of heroic men against an avalanche of iron, manganese, aluminum, and petroleum utilized in tanks and airplanes, bullets and bombs. It is not surprising, therefore, that in our own defense program major emphasis has been placed upon the problems of mineral supply and that in 1940 the activities of the Bureau of Mines, the Government agency chiefly concerned with the mineral industries, were largely directed toward furtherance of defense objectives.

All branches of the Bureau have contributed to the defense effort. Facts and figures were the first requirement of the agencies created to direct the preparedness program, for without them planning would have been difficult if not ineffective. Knowledge as to location of mineral supplies, domestic and foreign; past and current rates of production, consumption, and imports; stocks; and anticipated supplies and demand was indispensable. Accordingly, the facilities of the Bureau's Economics and Statistics Branch immediately were drafted for defense work. Statistical inquiries were expanded and speeded up, and experienced personnel was temporarily loaned to defense agencies to facilitate their organization. The Technologic Branch, under authorization of the Strategic Materials Act, greatly extended its investigation of domestic deposits of strategic minerals and its search for new processes to convert low- and off-grade domestic reserves into usable products. The work has yielded results that can be translated into production to relieve possible emergency shortages. The promotion of safety by the Health and Safety Branch assumed even greater importance as attention was focused on the need for maximum efficiency of labor, accompanied by safety for workers, in achieving defense objectives.

In presenting this year's edition of Minerals Yearbook, the Bureau of Mines has endeavored to record the highlights of the defense program as it affected the mineral industries. Despite the fact that much of the new data compiled cannot be published at this time because of military or commercial expediency, the current volume contains considerable information not previously available.

It is a pleasure again to record with grateful recognition the extensive cooperation given by many sources outside Government, without which the Bureau of Mines could not function effectively. Limited space precludes mention of all individuals, companies, and trade associations that have responded generously to requests for information and counsel. Their number is legion and their contribution invaluable. The cooperation of State officials who, through formal agreements with the Bureau of Mines, assist in collecting mineral

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statistics, thereby eliminating duplication of effort by the State and Federal agencies and promoting more accurate statistics, is deeply appreciated. State agents cooperating in the 1940 canvass were: Stewart J. Lloyd, acting State geologist, University, Ala.; Herman Gunter, State geologist, Tallahassee, Fla.; Garland Peyton, director, division of mines, mining, and geology, department of natural resources, Atlanta, Ga.; M. M. Leighton, chief, and Walter H. Voskuil, mineral economist, State geological survey division, Urbana, Ill.; A. C. Trowbridge, director, Iowa Geological Survey, Iowa City, Iowa; Raymond C. Moore, State geologist, Lawrence, Kans.; Edward B. Mathews, State geologist, Baltimore, Md.; R. A. Smith, State geologist, Lansing, Mich.; H. A. Buehler, State geologist, Rolla, Mo.; Meredith E. Johnson, State geologist, Trenton, N. J.; Jasper L. Stuckey, State geologist, Raleigh, N. C.; Robert H. Dott, director, Oklahoma Geological Survey, Norman, Okla.; E. P. Rothrock, State geologist, Vermillion, S. Dak.; E. H. Sellards, director, bureau of economic geology, Austin, Tex.; Arthur Bevan, State geologist, and Linwood H. Warwick, chief clerk, Virginia Geological Survey, Charlottesville, Va.; Harold E. Culver, supervisor, division of geology, department of conservation and development, Pullman, Wash.; Paul H. Price, State geologist, Morgantown, W. Va.; and E. F. Bean, State geologist, Madison, Wis. In addition, Walter W. Bradley, State mineralogist, San Francisco, Calif., assisted in the compilation of statistics for California.

R. R. Sayers, *Director*.

July 1, 1941.

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INTRODUCTION

National defense activities of the Bureau of Mines, particularly special canvasses for the various defense agencies by the Economics and Statistics Branch, have made available for publication in Minerals Yearbook, Review of 1940, much information that has not appeared in earlier volumes. Typical of such new information are statistics of magnesium production in the last 3 years and of magnesium consumption in each industry, results of a survey made to determine the adequacy of reserves of bauxite, data on the coke-producing capacities of byproduct and beehive ovens in the United States as of the close of 1940 and 1941, records of the shipments of coke in 1940 by States of destination and principal uses, discussion of stocks of and requirements for nickel, and estimates by the more important producers of mercury as to reserves and probable output at various price levels. In addition to these data much information has been compiled to supply the defense agencies with adequate background material needed in the administration of the rearmament program, which cannot be published because of either national defense requirements or confidential commitments to industry. It is hoped that at the close of the emergency these data may be published in future editions of Minerals Yearbook as part of the historical record of the current period.

In publishing Minerals Yearbook, Review of 1940, an effort has been made to increase the value of the volume to the reader through not only expanding wherever possible the field covered in the various chapters but also improving the physical features of the book. A paper stock of slightly less weight than that used heretofore but of equal durability has made possible a small reduction in thickness that should materially extend the period of service of those copies that ordinarily receive much handling. A number of additional charts have been developed, and all the charts that have appeared in earlier volumes and are published again in this volume have been redrawn in a manner that should improve their usefulness.

Adoption of a publishing plan that involved determination of the size of each chapter, in pages, before its preparation has made possible the issuance of preprints of every chapter and much earlier publication of the volume than in recent years. This plan, which has been effected without the omission of essential material from any of the chapters, required close adherence to manuscript-due dates by authors, careful coordination of the preparation of chart copy with the receipt of manuscript, and complete cooperation of the Government Printing Office. Successful execution of the plan bespeaks for those contributing to it more than usual interest and devotion to the several objectives sought and is the more noteworthy because of the many demands that have simultaneously been made on those same individuals for their services in connection with other national defense activities.

Acknowledgments.—After the National Bituminous Coal Commission was created July 1, 1937, collection of production statistics of the

bituminous-coal industry, previously conducted by the Bureau of Mines, was transferred to it. Through the cooperation of this agency and its successor, the Bituminous Coal Division, United States Department of the Interior, the statistical record of the industry, maintained by the Geological Survey and the Bureau of Mines since 1880, remains unbroken. The cooperation of the Bituminous Coal Division in contributing the chapter on Bituminous Coal in this volume is gratefully acknowledged.

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

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

The publishing staff of Minerals Yearbook, which includes economic analysts, copy editors, printing estimators, and statistical draftsmen, is wholly competent and has had much experience over a period of years in issuing the volume; to them belongs the credit for the achievement that publication of the book represents. Martha B. Clark, besides preparing the statistical summary of mineral production each year, has been largely responsible for the maintenance of continuity of data and uniformity of statistical presentation throughout the Minerals Yearbook volumes. Elva T. Shuey has served as editorial associate in reviewing and verifying chapters. Mabel E. Winslow acted as editorial consultant and was responsible for the editing of the entire manuscript. Cecilia W. Justice directed the stenographic and typing service incident to publication of the book. Shirley F. Colby supervised the preparation of charts and developed the numerous improved features incorporated in them. The Graphic Section of the Bureau, in Pittsburgh, Pa., Louis F. Perry, Chief, prepared most of the charts. Max Abel assisted in the administrative details of the Yearbook program and had charge of estimates of space requirements for printing. John H. Ady, Chief of the Publications Section of the Department and liaison officer between the Department and the Government Printing Office, contributed invaluable counsel in the development and execution of the publishing program.

H. D. Keiser.

July 1, 1941.

PART I. GENERAL SUMMARY

REVIEW OF THE MINERAL INDUSTRIES IN 1940

By E. W. Pehrson and H. D. Keiser

SUMMARY OUTLINE

The record of mineral production in 1940 presents convincing evidence of the outstanding contribution of the mineral industries to the national welfare and of the priceless endowment given the United States in the abundance and variety of its natural resources. Responding to the Nation's call for more and more raw materials from which to fabricate the instruments of national defense and national well-being, our mines and quarries in 1940 yielded the greatest quantity of minerals in history. The physical volume of production rose 11 percent above that in 1939 and exceeded the previous peak of 1937 by 5 percent; it was 10 percent higher than the predepression record established in 1929 and 45 percent above production levels of the World War of 1914–18. A further increase is indicated for 1941. All classes of minerals shared the advance—metals, nonmetals, and the fuels—solid, liquid, and gaseous.

Importance of conservation.—Production in such quantity and variety is ample testimony to the enormous extent of our mineral reserves, but prudence requires realization of the fact that these reserves are not inexhaustible and that current rates of extraction constitute a terrific drain on an irreplaceable national asset. Although the present emergency requires that, regardless of cost, every effort be made to make our country impregnable, the fact that minerals are so vital to national defense emphasizes the need for conservation more strongly than ever. During this period when defense preparations consume such a large proportion of our mineral supply, the best interests of the Nation would seem to be served by curtailing the less essential uses of minerals and by avoiding extravagant practices in production. True conservation implies wise use of natural resources without waste or needless exploitation and the preservation of such resources for the well-being of future generations insofar as such action is compatible with present needs. National preparedness requires sacrifices in the interests of speed, but in our haste to create military strength we should not overlook the fact that the extent to which we indulge in needless depletion at this time will impair our ability to meet similar emergencies in the future.

PRODUCTION

Value of mineral output.—The quantity of minerals produced in 1940 exceeded all previous records, but the value was considerably below former peaks due to the fact that average prices, though roughly 1 percent above those in 1939, were much lower than in previous years of high productive activity. The total value of the mineral output of the United States for 1940 was approximately $5,582,500,000—14 percent over 1939. It was the highest since 1926 and more than double that for each of the depression years 1932 and 1933. The highest annual value was reached in 1920, when high prices for minerals prevailed generally and coal prices soared to extraordinary heights in consequence of heavy export trade precipitated by the United Kingdom's inability (partly because of strikes) to meet heavy world demands for coal. In that year, the domestic mineral output was valued at $6,981,340,000. The 6-billion mark was exceeded in only one other year, 1926, when again a shortage of British coal occasioned by strikes caused a heavy increase in domestic export trade, production, and prices. The value of domestic mineral production in 1940 also was exceeded in 1923 and 1925.

Of the total value of mineral production in 1940, fuels contributed $3,080,200,000 (55 percent), metals $1,677,700,000 (30 percent), and nonmetallics other than fuels $824,600,000 (15 percent). The effects of the defense program were felt most strongly by metals, because of the demand for airplanes, ships, tanks, guns, and ammunition. The value of metal production increased 30 percent, whereas the output of fuels and other nonmetallics rose only 9 and 5 percent in value, respectively. Figure 1 shows the growth in value of various branches of mineral production from 1880 to 1940. Before 1908, metals were the principal product, but since then fuels have ranked first consistently, except in 1915 and 1916. The predominant position of the mineral fuels during the last 3 decades has been due largely to the phenomenal growth of the petroleum and natural-gas industries. In 1940, oil and gas wells contributed products worth over $2,000,000,000 or 36 percent of the total mineral output.

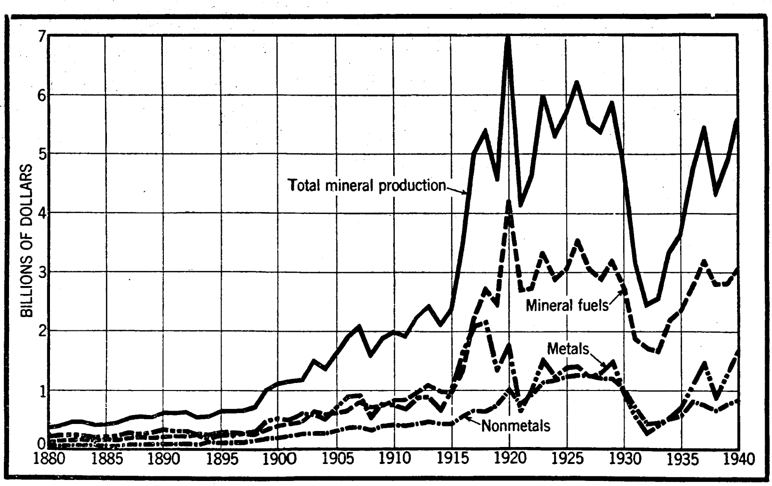

FIGURE 1.—Trends in value of mineral production in the United States, 1880–1940.

Trends in physical volume of production.—Figure 2 compares the physical volume of mineral production during the last 40 years with industrial and agricultural production and with growth of population, each expressed in terms of an index based upon the average for 1923–25.[1] The long-time trend of production during this 40-year period has been steadily upward, although year-to-year and cyclical fluctuations have been prominent. The production of minerals, which furnish tools, fuels, and raw materials for manufacture, has naturally been closely correlated with the trend of industrial production, experiencing the same violent ups and downs, whereas agricultural production has exhibited more moderate fluctuations.

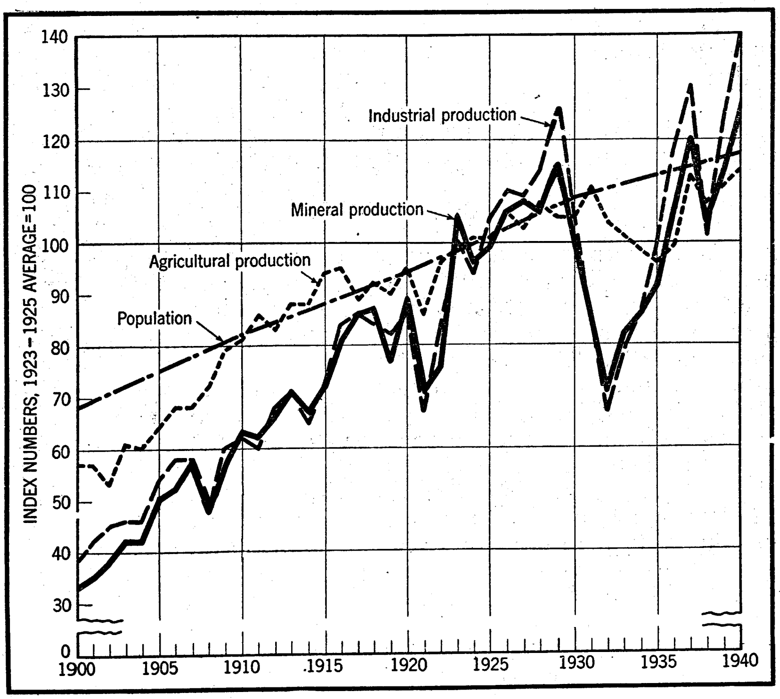

FIGURE 2.—Comparison of growth of physical volume of mineral production with that of agricultural and industrial production and population, 1900–1940.

The importance of metals in the manufacture of armament and in other defense needs is shown by the sharp upswing of mineral production between 1914 and 1918, when a rise of 20 points (30 percent) took place, and by that in 1940, when an all-time high was established in both mineral and industrial output. This record undoubtedly will be far surpassed in 1941, inasmuch as the Nation is confronted with the necessity of rapidly expanding the yield of all commodities required for national defense.

[1] The following indexes have been used: Volume of farm production, U. S. Dept. of Agriculture; mineral production, 1900–1918, from Warren Persons' Forecasting Business Cycles; mineral production, 1919–40, and industrial production, Federal Reserve Board; total population of the United States, Bureau of the Census.

STOCKS

Metal inventories during 1940 trended predominantly downward. Producers' stocks of the nonferrous metals were reduced drastically during the year, and consumers' stocks appear to have followed a similar though less-pronounced trend. A notable exception was tin, stocks of which increased abruptly as imports soared to unequaled heights. Stocks of foreign lead in the United States also increased and at the close of the year were the highest on record. Consumer stocks of manganese ore, chromite, and tungsten ore scored net gains, although the trend for chromite and tungsten ore was downward during the latter part of the year.

The quantity of pig iron and iron and steel scrap on hand at suppliers' and consumers' plants was lower at the end of 1940 than at the beginning. Inventories of cement and anthracite likewise decreased slightly; but those of petroleum and bituminous coal rose, and the latter reflected the improved rate of consumption. The Government acquired a substantial tonnage of strategic minerals during 1940 under its program of stock-piling for national defense.

CONSUMPTION

Although there were sharp advances in the consumption of most mineral commodities and new records were established for some, the average rate for all minerals in 1940 probably did not equal predepression peaks. The Federal Reserve Board index of industrial production (1935–39 average=100) rose from 108 in 1939 to a new high of 122 in 1940; the previous record of 110 had been established in 1929. Industrial activity sagged in the early months of 1940, as indicated by the decline in the adjusted index from 126 in December 1939 to 111 in April 1940, but as the defense program got under way the trend reversed abruptly. By December the index had reached 139. Failure of mineral consumption to reach new high points in 1940 in the face of such an outstanding advance in industrial production may be ascribed to the relatively low rate of building activity. The index of construction contracts awarded (value basis, 1923–25=100) was 81 in 1940—a substantial rise from 72 in 1939 but far below the 135 achieved in 1928. Because of this, the consumption of many nonmetallic minerals and some metals used extensively in building lagged in 1940 compared with predepression levels. The use of coal in recent years has been notably less than in predepression years because of competition from the liquid and gaseous fuels.

Outstanding records for actual consumption in 1940 were made by aluminum, chromite, magnesium, manganese, nickel, zinc, and petroleum, all of which reached new peaks.

PRICES

No precise composite index of average prices of mineral raw materials is available, but a weighted average for 22 major commodities, which comprised 95 percent of the total value of mineral production in 1940, indicates an increase of about 1 percent in 1940 compared with 1939. A somewhat larger increase in prices of nonferrous metals was offset by declines in unit realizations on sales of the liquid fuels, mineral building materials, and the fertilizer minerals.

According to the Bureau of Labor Statistics the wholesale price index (1926=100) of metals and metal products rose from 94.4 in 1939 to 95.8 in 1940. That of nonferrous metals, including some fabricated products, advanced from 78.0 to 81.3. Prices for aluminum and tin were reduced, whereas those of copper, lead, zinc, antimony, and mercury gained. Larger gains were discouraged by warnings issued during the latter part of the year by the Price Stabilization Division of the Advisory Commission to the Council of National Defense. The index for iron and steel products declined from 95.8 to 95.1; quotations for pig iron and scrap averaged higher in 1940 than in 1939, but iron-ore prices were lower. Coal prices moved upward compared with 1939, and anthracite made a larger gain than bituminous coal. The index for petroleum and its products dropped from 52.2 to 50.0, and lower prices also were realized by producers of lime, tile, cement, sand and gravel, stone, phosphate rock, and potash. The index number of wholesale prices for all commodities increased from 77.1 in 1939 to 78.6 in 1940.

Mineral prices in 1940 were far below previous peaks. The 1940 index for nonferrous metals, for example, was 23 percent lower than in 1929 and 44 percent below 1918. The iron and steel index, though slightly higher than in 1929, was 35 percent below that in 1918. Prices for petroleum and products were unusually low; the 1940 index was 30 percent lower than in 1929 and 63 percent below 1918. The 1940 index for all commodities was 18 percent below that in 1929 and 40 percent lower than in 1918.

EMPLOYMENT AND SAFETY

The year 1940 was signalized by increased employment in the mineral industries of the United States. Incomplete data indicate a rise of about 23,000 in the number of workers at mines, mills, smelters, etc., making an estimated total of 812,000 men employed in the industry in 1940. Bituminous-coal mines made notable gains in employment, although there were also large increases at mines producing iron ore, copper, and zinc. Employment at milling and smelting operations also increased, as did that at coking operations. Lesser gains in employment, and in some instances actual decreases, were shown by reports from stone-quarrying companies. No major strikes occurred in 1940.

Occupational hazards in the mineral industries resulted in accidents estimated to have caused 1,690 deaths and more than 78,000 disabling injuries to workers. The number of persons killed or injured was larger than in 1939, but as employment also increased the death rate per million man-hours of exposure to accident hazards increased only slightly (from 1.14 to 1.30) and the injury rate actually declined (from 64.56 to 60.28). Bituminous-coal mining suffered the largest increase in its fatality rate, mainly because of a series of mine disasters. Whereas only 1 major explosion occurred in 1939 with a loss of 28 lives, 6 major explosions occurred in 1940 with a loss of 276 lives. These catastrophies, with their heavy loss of life, hastened the enactment of a Federal law authorizing the Bureau of Mines to inspect all coal mines in the United States whose production of coal enters interstate commerce or whose output affects interstate commerce. The law was approved by President Roosevelt on May 7, 1941.

NATIONAL DEFENSE ACTIVITY

Because the national defense program dominated the mineral industries in 1940, a review of the year would be incomplete without listing the principal Government defense agencies concerned with problems in the mineral field. It will be recalled that, following the World War of 1914–18, Congress passed the National Defense Act of 1920, which charged the Assistant Secretary of War with the responsibility of developing plans for industrial mobilization to be used in case of emergency. The plans announced by this office in 1939 contemplated, in the event of war, the appointment of a civilian Administrator of War Resources, responsible only to the President.

To assure effective action before the actual outbreak of war, the plans also provided that, before M-day, the agency would be organized in skeleton form, or the Army and Navy Munitions Board (established in 1922 by the Secretaries of War and Navy to handle industrial planning problems requiring coordination of Army and Navy procurement activities) would undertake preliminary planning.

War Resources Board.—When war in Europe became imminent in the summer of 1939, the first step in the program outlined above was taken as a precautionary measure. On August 9, 1939, the Assistant Secretaries of War and Navy, then serving as acting heads of their respective departments, announced the formation of a civilian War Resources Board to act as advisor to the Army and Navy Munitions Board. However, the new Board was short-lived. On September 8 the President issued an Executive order providing for the establishment, within his Executive Office and in the event or threat of a national emergency, of such office for emergency management as he shall determine. Late in September the President announced that the War Resources Board would complete its report and disband in 10 days or 2 weeks. The report was not made public.

Minerals Advisory Committee.—At the close of 1938, a Minerals Advisory Committee to the Army and Navy Munitions Board was appointed, with Dr. C. K. Leith as chairman. Other members included J. W. Furness (secretary), Col. A. S. Dwight, D. F. Hewett, and M. W. Tuthill, with representatives of the War and Navy Departments as liaison members. Tuthill resigned from the committee in May 1939, and J. E. Pogue was appointed in June 1939. E. W. Pehrson became a member in April 1940 and was designated secretary after Furness relinquished that post, though continuing as a member of the committee. Seventeen civilian commodity subcommittees were organized and each prepared confidential reports on the national defense aspects of their respective minerals. These and a general summary prepared by the Minerals Advisory Committee were submitted during the latter part of 1939 and were used extensively by the Army and Navy Munitions Board in revising its official procurement plans. In April 1940, the Minerals Advisory Committee began a review of the official plans, but in June this work was transferred to the defense agencies set up to expedite the preparedness program.

Advisory Commission to the Council of National Defense.—The speedy success of Germany in invading the Low Countries and France in May 1940 gave considerable impetus to defense preparations in the United States. Billions of dollars were promptly appropriated by Congress to meet the threat of Germany's air force and mechanized mode of warfare. On May 28, the President appointed the Advisory Commission to the Council of National Defense under authority granted by Congress in 1916, which provides for the creation of an ex officio National Defense Council with an appointive Advisory Commission of no more than seven members. The purpose of the new Commission was to translate legislation into action. The seven members of the Commission and their fields of activity were:

Ralph Budd, transportation.
Chester Davis, agriculture.
Harriet Elliott, consumer protection.
Leon Henderson, price stabilization.
Sidney Hillman, labor.
William S. Knudsen, industrial production.
Edward R. Stettinius, Jr., industrial materials.

Several collateral divisions subsequently were added to the organization, including a Coordinator of Purchases to coordinate the various purchasing activities of the Government concerned with defense.

The Mining and Mineral Products Division of the Industrial Materials Department, with W. L. Batt as division executive and C. K. Leith as consultant, began functioning June 3. Dr. Leith maintained headquarters with the Bureau of Mines while preliminary plans for the enlarged program were being formulated and until a large enough staff could be obtained to administer it. Several outstanding mineral experts were engaged as consultants. Activities of the division were directed chiefly to speeding up and expanding the stock-piling program inaugurated in 1939 under the Strategic Materials Act; stimulating production at home and abroad; revising procurement plans; estimating future requirements and supplies; and coordinating supply and essential demand as shortages of some minerals developed in the latter part of 1940. Frequent upward revisions in and the ultimate immensity of military requirements for planes, tanks, ships, and munitions necessitated drastic upward alteration of previously conceived notions of the potential wartime demand for mineral raw materials. In some instances it appeared that military objectives for matériel would not be met because the resources of the country could not produce the minerals required therefor. In January 1941, the personnel and functions of the division were transferred to the Office of Production Management.

Office for Emergency Management.—This office is essentially an administrative agency of the Executive Office designed to assist the President. The creation of this office was authorized in the Executive order of September 8, 1939, previously mentioned, but the organization was not formally established until May 25, 1940. On January 7, 1941, the Office for Emergency Management was designated as the agency to coordinate the activities of the Council of National Defense and its Advisory Commission, the Office of Production Management, and certain other defense agencies.

Office of Production Management.—The Office of Production Management was created by Executive order on January 7, 1941, as a branch of the Office for Emergency Management. The agency has four divisions—Production, Procurement, Priorities, and Labor—to which the equivalent functions and personnel of the advisory Commission to the Council of National Defense were transferred.

The Production Division, of which John D. Biggers is director and W. L. Batt deputy director, has within it a Materials Branch, which includes a Metals and Minerals Section. The function of this group is to recommend means for obtaining adequate supplies of mineral raw materials for defense needs. As of June 15, 1941, the following were serving as raw material consultants in this section:

C. K. Leith, minerals.
S. E. Hackett, iron, steel, and ferrous alloys.
R. C. Allen, ferrous raw materials.
R. H. Ridgway, iron and steel scrap.
Andrew Leith, manganese and chromium.
Louis Jordan, nickel.
J. A. Church, copper, zinc, and brass.
H. C. Sykes, mica.
E. Vogelsang, tin and lead.
H. K. Masters, antimony, tungsten, and molybdenum.
R. J. Lund, miscellaneous minerals.
F. B. Cliffe and G. R. Holden, aluminum and magnesium.

Similar responsibility for petroleum, natural gas, and petroleum and coal products is delegated to the Chemical Section, of which E. R. Weidlein is chief.

The Priorities Division, headed by E. R. Stettinius, Jr., has charge of allocating supplies of deficient materials for defense purposes.

Office of Price Administration and Civilian Supply.—This department of the Office for Emergency Management, established by Executive order on April 11, 1941, combined the functions of the Price Stabilization and Consumer Protection divisions of the Advisory Commission. The Office has two divisions, one for price stabilization and the other for administration of priorities for civilian supplies. The latter function is conducted in cooperation with the Priorities Division of the Office of Production Management. Donald H. Wallace is price executive for nonferrous metals, M. Q. Shaughnessy for fuels, and Roswell Whitman for ferrous metals. J. L. Maury is in charge of civilian allocations for nonferrous metals, E. T. McCormick for fuels, and M. G. de Chazeau for ferrous materials.

Administrator of Export Control.—By an act of Congress approved July 2, 1940, the President was authorized to prohibit or curtail exports as needed in the interests of national defense. The office of Administrator of Export Control, responsible directly to the President, was created by Executive order on the same date. The first proclamation under the law, also issued July 2, 1940, prohibited the exportation of all strategic and critical minerals except under license. Subsequent proclamations extended control to other commodities, so that by the latter part of June 1941 exports of virtually all the important minerals except coal and some nonmetallics required Government license. Administration of export control has been directed toward conserving supplies of materials essential to the national defense program and preventing strategic commodities from getting into the hands of unfriendly powers.

Other agencies.—Several other temporary defense agencies have functions less directly concerned with the mineral industry than those discussed above. The Office for Coordination of Commercial and Cultural Relations Between the American Republics, for example, has been instrumental in promoting geological studies of strategic mineral deposits in Latin America by the staff of the Geological

Survey and in strengthening commercial and cultural ties within the Western Hemisphere.

Many regular Government organizations share major responsibility on defense problems with the temporary agencies. The Bureau of Mines and the Geological Survey, for example, are conducting an extensive investigation of domestic resources looking toward larger domestic supplies. To assist in the procurement of strategic minerals from Latin America four mining engineers of the Bureau of Mines have been assigned to the United States embassies in Argentina, Peru, Brazil, and Chile. In furtherance of the policy of Western Hemisphere solidarity a law was approved September 26, 1940, authorizing the Export-Import Bank of Washington, a subsidiary of the Reconstruction Finance Corporation, to make loans to develop the resources, stabilize the economies, and assist in orderly marketing of the products of the countries of the Western Hemisphere.

GOVERNMENT STOCK PILES

Early in May 1940, it became evident that the Government stock-piling program authorized by the Strategic Materials Act (Public, No. 117—76th Cong.) would have to be greatly expanded and accelerated. The methods of purchase prescribed by the act did not permit buying by private negotiation, and the slower procedure of advertised bidding was entirely impracticable under conditions then prevailing in world markets. Moreover, the funds available under the act were inadequate to complete a satisfactory stock-piling program. For these reasons, it was decided to transfer procurement of some of the major items on the strategic materials list, such as tin, manganese, and rubber, to the Reconstruction Finance Corporation, where speedier methods of purchase could be adopted. This was accomplished on June 28, 1940, by creation of the Metals Reserve Co., an organization capitalized at $5,000,000, to which the Reconstruction Finance Corporation authorized immediately an additional loan of $100,000,000 for financing the purchase of tin, manganese, and other metals. Additional loans were made as the purchasing activity of the company was expanded to include a variety of mineral products. As of April 30, 1941, the Metals Reserve Co. had negotiated purchase contracts for antimony, asbestos, chromite, copper, graphite, manganese ore, mica, tungsten ore, tin, and zinc totaling $608,935,000.

Purchases were continued throughout 1940 by the Procurement Division of the Treasury Department under Public No. 117. Subsequent legislation changed the purchasing procedure stipulated in the original act to permit buying by private negotiation instead of by public bidding, as required formerly. Of the $100,000,000 authorized by the act, $70,000,000 had been appropriated as of June 15, 1941.

Details of the Government purchasing programs, insofar as they are available for publication, are given in the commodity chapters of this volume.

STIMULATION OF DOMESTIC PRODUCTION

Domestic production is being stimulated by direct Government aid to individual producers rather than by general appeals to the public at large, as was the case during the World War of 1914–18.

The consensus among officials in Washington is that a general appeal should be avoided to prevent repetition of the War Minerals Relief aftermath of the last war. The Government is prepared to consider giving assistance, by purchase contract or otherwise, to any sound proposal for increasing production, wherever increased output is required for national defense purposes. No one should risk engaging in unprofitable production with the expectation that the Government will reimburse him for losses at some later date.

The Government program of direct aid is carried out chiefly through the Reconstruction Finance Corporation and its subsidiaries, the Metals Reserve Co. and the Defense Plant Corporation. The Metals Reserve Co. assists prospective producers by guaranteeing a market for a fixed tonnage at fixed prices by advance contracts. The Defense Plant Corporation, organized August 22, 1940, and the Reconstruction Finance Corporation assist chiefly by financing new plants either for private or Government operation. Details of the activities of these agencies are given in the commodity chapters of Minerals Yearbook.

With a view to meeting possible needs for emergency production, the Bureau of Mines and the Geological Survey speeded up their investigation of domestic deposits of low- or off-grade strategic minerals. The metallurgical research program of the Bureau of Mines likewise was expanded. Processes for treating low-grade manganese ores reached the pilot-plant stage in 1940, and construction of several plants was begun. Research on chromium and magnesium, as well as other strategic or critical minerals, was continued with the expectation that feasible methods of utilizing domestic resources would be developed.

STATISTICAL SUMMARY OF MINERAL PRODUCTION

(GENERAL UNITED STATES SUMMARY AND DETAILED PRODUCTION BY STATES)

By Martha B. Clark

SUMMARY OUTLINE

INTRODUCTION

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

UNIT OF MEASUREMENT

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

ELIMINATION OF DUPLICATION

In the totals for the United States, shown in the following "general" tables, duplication has been eliminated wherever practicable, and in the State totals given in the State tables virtually all duplication has been eliminated. For instance, in both general and State tables the output of coke is shown but its value is not included in the totals, as the value of the coal used in its manufacture enters into the value of the coal production which is included in the totals. For asphalt, both native and oil are shown in the general tables, but the value of the oil asphalt is excluded from the totals as it duplicates that of the petroleum from which it is manufactured. For the clay industries, no figures have been available for total clay produced. For years before 1936, the total value of clay products is included in both general and State totals as representing the first marketable form of the greater part of the clay produced; the quantity and value of the clay mined and sold in the raw state by miners to users of clay are shown separately also, but the value is not included in the totals as it is duplicated largely in that for clay products. For years beginning with 1936, as the Bureau of Mines believes that a closer approach to

GENERAL TABLES

Mineral products of the United States, 1938–40 [1]

Product	1938 Quantity	1938 Value	1939 Quantity	1939 Value	1940 Quantity	1940 Value
METALLIC						
Aluminum ... pounds	286,882,000	$56,659,000	327,090,000	$64,600,000	412,560,000	$75,292,000
Antimonial lead ... short tons (2,000 pounds)	[2] 24,123	(2)	[2] 21,995	(2)	[2] 29,762	(2)
Antimony:						
Metal ... do	(3 4)	(3 4)	(3 4)	(3 4)	(3 4)	(3 4)
Ore and concentrates ... do	2,730	61,500	3,174	37,200	1,124	72,900
Bauxite ... long tons (2,240 pounds)	311,354	1,812,545	375,301	2,166,236	434,988	2,578,968
Cadmium ... pounds	4,077,961	3,018,000	4,411,530	2,382,000	5,921,488	4,145,000
Chromite ... long tons	812	10,730	3,614	46,892	2,662	28,784
Copper,[5] sales value ... pounds	1,124,656,539	110,216,000	1,425,349,488	148,236,000	1,818,167,516	205,453,000
Ferro-alloys ... long tons	464,112	42,459,513	841,162	76,156,588	1,154,161	128,127,810
Gold [6] ... troy ounces	5,089,811	178,143,400	5,611,171	196,391,000	6,003,105	210,108,700
Iron:						
Ore [4] ... long tons	26,430,910	[4] 74,322,405	54,827,100	[4] 158,537,696	75,198,084	[4] 189,086,799
Pig ... do	18,202,354	356,875,369	32,091,485	626,824,690	41,927,615	840,442,032
Lead (refined),[5] sales value ... short tons	331,964	30,541,000	420,967	39,571,000	433,065	43,307,000
Magnesium (new ingot) ... pounds	4,819,617	(7)	10,650,121	(7)	12,823,633	[8] 3,462,380
Manganese ore (35 percent or more Mn) ... long tons	25,321	681,679	29,307	794,746	40,123	1,169,024
Manganiferous ore (5 to 35 percent Mn) ... do	308,860	858,356	709,247	2,148,321	1,136,547	3,348,042
Mercury:						
Metal ... flasks (76 pounds net)	17,991	1,357,781	18,633	1,936,714	37,777	6,681,618
Ore ... short tons	(9)	(10)	(9)	(10)	(9)	(10)
Molybdenum ... pounds	25,727,000	17,977,000	32,415,000	22,157,000	25,329,000	17,189,000
Nickel ... short tons	416	(7)	394	(7)	554	(7)
Ores (crude), old tailings, etc.:						
Copper ... do	37,871,000	(10)	55,221,000	(10)	69,278,000	(10)
Dry and siliceous (gold and silver) ... do	18,038,000	(10)	19,467,000	(10)	18,700,000	(10)
Lead ... do	4,103,000	(10)	5,387,000	(10)	6,144,000	(10)
Lead-copper ... do	1,000	(10)	8,000	(10)	10,000	(10)
Zinc ... do	7,873,000	(10)	7,576,000	(10)	9,521,000	(10)
Zinc-copper ... do	33,000	(10)	67,000	(10)	79,000	(10)
Zinc-lead ... do	8,944,000	(10)	11,518,000	(10)	12,063,000	(10)
Zinc-lead-copper ... do	—	—	12,000	(10)	765,000	(10)
Platinum metals (refined) (value at New York City) ... troy ounces	36,213	1,263,000	41,441	1,566,000	47,339	1,986,000
Selenium ... pounds	166,494	(7)	345,726	(7)	368,709	(7)
Silver [11] ... troy ounces	62,665,335	40,510,924	65,119,513	44,202,279	69,585,734	49,483,189
Tantalum ore ... pounds	36,189	35,127	340	200	—	—
Tellurium ... do	26,944	(7)	63,431	(7)	88,996	(7)
Tin (metallic equivalent) ... short tons	106	90,000	38	38,400	49	48,900
Titanium ore:						
Ilmenite ... do	(7)	(7)	(7)	(7)	(7)	(7)

Rutile..........do....	(7)	(7)	(7)	(7)	(7)	(7)
Tungsten ore (60-percent concentrates)..........do....	3, 044	3, 161, 498	4, 287	4, 402, 182	5, 319	6, 576, 318
Uranium and vanadium ores..........do....	251, 687	898. 779	279, 354	1, 053, 660	96, 779	1, 029, 800
Zinc,[5] sales value..........do....	436. 007	41, 857, 000	491, 058	51, 070, 000	589, 988	74, 338, 000
Other metallic [12]..........		907, 612		1, 110, 817		1, 215, 368
Total value of metallic products (approximate)..........		892, 600, 000		1, 291, 200, 000		1, 677, 700, 000
NONMETALLIC						
Arsenious oxide..........short tons..	13, 160	393, 022	22, 439	495, 500	23, 339	561, 300
Asbestos..........do....	10, 440	247, 264	15, 459	512, 788	20. 060	674, 508
Asphalt:						
Native..........do....	477, 741	2, 874, 803	459. 848	3, 066, 844	490, 665	2, 725, 337
Oil (including road oil)[4]..........do....	4, 221, 824	[4] 34, 332, 343	4, 860. 540	[4] 36, 038, 696	5, 262, 959	[4] 41, 398, 735
Barite (crude)..........do....	309, 663	2, 004, 521	383, 609	2, 344, 103	409, 353	2, 596, 743
Boron minerals..........do....	215, 662	4, 739. 291	245, 284	5, 689, 797	243, 355	5, 643, 390
Bromine..........pounds..	33, 324, 116	6, 610, 056	37, 882, 005	7, 611, 400	59, 266, 275	11, 772. 515
Calcium-magnesium chloride (75 percent $NaCl_2$)..........short tons..	96, 470	1. 218, 938	108. 441	1, 307, 717	94, 238	1. 485. 784
Cement..........barrels (376 pounds net)..	108, 192, 076	156, 703, 002	125, 056, 594	184, 254, 932	132, 864, 383	193, 464, 869
Clay:						
Products (other than pottery and refractories) [13]..........		88, 798, 513		122, 528, 069		(13)
Raw (sold by producers)..........short tons..	2, 730, 861	11, 775, 572	3, 760, 694	15, 354, 918	4, 700, 951	18, 162, 485
Coal:						
Bituminous [14]..........do....	[15] 348, 544, 764	[16] 678, 653, 000	[15] 393, 065, 000	[17] 728, 234, 000	[15] 453, 245. 000	[16] 861, 166, 000
Pennsylvania anthracite..........do....	46, 099, 027	180, 600, 167	51, 487, 377	187, 175, 000	51, 484, 640	205, 490, 000
Coke [4]..........do....	32, 495, 815	[4] 167, 181, 834	44, 326, 641	[4] 212, 884, 050	57, 072, 134	[4] 273, 832, 410
Diatomite..........do....	(18)	(18)	(18)	(18)	(18)	(18)
Emery..........do....			765	6, 828	1, 046	9, 349
Feldspar (crude)..........long tons..	196, 119	895, 081	253, 466	1, 112, 857	290, 763	1, 271, 995
Fluorspar..........short tons..	80, 403	1, 599, 666	182, 771	3, 704, 959	233, 600	4, 744, 808
Fuller's earth..........do....	170, 852	1, 707, 869	167, 070	1, 691, 855	146, 568	1, 471, 083
Garnet for abrasive purposes..........do....	2, 669	191, 658	4, 056	278, 534	4, 716	259, 345
Gems and precious stones		(19)		(19)		(19)
Graphite:						
Amorphous..........short tons..	(18)	(18)	(18)	(18)	(18)	(18)
Crystalline ....pounds..	(18)	(18)	(18)	(18)		
Grindstones and pulpstones..........short tons..	6, 206	240, 006	10, 434	426, 375	13, 323	496, 448
Gypsum (crude) ....do....	2, 684, 205	4, 271, 674	3, 226, 737	4, 431, 005	3, 699, 015	5, 227, 910
Helium..........cubic feet..	[20] 6, 099, 960	[20] 64, 259	[20] 6, 281, 800	[20] 75, 262	[20] 9, 450, 855	[20] 85, 061
Iodine..........pounds..	(18)	(18)	(18)	(18)	(18)	(18)
Kyanite..........short tons..	(9)	(9)	2, 950	69, 000	4, 241	93, 716
Lime..........do....	3, 346, 954	24, 137, 638	4, 254, 348	30, 049, 394	4, 886, 929	33, 956, 385
Lithium minerals..........do....	892	47, 088	1, 990	97, 000	1, 961	79, 679
Magnesite (crude)..........do....	97, 000	725, 000	198, 980	1, 465, 190	333, 166	2, 487, 969
Magnesium salts (natural) (including brucite)..........pounds..	141, 465, 613	1, 588, 570	171, 508, 000	2, 159, 019	216, 532, 000	2, 452, 814
Marl:						
Calcareous..........short tons..	23, 572	40, 270	22, 114	38, 492	25, 516	42, 481
Greensand..........do....	6, 576	152, 000	6, 466	150, 500	6, 481	209, 938
Mica:						
Scrap..........do....	20, 257	256, 382	24, 672	311, 895	22, 386	314, 565
Sheet..........pounds..	939, 507	139, 333	813, 708	138, 963	1, 625, 437	291, 685

See footnotes at end of table.

Mineral products of the United States, 1938–40—Continued

Product	1938		1939		1940	
	Quantity	Value	Quantity	Value	Quantity	Value
NONMETALLIC—continued						
Millstones		$3,743		$11,084		$6,558
Mineral paints:						
Cadmium compounds [21] ... pounds	[9]	710,000	[9]	1,056,000	[9]	1,256,000
Natural pigments [22] ... short tons	[22]	[22]	[22]	[22]	[22]	[22]
Zinc and lead pigments [23] ... do	123,146	13,969,840	162,774	19,029,802	164,775	19,334,347
Mineral waters ... gallons sold	[19]	[19]	[19]	[19]	[19]	[19]
Natural gas ... M cubic feet	2,295,562,000	500,698,000	2,476,756,000	534,240,000	2,672,000,000	591,509,000
Natural gasoline ... gallons	2,156,574,000	87,266,000	2,169,300,000	90,050,000	2,320,458,000	70,000,000
Oilstones, etc ... short tons	511	130,277	620	115,805	[18]	[18]
Olivine ... do	[9]	[9]	3,000	15,000	2,500	15,000
Peat ... do	45,933	286,127	55,483	362,066	70,097	516,865
Petroleum ... barrels (42 gallons)	1,214,355,000	1,373,060,000	1,264,962,000	1,294,470,000	1,351,847,000	1,352,000,000
Phosphate rock ... long tons	3,739,238	12,952,143	3,757,067	12,294,042	4,002,700	12,334,662
Potassium salts ... short tons	[24] 286,437	9,748,290	[24] 366,287	12,028,195	[24] 393,058	12,562,050
Pumice ... do	65,742	312,886	89,159	424,780	82,407	449,914
Pyrites ... long tons	555,629	1,685,766	516,408	1,550,449	617,513	1,892,000
Salt (sodium chloride) ... short tons	8,025,768	23,242,561	9,277,911	24,509,680	10,003,448	26,118,107
Sand and gravel:						
Glass sand ... do	2,109,462	3,601,734	2,468,290	4,280,936	2,759,544	4,881,508
Sand (molding, building, etc.) and gravel ... do	179,216,771	82,321,113	223,540,000	101,785,000	235,548,000	105,806,000
Sand-lime brick [13] ... thousands of brick	94,978	938,912	137,523	1,411,796	[13]	[13]
Silica (quartz) ... short tons	18,611	88,197	34,959	153,038	31,865	176,390
Slate ... do	492,690	5,655,313	531,380	6,682,214	473,450	5,738,269
Sodium salts (carbonates and sulfates) (natural) ... do	180,220	1,832,140	262,222	2,556,686	317,267	3,157,916
Stone [25] ... do	124,838,940	139,255,046	147,447,130	158,461,515	153,733,040	160,044,115
Sulfur ... long tons	1,628,847	27,300,000	2,233,817	35,500,000	2,558,742	40,900,000
Sulfuric acid (60° Baumé) (byproduct) [26] ... short tons	687,176	5,558,926	778,441	6,213,027	[27]	[27]
Talc, pyrophyllite, and ground soapstone [25] ... do	212,775	2,302,560	253,976	2,700,834	281,375	3,008,320
Tripoli ... do	22,188	329,081	33,474	466,380	30,212	366,569
Vermiculite ... do	20,700	192,000	21,174	174,587	22,209	148,723
Other nonmetallic [28]		1,848,890		2,363,251		2,791,146
Total value of nonmetallic products (approximate)		3,470,600,000		3,623,100,000		3,904,800,000
SUMMARY						
Total value:						
Metallic		892,600,000		1,291,200,000		1,677,700,000
Nonmetallic:						
Fuels		2,820,300,000		2,834,200,000		3,080,200,000
Other		650,300,000		788,900,000		824,600,000
Grand total approximate value of mineral products		4,363,200,000		4,914,300,000		5,582,500,000

[1] In this general statement certain of the figures represent shipments rather than quantity mined, and some of the figures for 1940 are subject to revision. For details see following chapters of this volume.

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

[3] Largely from foreign ore; Bureau of Mines not at liberty to publish figures.

[4] Value not included in total value.

[5] Product from domestic ores only.

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

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

[8] Value calculated at nominal price—27 cents per pound.

[9] Figures not available.

[10] Figures showing values not available.

[11] According to Bureau of the Mint.

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

1938: Bismuth, iron ore sold for magnets (2 long tons), and iron ore sold for paint (9,694 long tons, $44,249).

1939: Bismuth and iron ore sold for paint (12,235 long tons, $66,817).

1940: Beryllium ore (beryl), bismuth, cobalt oxide, and iron ore sold for paint (8,912 long tons, $45,578).

[13] Figures obtained through cooperation with Bureau of the Census. Figures for 1940 not yet available; estimate of value included in total value of nonmetallic products.

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

[15] According to Bituminous Coal Division; figures for 1939 and 1940 are preliminary.

[16] Value is estimated from various sources and includes selling expenses.

[17] Value is estimated from incomplete returns to the Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.

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

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

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

[21] Largely for use in manufacture of pigments. Figures for quantity of pigment not available.

[22] Canvass discontinued after 1915. Figures for iron ore sold for paint given in footnote 12.

[23] Sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide.

[24] Equivalent as K_2O.

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

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

[27] Figures not yet available; estimate of value included in total value of nonmetallic products.

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

1938: Natural sulfonated bitumen, chats (2,836,700 short tons, $414,300), flint lining for tube mills, optical fluorspar (5 ounces, $5), pebbles for grinding, and silica sand and sandstone (ground) (237,167 short tons, $1,425,445).

1939: Andalusite, aplite, natural sulfonated bitumen, calcite (Iceland spar), chats (2,237,200 short tons, $294,200), dumortierite, flint lining for tube mills, optical fluorspar (undetermined quantity, $25), pebbles for grinding, silica sand and sandstone (ground) (310,512 short tons, $1,930,301), and sulfur ore (79 long tons, $743).

1940: Andalusite, aplite, natural sulfonated bitumen, chats (3,725,587 short tons, $557,266), dumortierite, flint lining for tube mills, pebbles for grinding, silica sand and sandstone (ground) (342,218 short tons, $2,088,314), strontium ore, and sulfur ore (280 long tons, $3,203).

the value of domestic clay in its first marketable form results from the inclusion of the value of clay sold by producers and of clay products other than pottery and refractories, the United States and State totals include such values for the clay industries. This change in practice should be borne in mind when comparing the values beginning 1936 with those for earlier years.

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

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

The sum of the State totals on page 18 does not reach the total for the United States given in the table on page 17 partly because figures for certain of the products included in the United States total are not available by States of origin. This fact is brought out in the opening text of this chapter and in the table on pages 19–21.

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

Many other less important differences are involved, but both State and United States totals are as complete and definite as seems possible with the data available. The practice is consistent from year to

Value of mineral products of the United States, 1880–1940 [1]

Year	Metallic	Nonmetallic			Grand total
		Fuels [2]	Other	Total	
1880 [1]	$190, 881, 000	$120, 241, 000	$56, 341, 000	$176, 582, 000	$367, 463, 000
1881	192, 663, 000	149, 798, 000	60, 659, 000	210, 457, 000	403, 120, 000
1882	219, 070, 000	170, 479, 000	63, 557, 000	234, 036, 000	453, 106, 000
1883	201, 131, 000	185, 760, 000	61, 170, 000	246, 930, 000	448, 061, 000
1884	182, 784, 000	165, 825, 000	58, 431, 000	224, 256, 000	407, 040, 000
1885	174, 718, 000	183, 075, 000	61, 758, 000	244, 833, 000	419, 551, 000
1886	204, 795, 000	184, 608, 000	66, 782, 000	251, 390, 000	456, 185, 000
1887	241, 183, 000	217, 251, 000	77, 199, 000	294, 450, 000	535, 633, 000
1888	242, 460, 000	231, 459, 000	79, 880, 000	311, 339, 000	553, 799, 000
1889	250, 823, 000	208, 297, 000	83, 206, 000	291, 503, 000	542, 326, 000
1890	303, 937, 000	230, 962, 000	80, 530, 000	311, 492, 000	615, 429, 000
1891	280, 985, 000	237, 160, 000	82, 704, 000	319, 864, 000	600, 849, 000
1892	284, 215, 000	248, 344, 000	89, 673, 000	338, 017, 000	622, 232, 000
1893	223, 654, 000	251, 735, 000	70, 104, 000	321, 839, 000	545, 493, 000
1894	187, 335, 000	235, 618, 000	127, 292, 000	362, 910, 000	550, 245, 000
1895	248, 533, 000	268, 438, 000	125, 720, 000	394, 158, 000	642, 691, 000
1896	252, 575, 000	268, 161, 000	120, 305, 000	388, 466, 000	641, 041, 000
1897	270, 434, 000	253, 598, 000	127, 580, 000	381, 178, 000	651, 612, 000
1898	308, 747, 000	267, 513, 000	150, 782, 000	418, 295, 000	727, 042, 000
1899	484, 021, 000	340, 773, 000	185, 302, 000	526, 075, 000	1, 010, 096, 000
1900	514, 232, 000	406, 376, 000	188, 328, 000	594, 704, 000	1, 108, 936, 000
1901	493, 814, 000	442, 409, 000	218, 855, 000	661, 264, 000	1, 155, 078, 000
1902	605, 017, 000	469, 079, 000	253, 855, 000	722, 934, 000	1, 327, 951, 000
1903	589, 253, 000	634, 226, 000	271, 902, 000	906, 128, 000	1, 495, 381, 000
1904	501, 314, 000	584, 043, 000	273, 824, 000	857, 867, 000	1, 359, 181, 000
1905	702, 785, 000	602, 258, 000	318, 722, 000	920, 980, 000	1, 623, 765, 000
1906	886, 280, 000	652, 398, 000	362, 202, 000	1, 014, 600, 000	1, 900, 880, 000
1907	904, 151, 000	789, 128, 000	376, 291, 000	1, 165, 419, 000	2, 069, 570, 000
1908	550, 890, 000	716, 034, 000	324, 849, 000	1, 040, 883, 000	1, 591, 773, 000
1909	755, 092, 000	746, 204, 000	385, 811, 000	1, 132, 015, 000	1, 887, 107, 000
1910	750, 027, 000	828, 213, 000	409, 604, 000	1, 237, 817, 000	1, 987, 844, 000
1911	681, 023, 000	835, 763, 000	407, 295, 000	1, 243, 058, 000	1, 924, 081, 000
1912	862, 191, 000	945, 541, 000	430, 062, 000	1, 375, 603, 000	2, 237, 794, 000
1913	879, 058, 000	1, 087, 843, 000	466, 644, 000	1, 554, 487, 000	2, 433, 545, 000
1914	687, 101, 000	992, 837, 000	431, 234, 000	1, 424, 071, 000	2, 111, 172, 000
1915	993, 353, 000	972, 617, 000	428, 674, 000	1, 401, 291, 000	2, 394, 644, 000
1916	1, 622, 129, 000	1, 332, 584, 000	553, 726, 000	1, 886, 310, 000	3, 508, 439, 000
1917	2, 088, 914, 000	2, 237, 837, 000	665, 745, 000	2, 903, 582, 000	4, 992, 496, 000
1918	2, 156, 588, 000	2, 736, 151, 000	647, 969, 000	3, 384, 120, 000	5, 540, 708, 000
1919	1, 361, 099, 000	2, 510, 894, 000	751, 777, 000	3, 262, 671, 000	4, 623, 770, 000
1920	1, 763, 675, 000	4, 192, 910, 000	1, 024, 755, 000	5, 217, 665, 000	6, 981, 340, 000
1921	654, 700, 000	2, 703, 470, 000	780, 330, 000	3, 483, 800, 000	4, 138, 500, 000
1922	988, 100, 000	2, 737, 880, 000	921, 310, 000	3, 659, 190, 000	4, 647, 290, 000
1923	1, 511, 930, 000	3, 317, 100, 000	1, 157, 470, 000	4, 474, 570, 000	5, 986, 500, 000
1924	1, 233, 370, 000	2, 898, 630, 000	1, 173, 800, 000	4, 072, 430, 000	5, 305, 800, 000
1925	1, 382, 155, 000	3, 058, 680, 000	1, 236, 795, 000	4, 295, 475, 000	5, 677, 630, 000
1926	1, 405, 345, 000	3, 541, 916, 000	1, 266, 339, 000	4, 808, 255, 000	6, 213, 600, 000
1927	1, 220, 633, 000	3, 060, 047, 000	1, 249, 320, 000	4, 309, 367, 000	5, 530, 000, 000
1928	1, 288, 290, 000	2, 884, 962, 000	1, 211, 948, 000	4, 096, 910, 000	5, 385, 200, 000
1929	1, 480, 390, 000	3, 190, 527, 000	1, 216, 683, 000	4, 407, 210, 000	5, 887, 600, 000
1930	985, 790, 000	2, 764, 500, 000	1, 014, 510, 000	3, 779, 010, 000	4, 764, 800, 000
1931	569, 790, 000	1, 892, 400, 000	704, 410, 000	2, 596, 810, 000	3, 166, 600, 000
1932	285, 875, 000	1, 743, 400, 000	432, 425, 000	2, 175, 825, 000	2, 461, 700, 000
1933	417, 065, 000	1, 683, 400, 000	454, 635, 000	2, 138, 035, 000	2, 555, 100, 000
1934	548, 934, 000	2, 233, 300, 000	543, 166, 000	2, 776, 466, 000	3, 325, 400, 000
1935	733, 130, 000	2, 330, 000, 000	586, 870, 000	2, 916, 870, 000	3, 650, 000, 000
1936	1, 081, 600, 000	2, 759, 200, 000	716, 000, 000	3, 475, 200, 000	4, 556, 800, 000
1937	1, 468, 200, 000	3, 200, 500, 000	744, 700, 000	3, 945, 200, 000	5, 413, 400, 000
1938	892, 600, 000	2, 820, 300, 000	650, 300, 000	3, 470, 600, 000	4, 363, 200, 000
1939	1, 291, 200, 000	2, 834, 200, 000	788, 900, 000	3, 623, 100, 000	4, 914, 300, 000
1940 [3]	1, 677, 700, 000	3, 080, 200, 000	824, 600, 000	3, 904, 800, 000	5, 582, 500, 000
Grand total	46, 409, 727, 000	83, 869, 052, 000	28, 695, 610, 000	112, 564, 662, 000	158, 974, 389, 000

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

year, and it is believed that the reader can determine readily just what minerals are covered by the total concerned.

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

Value of mineral products of the United States, 1936–39, by States [1]

State	1936	1937	1938	1939
Alabama	$44, 752, 688	$53, 518, 993	$46, 296, 293	$52, 124, 382
Alaska	23, 737, 714	27, 927, 958	28, 796, 753	25, 673, 566
Arizona	60, 532, 996	94, 564, 494	60, 756, 253	75, 056, 965
Arkansas	21, 296, 783	25, 578, 393	29, 395, 086	29, 507, 194
California	437, 565, 809	476, 880, 603	490, 108, 428	467, 612, 196
Colorado	56, 214, 827	67, 338, 548	60, 369, 440	64, 071, 621
Connecticut	3, 317, 494	3, 689, 554	3, 059, 688	4, 306, 351
Delaware	444, 093	397, 362	320, 621	401, 333
District of Columbia	547, 576	522, 687	568, 717	591, 837
Florida	12, 973, 243	13, 811, 958	12, 866, 981	13, 060, 453
Georgia	11, 756, 592	12, 584, 060	11, 598, 421	14, 633, 361
Idaho	29, 965, 964	40, 633, 119	31, 738, 606	33, 138, 635
Illinois	117, 916, 128	133, 437, 554	130, 155, 083	210, 295, 738
Indiana	52, 281, 539	54, 886, 756	47, 892, 364	53, 423, 223
Iowa	28, 359, 140	26, 941, 350	24, 794, 058	25, 483, 936
Kansas	121, 689, 562	154, 376, 403	129, 675, 438	123, 391, 521
Kentucky	113, 435, 307	127, 423, 680	106, 654, 903	113, 243, 154
Louisiana	153, 358, 397	182, 118, 905	172, 306, 761	168, 902, 949
Maine	3, 423, 353	4, 129, 391	3, 548, 638	3, 769, 671
Maryland	11, 157, 550	10, 634, 854	9, 407, 723	11, 837, 593
Massachusetts	7, 559, 253	7, 813, 345	6, 666, 281	8, 179, 860
Michigan	100, 646, 492	119, 167, 573	81, 380, 602	115, 969, 514
Minnesota	94, 568, 991	152, 107, 070	51, 425, 289	106, 427, 607
Mississippi	3, 846, 104	4, 821, 950	5, 209, 547	5, 192, 156
Missouri	41, 350, 860	52, 446, 272	39, 560, 739	45, 619, 104
Montana	65, 569, 150	82, 086, 815	48, 602, 547	63, 354, 645
Nebraska	3, 843, 562	4, 837, 809	4, 028, 712	4, 390, 291
Nevada	32, 693, 129	38, 871, 816	27, 031, 281	34, 670, 879
New Hampshire	1, 182, 055	1, 219, 869	1, 146, 606	1, 187, 339
New Jersey	24, 421, 046	31, 467, 931	24, 408, 545	30, 271, 293
New Mexico	45, 942, 006	72, 855, 745	63, 568, 953	69, 921, 765
New York	71, 647, 775	77, 665, 874	73, 217, 430	78, 383, 851
North Carolina	9, 955, 519	11, 160, 444	14, 959, 228	18, 533, 720
North Dakota	2, 902, 453	2, 873, 011	2, 653, 473	2, 689, 627
Ohio	122, 684, 043	131, 025, 104	104, 812, 531	119, 750, 853
Oklahoma	305, 191, 649	367, 444, 222	272, 860, 078	236, 176, 614
Oregon	7, 080, 975	6, 609, 710	7, 536, 408	8, 636, 440
Pennsylvania	599, 457, 486	599, 817, 364	472, 773, 327	532, 355, 651
Rhode Island	929, 103	862, 710	911, 599	980, 916
South Carolina	3, 432, 662	4, 022, 325	4, 364, 034	5, 422, 979
South Dakota	23, 221, 620	23, 472, 873	23, 583, 359	24, 811, 231
Tennessee	31, 121, 865	34, 893, 847	32, 428, 512	40, 119, 893
Texas	638, 643, 488	813, 290, 605	740, 147, 465	701, 939, 862
Utah	61, 209, 302	105, 652, 422	59, 236, 355	80, 221, 937
Vermont	6, 225, 396	7, 042, 547	6, 439, 552	6, 972, 234
Virginia	37, 295, 168	46, 019, 085	42, 370, 169	43, 582, 537
Washington	22, 921, 456	26, 658, 257	21, 167, 004	31, 590, 023
West Virginia	271, 501, 941	306, 590, 947	254, 995, 309	275, 562, 954
Wisconsin	13, 277, 983	15, 239, 524	10, 636, 741	12, 704, 942
Wyoming	34, 498, 261	41, 087, 908	37, 364, 363	39, 425, 468

[1] In this table iron ore, not pig iron, is taken as the basis of iron valuation, and for other metals mine production (recoverable content of metals) is the basis. State totals for 1940 not yet available.

Mineral products of the United States and principal producing States in 1939

Rank in value	Product	Principal producing States [1]	
		In order of quantity	In order of value
15	Aluminum	New York, Tennessee, North Carolina	Rank same as for quantity.
82	Andalusite	California, Nevada	Do.
(2)	Antimonial lead	Not separable by States	Not separable by States.
87	Antimony ore	Idaho, Alaska, California, Nevada	Idaho, Alaska, Nevada, California.
84	Aplite	Virginia	Rank same as for quantity.
61	Arsenious oxide	Montana, Utah	Do.
60	Asbestos	Vermont, Arizona, Georgia and North Carolina, Maryland	Vermont, Arizona, Maryland, Georgia and North Carolina.
	Asphalt:		
36	Native	Texas, Kentucky, Oklahoma, Alabama	Utah, Kentucky, Oklahoma, Texas.
19	Oil	Not separable by States	Not separable by States.
39	Barite (crude)	Missouri, Georgia, Tennessee, California	Rank same as for quantity.
41	Bauxite	Arkansas, Alabama, Georgia	Do.
56	Bismuth	Not separable by States	Not separable by States.
95	Bitumen (natural sulfonated)	Utah	Rank same as for quantity.
32	Boron minerals	California, Nevada	Do.
29	Bromine	North Carolina, Michigan, California, West Virginia	Do.
38	Cadmium	Not separable by States	Not separable by States.
54	Cadmium compounds	do	Do.
94	Calcite (Iceland spar)	New Mexico	Rank same as for quantity.
52	Calcium-magnesium chloride	Michigan, West Virginia, Ohio	Do.
7	Cement	Pennsylvania, California, Michigan, New York	Pennsylvania, California, Texas, Michigan.
69	Chats	Oklahoma, Missouri, Kansas	Rank same as for quantity.
83	Chromite	California, Oregon	Do.
	Clay:		
11	Products (other than pottery and refractories).		Ohio, Pennsylvania, California, Illinois.
25	Raw (sold by producers)	Pennsylvania, Georgia, Ohio, Missouri	Georgia, Pennsylvania, South Carolina, Missouri.
2	Coal:		
	Bituminous	West Virginia, Pennsylvania, Illinois, Kentucky	Rank same as for quantity.
	Pennsylvania anthracite	Pennsylvania	Do.
5	Coke	Pennsylvania, Ohio, Indiana, New York	Pennsylvania, Indiana, Ohio, New York.
10	Copper	Arizona, Utah, Montana, Nevada	Rank same as for quantity.
49	Diatomite	California, Oregon, Washington, Nevada	California, Oregon, Washington, Massachusetts.
96	Dumortierite	Nevada	Rank same as for quantity.
93	Emery	New York	Do.
53	Feldspar (crude)	North Carolina, South Dakota, New Hampshire, Colorado	North Carolina, New Hampshire, South Dakota, Colorado.
14	Ferro-alloys	Pennsylvania, New York, Ohio, West Virginia	Pennsylvania, New York, West Virginia, Ohio.
91	Flint lining for tube mills	Minnesota	Rank same as for quantity.
35	Fluorspar	Kentucky, Illinois, Colorado, New Mexico	Do.
46	Fuller's earth	Georgia, Texas, Florida, Illinois	Georgia, Florida, Texas, Illinois.
70	Garnet (abrasive)	New York, North Carolina, New Hampshire, Vermont	New York, New Hampshire, North Carolina, Vermont.

See footnotes at end of table.

Mineral products of the United States and principal producing States in 1939—Continued

Rank in value	Product	Principal producing States: In order of quantity	Principal producing States: In order of value
(3)	Gems and precious stones	No canvass for 1939	No canvass for 1939.
6	Gold	California, Alaska, South Dakota, Colorado	Rank same as for quantity.
88	Graphite:		
	Amorphous	Nevada, Georgia	Georgia, Nevada.
	Crystalline	New York	Rank same as for quantity.
65	Grindstones and pulpstones	Ohio, West Virginia, Washington	Do.
33	Gypsum (crude)	New York, Michigan, Iowa, Texas	New York, Michigan, Iowa, Nevada.
80	Helium	Texas	Rank same as for quantity.
67	Iodine (natural)	California	Do.
	Iron:		
8	Ore	Minnesota, Michigan, Alabama, Pennsylvania	Do.
3	Pig	Pennsylvania, Ohio, Indiana, Illinois	Do.
58	Sinter	Tennessee	Do.
81	Kyanite	California, Georgia, Virginia, North Carolina	Georgia, California, North Carolina, Virginia.
18	Lead	Missouri, Idaho, Utah, Oklahoma	Rank same as for quantity.
21	Lime	Ohio, Pennsylvania, Missouri, West Virginia	Do.
78	Lithium minerals	South Dakota, California	California, South Dakota.
50	Magnesite (crude)	Washington, California, Nevada, Vermont	Rank same as for quantity.
40	Magnesium	Michigan	Do.
42	Magnesium salts (natural)	Michigan, Nevada, California, Washington	Michigan, California, Nevada, Washington.
57	Manganese ore	Montana, Tennessee, Arkansas, Georgia	Rank same as for quantity.
43	Manganiferous ore	Minnesota, New Mexico, Colorado, Georgia	Do.
71	Manganiferous zinc residuum	New Jersey	Do.
	Marl:		
85	Calcareous	West Virginia, Virginia, Nevada, Minnesota	Do.
75	Greensand	New Jersey	Do.
44	Mercury	California, Oregon, Idaho, Nevada	Do.
63	Mica	North Carolina, Georgia, Virginia, California	North Carolina, Connecticut, Georgia, Virginia.
	Scrap	do	North Carolina, Georgia, Virginia, South Dakota.
	Sheet	North Carolina, Connecticut, South Dakota, New Hampshire.	Rank same as for quantity.
90	Millstones		North Carolina, New York, Virginia.
24	Mineral paints (zinc and lead pigments)	Pennsylvania, Illinois, Kansas, Indiana	Rank same as for quantity.
(3)	Mineral waters	No canvass for 1939	No canvass for 1939.
23	Molybdenum	Colorado, Utah, New Mexico, Arizona	Rank same as for quantity.
4	Natural gas	Texas, California, Louisiana, Oklahoma	Texas, California, West Virginia, Louisiana.
13	Natural gasoline	Texas, California, Oklahoma, Louisiana	California, Texas, Oklahoma, Louisiana.
72	Nickel	Not separable by States	Not separable by States.
77	Oilstones, etc	Ohio, Arkansas, New Hampshire, Indiana	Arkansas, New Hampshire, Ohio, Indiana.
89	Olivine	North Carolina	Rank same as for quantity.
(4)	Ores (crude), etc.:		
	Copper	Utah, Arizona, Nevada, Michigan	Value not available.
	Dry and siliceous (gold and silver)	California, Alaska, Nevada, South Dakota	Do.

	Lead	Missouri, Idaho, Utah, Montana	Do.
	Lead-copper	Utah, Colorado, New Mexico, Nevada	Do.
	Zinc	Oklahoma, Kansas, Tennessee, New Jersey	Do.
	Zinc-copper	Arizona	Do.
	Zinc-lead	Oklahoma, Kansas, Idaho, Virginia	Do.
	Zinc-lead-copper	Utah	Do.
68	Peat	New York, New Jersey, Michigan, California	New York, New Jersey, Michigan, Maine.
92	Pebbles for grinding	California, Minnesota	Minnesota, California.
1	Petroleum	Texas, California, Oklahoma, Illinois	Rank same as for quantity.
26	Phosphate rock	Florida, Tennessee, Idaho, Montana	Do.
47	Platinum metals	Alaska, California, Oregon	Do.
27	Potassium salts	New Mexico, California. Utah, Maryland	New Mexico, California, Maryland, Utah.
66	Pumice	Kansas, California, Nebraska, New Mexico	California, Kansas, New Mexico, Nebraska.
48	Pyrites	Tennessee, Virginia, New York, California	Rank same as for quantity.
22	Salt	Michigan, New York, Ohio, Louisiana	Michigan, New York, Louisiana, Ohio.
12	Sand and gravel	New York, California, Washington, Michigan	New York, Pennsylvania, California, Ohio.
51	Sand lime brick	New York, New Jersey, Michigan, Minnesota	Rank same as for quantity.
59	Selenium	Not separable by States	Not separable by States.
74	Silica (quartz)	Wisconsin, California, North Carolina, Ohio	California, Wisconsin, North Carolina, New York.
45	Silica sand and sandstone (ground)	Illinois, New Jersey, Ohio, Pennsylvania	New Jersey, Illinois, Ohio, West Virginia.
17	Silver	Idaho, Utah, Montana, Colorado	Rank same as for quantity.
30	Slate		Pennsylvania, Vermont, Virginia, New York.
28	Sodium salts (other than NaCl) (natural)	California, Texas, Wyoming, Utah	Rank same as for quantity.
9	Stone	Pennsylvania, Michigan, Ohio, New York	Pennsylvania, Ohio, New York, Tennessee.
20	Sulfur	Texas, Louisiana, California, Utah	Rank same as for quantity.
31	Sulfuric acid from copper and zinc smelters and roasters and from roasting of high-sulfide gold and silver concentrates.	Pennsylvania, Illinois, Tennessee, Arizona	Pennsylvania, Illinois, Tennessee, Oklahoma.
97	Sulfur ore	Nevada, Colorado	Colorado, Nevada.
37	Talc, pyrophyllite, and ground soapstone [5]	New York, Vermont, North Carolina, California	New York, California, Vermont, North Carolina.
98	Tantalum ore	New Mexico, South Dakota, Wyoming	Rank same as for quantity.
79	Tellurium	Not separable by States	Not separable by States.
86	Tin	Alaska, South Dakota, Montana, New Mexico	Rank same as for quantity.
	Titanium ore:		
76	Ilmenite	Virginia, California	Do.
64	Rutile	Virginia, Arkansas	Do.
62	Tripoli	Missouri, Illinois, Oklahoma, Arkansas	Missouri, Illinois, Arkansas, Oklahoma.
34	Tungsten ore	Nevada, California, Colorado, Idaho	Rank same as for quantity.
55	Uranium and vanadium ores	Arizona, Colorado, Utah	Colorado, Utah, Arizona.
73	Vermiculite	Montana, Colorado, North Carolina, Wyoming	Rank same as for quantity.
16	Zinc	Oklahoma, New Jersey, Kansas, Idaho	Do.

[1] Rank of States in metal production (except aluminum, ferro-alloys, and pig iron) arranged according to mine reports, not smelter output.
[2] Separate figures for antimonial lead from primary sources not available.
[3] No canvass for 1939.
[4] Value not available.
[5] Exclusive of soapstone used as dimension stone (all from Virginia), which is included in figures for stone.

States and their principal mineral products in 1939 [1]

State	Rank	Percent of total value for United States	Principal mineral products in order of value
Alabama	20	1.23	Coal, iron ore, cement, stone.
Alaska	30	.61	Gold, platinum metals, coal, silver.
Arizona	15	1.77	Copper, gold, silver, lead.
Arkansas	29	.70	Petroleum, coal, bauxite, natural gas.
California	3	11.04	Petroleum, natural gas, gold, natural gasoline.
Colorado	17	1.51	Molybdenum, coal, gold, silver.
Connecticut	44	.10	Stone, clay products, sand and gravel, lime.
Delaware	50	.01	Clay products, stone, sand and gravel, raw clay.
District of Columbia	49	.01	Clay products.
Florida	35	.31	Phosphate rock, cement, stone, sand and gravel.
Georgia	34	.35	Stone, raw clay, clay products, cement.
Idaho	26	.78	Silver, lead, zinc, gold.
Illinois	6	4.97	Petroleum, coal, stone, cement.
Indiana	19	1.26	Coal, cement, stone, clay products.
Iowa	31	.60	Cement, coal, stone, clay products.
Kansas	8	2.91	Petroleum, natural gas, zinc, cement.
Kentucky	11	2.67	Coal, natural gas, petroleum, stone.
Louisiana	7	3.99	Petroleum, natural gas, sulfur, natural gasoline.
Maine	45	.09	Stone, sand and gravel, cement, clay products.
Maryland	37	.28	Coal, sand and gravel, cement, clay products.
Massachusetts	39	.19	Stone, sand and gravel, lime, clay products.
Michigan	10	2.74	Iron ore, petroleum, cement, copper.
Minnesota	12	2.51	Iron ore, stone, sand and gravel, manganiferous ore.
Mississippi	42	.12	Natural gas, sand and gravel, clay products, raw clay.
Missouri	21	1.08	Lead, cement, coal, stone.
Montana	18	1.50	Copper, gold, natural gas, silver.
Nebraska	43	.10	Cement, sand and gravel, stone, clay products.
Nevada	25	.82	Copper, gold, silver, tungsten ore.
New Hampshire	47	.03	Stone, clay products, sand and gravel, feldspar.
New Jersey	28	.71	Zinc, clay products, sand and gravel, stone.
New Mexico	16	1.65	Petroleum, copper, natural gas, potassium salts.
New York	14	1.85	Natural gas, cement, petroleum, stone.
North Carolina	33	.44	Stone, clay products, bromine, sand and gravel.
North Dakota	46	.06	Coal, sand and gravel, clay products, natural gas.
Ohio	9	2.83	Coal, clay products, natural gas, stone.
Oklahoma	5	5.58	Petroleum, natural gas, natural gasoline, zinc.
Oregon	38	.20	Gold, stone, cement, sand and gravel.
Pennsylvania	2	12.57	Coal, petroleum, natural gas, cement.
Rhode Island	48	.02	Stone, sand and gravel, clay products, lime.
South Carolina	41	.13	Stone, clay products, raw clay, gold.
South Dakota	32	.59	Gold, stone, cement, sand and gravel.
Tennessee	23	.95	Coal, stone, cement, phosphate rock.
Texas	1	16.57	Petroleum, natural gas, sulfur, natural gasoline.
Utah	13	1.89	Copper, gold, silver, coal.
Vermont	40	.16	Stone, slate, lime, asbestos.
Virginia	22	1.03	Coal, stone, clay products, cement.
Washington	27	.75	Cement, sand and gravel, coal, gold.
West Virginia	4	6.51	Coal, natural gas, petroleum, stone.
Wisconsin	36	.30	Stone, iron ore, sand and gravel, cement.
Wyoming	24	.93	Petroleum, coal, natural gas, natural gasoline.

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

Prices of gold, silver, copper, lead, and zinc, 1932–40 [1]

Year	Gold [2]	Silver [3]	Copper [4]	Lead [4]	Zinc [4]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1932	[5] $20.67+	$0.282	$0.063	$0.030	$0.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[6] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[6] .646+	.098	.046	.048
1939	35.00	[7] .678+	.104	.047	.052
1940	35.00	[8] .711+	.113	.050	.063

[1] Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+ per fine ounce. For table of prices for silver, copper, lead, and zinc from 1850 to 1931, by years, see Mineral Resources, 1931, pt. 1, p. A115.
[2] 1932: Legal coinage value; 1933–34: Yearly average weighted Government price; 1935–40: Price under authority of Gold Reserve Act of January 31, 1934.
[3] 1932–33: Average New York price for bar silver; 1934 and 1938–40: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.
[4] Yearly average weighted price of all grades of primary metal sold by producers.
[5] $20.671835. [6] $0.64646464. [7] $0.67878787. [8] $0.71111111.

STATE TABLES

Mineral production of Alabama, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Asphalt (native) short tons	(1)	(1)	(1)	(1)
Barite do			(1)	(1)
Bauxite long tons	(1)	(1)	(1)	(1)
Cement barrels	[2] 4,548,079	[2] $6,114,246	[2] 5,042,921	[2] $6,690,765
Clay:				
Products (other than pottery and refractories)		[3] 1,487,067		[3] 2,306,712
Raw (sold by producers) short tons	25,871	41,885	51,015	83,933
Coal do	[4] 11,061,493	[5] 26,769,000	[4] 11,995,000	[6] 27,708,000
Coke do	3,378,044	[7] 9,888,292	3,854,505	[7] 10,917,559
Ferro-alloys long tons	19,446	[7] 1,707,736	28,071	[7] 1,802,917
Gold troy ounces	41	1,435	3	105
Iron:				
Ore long tons	4,281,332	7,341,620	5,985,208	9,971,024
Pig do	1,990,342	[7] 29,190,091	2,717,502	[7] 43,902,681
Lime short tons	151,937	911,033	176,513	1,004,785
Manganese ore long tons	202	3,030	187	3,742
Manganiferous ore do	356	2,797	519	4,561
Mineral waters gallons sold	(8)	(8)	(8)	(8)
Ore (dry and siliceous) (gold and silver) short tons	300	(9)	10	(9)
Sand and gravel do	3,110,183	782,131	1,283,577	687,265
Silver troy ounces	4	3		
Stone short tons	1,326,160	1,809,379	1,855,990	2,516,584
Miscellaneous [10]		1,032,667		1,146,906
Total value, eliminating duplications		46,296,293		52,124,382

[1] Value included under "Miscellaneous."
[2] Exclusive of puzzolan, value for which is included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] According to Bituminous Coal Division; figures for 1939 are preliminary.
[5] Value is estimated from various sources and includes selling expenses.
[6] Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
[7] Value not included in total value for State.
[8] No canvass.
[9] Not valued as ore; value of recoverable metal content included under the metals.
[10] Includes minerals indicated by "1" and "2" above.

Mineral production of Alaska, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Antimony ore (concentrates) short tons	(1)	(1)	(1)	(1)
Arsenic do	(2)	(2)	(2)	(2)
Coal do	[3] 159,230	[3] $620,900	[3] 146,250	[3] $585,000
Copper pounds	29,098,000	2,851,604	256,000	26,624
Gold troy ounces	664,973	23,274,055	676,737	23,685,795
Lead short tons	994	91,448	937	88,078
Mercury flasks (76 pounds)	8	604		
Ores (crude), etc.:				
Copper short tons	89,174	( )	165	(4)
Dry and siliceous (gold and silver) do	4,767,545	(4)	4,751,492	(4)
Platinum metals (crude) troy ounces	39,889	1,229,300	31,300	997,000
Sand and gravel short tons	(1)	(1)	[5] 42,332	[5] 23,112
Silver troy ounces	479,853	310,208	201,054	136,473
Stone short tons	189,090	204,232	(1)	(1)
Tin (metallic equivalent) do	105	89,100	37	37,300
Miscellaneous [6]		125,302		94,184
Total value, eliminating duplications		28,796,753		25,673,566

[1] Value included under "Miscellaneous."
[2] Figures not available.
[3] According to the Alaskan Branch of the Geological Survey.
[4] Not valued as ore; value of recoverable metal content included under the metals.
[5] "Government-and-contractor." Value of "Commercial" included under "Miscellaneous."
[6] Includes minerals indicated by "1" and "5" above.

Mineral production of Arizona, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Arsenious oxide short tons	(1)	(1)	(1)	(1)
Asbestos do	942	$31,063	904	$95,807
Barite do	(2)	(2)	(2)	(2)
Clay:				
Products (other than pottery and refractories)		[3] 180,305		[3] 237,542
Raw (sold by producers) short tons	(2)	(2)	(2)	(2)
Coal do	(2 4)	(2 5)	(2 4)	(2 6)
Copper pounds	421,594,000	41,316,212	524,224,000	54,519,296
Feldspar (crude) long tons	(2)	(2)	(2)	(2)
Fluorspar short tons	1,093	(2)	(2)	(2)
Gems and precious stones		(7)		(7)
Gold troy ounces	305,043	10,676,505	316,453	11,075,855
Gypsum (crude) short tons			(2)	(2)
Lead do	10,571	972,532	10,771	1,012,474
Lime do	39,568	353,224	57,233	448,860
Mercury flasks (76 pounds)			(2)	(2)
Mica, scrap short tons	(2)	(2)	(2)	(2)
Molybdenum pounds	1,061,995	(2)	711,192	(2)
Ores (crude), etc.:				
Copper short tons	13,047,356	(8)	17,468,926	(8)
Dry and siliceous (gold and silver) do	928,707	(8)	1,042,004	(8)
Lead do	6,072	(8)	9,778	(8)
Lead-copper do	201	(8)	30	(8)
Zinc do	160	(8)	670	(8)
Zinc-copper do	32,974	(8)	67,074	(8)
Zinc-lead do	187,694	(8)	204,778	(8)
Sand and gravel do	1,184,965	549,294	655,155	261,316
Sand-lime brick thousands of brick	(2 3)	(2 3)	(2 3)	(2 3)
Silica (quartz) short tons	(2)	(2)	(2)	(2)
Silver troy ounces	7,479,153	4,835,008	7,824,004	5,310,839
Stone short tons	431,310	337,078	665,290	626,281
Sulfuric acid [9] do	(2 10)	(2 10)	(2 10)	(2 10)
Tungsten ore (60-percent concentrates) do	37	30,863	100	103,980
Vanadium ores do	165,465	(2)	(2)	(2)
Zinc do	5,814	558,144	6,711	697,944
Miscellaneous [11]		1,406,991		1,152,950
Total value, eliminating duplications		60,756,253		75,056,965

[1] Figures not available.
[2] Value included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] According to Bituminous Coal Division; figures for 1939 are preliminary.
[5] Value is estimated from various sources and includes selling expenses.
[6] Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
[7] No canvass.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] From copper smelting.
[10] Value not included in total value for State.
[11] Includes minerals indicated by "[2]" above.

Mineral production of Arkansas, 1938–39

Product	1938 Quantity	1938 Value	1939 Quantity	1939 Value
Bauxite ... long tons	293,280	$1,679,663	361,256	$2,074,954
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] 656,637		[2] 944,661
Raw (sold by producers) ... short tons	(1)	(1)	(1)	(1)
Coal ... do	[3] 1,197,047	[4] 4,013,000	[3] 1,122,000	[5] 3,590,000
Gems and precious stones		(6)		(6)
Iron ore sold for magnets ... long tons	2	(1)		
Lead ... short tons	7	644		
Lime ... do	(1)	(1)	(1)	(1)
Manganese ore ... long tons	2,987	(1)	5,365	(1)
Manganiferous ore ... do	3,477	(1)	1,970	(1)
Mercury ... flasks (76 pounds)	(1)	(1)	364	37,834
Mineral waters ... gallons sold	(6)	(6)	(6)	(6)
Natural gas ... M cubic feet	11,301,000	2,168,000	10,107,000	1,996,000
Natural gasoline ... gallons	25,648,000	905,000	24,634,000	962,000
Oilstones ... short tons	41	43,777	(1)	(1)
Ores (crude), etc.:				
Lead ... do	(7)	(8)	(7)	(8)
Zinc ... do	(7)	(8)	(7)	(8)
Petroleum ... barrels	18,180,000	16,900,000	21,238,000	16,790,000
Sand and gravel ... short tons	1,697,600	779,219	2,646,793	1,030,270
Slate		(1)		(1)
Stone ... short tons	[9] 308,760	[9] 293,497	641,460	640,330
Titanium minerals: Rutile ... do	(1)	(1)	(1)	(1)
Tripoli ... do	(1)	(1)	(1)	(1)
Zinc ... do	152	14,592	123	12,792
Miscellaneous [10]		1,941,057		1,428,353
Total value, eliminating duplications		29,395,086		29,507,194

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division; figures for 1939 are preliminary.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
[6] No canvass.
[7] Figures not available.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[10] Includes minerals indicated by "1" and "9" above.

Mineral production of California, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Andalusite .... short tons..	(1)	(1)	(2)	(2)
Antimony ore (concentrates) .... do....	(2)	(2)	(2)	(2)
Arsenious oxide .... do....	(1)	(1)	(1)	(1)
Asphalt (native) .... do....	(2)	(2)	(2)	(2)
Barite .... do....	(2)	(2)	(2)	(2)
Boron minerals .... do....	215, 662	$4, 739, 291	244, 984	$5, 685, 297
Bromine .... pounds..	(2)	(2)	(2)	(2)
Cement .... barrels..	10, 539, 010	15, 689, 210	11, 293, 989	15, 889, 395
Chromite .... long tons..	812	10, 730	3, 514	(2)
Clay:				
Products (other than pottery and refractories)...	------------	[3] 6, 636, 860	------------	[3] 8, 304, 038
Raw (sold by producers) .... short tons..	307, 122	966, 438	310, 710	894, 809
Copper .... pounds..	1, 612, 000	157, 976	8, 360, 000	869, 440
Diatomite .... short tons..	(2)	(2)	(2)	(2)
Feldspar (crude) .... long tons..	1, 396	7, 675	2, 076	12, 655
Fuller's earth .... short tons..	(2)	(2)	(2)	(2)
Gems and precious stones	------------	(4)	------------	(4)
Gold .... troy ounces..	1, 311, 129	45, 889, 515	1, 435, 264	50, 234, 240
Gypsum (crude) .... short tons..	162, 056	334, 208	188, 364	306, 350
Iodine .... pounds..	(2)	(2)	(2)	(2)
Iron ore—				
Sold to furnaces, etc .... long tons..	28, 378	(2)	17, 173	(2)
Sold for paint .... do....	(2)	(2)	------------	------------
Kyanite .... short tons..	(1)	(1)	(2)	(2)
Lead .... do....	495	45, 540	526	49, 444
Lime .... do....	71, 596	712, 388	87, 407	833, 326
Lithium minerals .... do....	(2)	(2)	(2)	(2)
Magnesite .... do....	(2)	(2)	(2)	(2)
Magnesium salts (natural) .... pounds..	(2)	(2)	(2)	(2)
Manganese ore .... long tons..	------------	------------	6	(2)
Marl, calcareous .... short tons..	(2)	(2)	(2)	(2)
Mercury .... flasks (76 pounds)..	12, 277	926, 545	11, 127	1, 156, 540
Mica, scrap .... short tons..	(2)	(2)	(2)	(2)
Mineral paints (zinc and lead pigments) .... do....	(2 5)	(2 5)	(2 5)	(2 5)
Mineral waters .... gallons sold..	(4)	(4)	(4)	(4)
Molybdenum .... pounds..	------------	------------	(2)	(2)
Natural gas .... M cubic feet..	315, 168, 000	88, 225, 000	348, 361, 000	91, 572, 000
Natural gasoline .... gallons..	660, 890, 000	41, 085, 000	607, 237, 000	35, 454, 000
Ores (crude), etc.:				
Copper .... short tons..	66, 943	(6)	367, 477	(6)
Dry and siliceous (gold and silver) .... do....	4, 580, 462	(6)	5, 209, 637	(6)
Lead .... do....	844	(6)	706	(6)
Zinc-lead .... do....	------------	------------	33	(6)
Peat .... do....	4, 385	25, 192	4, 199	22, 240
Pebbles for grinding .... do....	(2)	(2)	(2)	(2)
Petroleum .... barrels..	249, 749, 000	257, 250, 000	224, 354, 000	229, 000, 000
Platinum metals (crude) .... troy ounces..	1, 000	(2)	1, 140	(2)
Potassium salts .... short tons..	(2)	(2)	(2)	(2)
Pumice .... do....	18, 584	106, 724	36, 216	144, 772
Pyrites .... long tons..	(2)	(2)	(2)	(2)
Salt (sodium chloride) .... short tons..	349, 856	1, 940, 449	404, 689	1, 980, 777
Sand and gravel .... do....	11, 895, 272	7, 577, 587	13, 661, 406	6, 711, 214
Sand and sandstone (ground) .... do....	(2)	(2)	(2)	(2)
Silica (quartz) .... do....	1, 494	20, 809	(2)	(2)
Silver .... troy ounces..	2, 590, 804	1, 674, 863	2, 599, 139	1, 764, 264
Slate	------------	27, 877	------------	(2)
Sodium salts (carbonates and sulfates) (natural) short tons..	149, 060	1, 514, 400	209, 398	1, 988, 929
Stone .... do....	7, 634, 260	6, 632, 719	5, 734, 100	4, 673, 751
Sulfur .... long tons..	(2)	(2)	(2)	(2)
Sulfuric acid [7] .... short tons..	(2 5)	(2 5)	(2 5)	(2 5)
Talc, pyrophyllite, and ground soapstone .... do....	30, 059	391, 456	33, 796	483, 839
Titanium ore: Ilmenite .... do....	------------	------------	(2)	(2)
Tripoli .... do....	(2)	(2)	(2)	(2)
Tungsten ore (60-percent concentrates) .... do....	839	878, 072	1, 263	1, 140, 597
Zinc .... do....	------------	------------	6	624
Miscellaneous [8]	------------	6, 772, 471	------------	8, 589, 243
Total value, eliminating duplications	------------	490, 108, 428	------------	467, 612, 196

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

Mineral production of Colorado, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Arsenious oxide ..... short tons	(1)	(1)	(1)	(1)
Barite ..... do	-----	-----	(2)	(2)
Cement ..... barrels	(2)	(2)	(2)	(2)
Clay:				
Products (other than pottery and refractories)	-----	[3] $1,170,874	-----	[3] $1,687,568
Raw (sold by producers) ..... short tons	102,817	114,927	128,391	150,803
Coal ..... do	[4] 5,663,144	[5] 14,828,000	[4] 5,890,000	[6] 14,548,000
Coke ..... do	241,526	(2 7)	454,869	(2 7)
Copper ..... pounds	28,342,000	2,777,516	26,430,000	2,748,720
Feldspar (crude) ..... long tons	27,452	104,673	29,995	107,536
Ferro-alloys ..... do	(2 7)	(2 7)	(2 7)	(2 7)
Fluorspar ..... short tons	1,704	(2)	7,569	107,459
Fuller's earth ..... do	(2)	(2)	(2)	(2)
Gems and precious stones	-----	(8)	-----	(8)
Gold ..... troy ounces	367,468	12,861,380	366,852	12,839,820
Gypsum (crude) ..... short tons	21,591	41,080	24,013	40,694
Iron, pig ..... long tons	(2 7)	(2 7)	(2 7)	(2 7)
Lead ..... short tons	9,455	869,860	8,222	772,868
Lime ..... do	9,564	95,207	10,699	103,097
Manganiferous ore ..... long tons	655	(2)	7,516	(2)
Mica, scrap ..... short tons	870	9,842	(2)	(2)
Mineral waters ..... gallons sold	(8)	(8)	(8)	(8)
Molybdenum ..... pounds	20,763,884	(2)	25,437,893	(2)
Natural gas ..... M cubic feet	1,904,000	464,000	2,015,000	467,000
Natural gasoline ..... gallons	386,000	10,000	390,000	13,000
Ores (crude), etc.:				
Copper ..... short tons	333,103	(9)	342,499	(9)
Dry and siliceous (gold and silver) ..... do	1,528,658	(9)	1,542,235	(9)
Lead ..... do	19,646	(9)	14,700	(9)
Lead-copper ..... do	37	(9)	1,464	(9)
Zinc ..... do	145	(9)	344	(9)
Zinc-lead ..... do	114,506	(9)	13,351	(9)
Peat ..... do	(2)	(2)	(2)	(2)
Petroleum ..... barrels	1,412,000	1,540,000	1,404,000	1,330,000
Pyrites ..... long tons	(2)	(2)	(2)	(2)
Salt ..... short tons	(2)	(2)	(2)	(2)
Sand and gravel ..... do	3,841,759	1,432,975	[10] 627,306	[10] 361,747
Silver ..... troy ounces	7,932,095	5,127,819	8,496,488	5,767,313
Stone ..... short tons	897,270	1,051,333	900,460	1,040,579
Sulfur ore ..... long tons	-----	-----	36	400
Tungsten ore (60-percent concentrates) ..... short tons	240	(2)	479	488,628
Uranium and vanadium ores ..... do	(2)	(2)	85,225	(2)
Vermiculite ..... do	(2)	(2)	(2)	(2)
Zinc ..... do	4,553	437,088	1,830	190,320
Miscellaneous [11]	-----	21,266,795	-----	29,191,896
Total value, eliminating duplications	-----	60,369,440	-----	64,071,621

[1] Figures not available.
[2] Value included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] According to Bituminous Coal Division; figures for 1939 are preliminary.
[5] Value is estimated from various sources and includes selling expenses.
[6] Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
[7] Value not included in total value for State.
[8] No canvass.
[9] Not valued as ore; value of recoverable metal content included under the metals.
[10] "Commercial." Value of "Government-and-contractor" included under "Miscellaneous."
[11] Includes minerals indicated by "2" and "10" above.

Mineral production of Connecticut, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories)		(1 2)		2 $1,257,049
Raw (sold by producers)...short tons	3,381	$6,199	(1)	(1)
Coke...do	(1 3)	(1 3)	(1 3)	(1 3)
Feldspar (crude)...long tons	7,461	45,153	10,033	53,120
Lime...short tons	(1)	(1)	(1)	(1)
Mica:				
Scrap...do	(1)	(1)	(1)	(1)
Sheet...pounds	(1)	(1)	(1)	(1)
Mineral waters...gallons sold	(4)	(4)	(4)	(4)
Peat...short tons			(1)	(1)
Sand and gravel...do	1,376,963	522,777	1,988,933	773,163
Stone...do	1,529,730	1,731,707	1,816,650	2,077,366
Miscellaneous [5]		3,819,281		3,116,255
Total value, eliminating duplications		3,059,688		4,306,351

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

Mineral production of Delaware, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories)		1 $128,295		1 $185,632
Raw (sold by producers)...short tons	(2)	(2)	(2)	(2)
Sand and gravel...do	108,875	63,366	102,850	61,556
Stone...do	(2)	(2)	(2)	(2)
Miscellaneous [3]		128,960		154,145
Total value, eliminating duplications		320,621		401,333

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

Mineral production of the District of Columbia, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Clay products (other than pottery and refractories)		(1 2)		(1 2)
Stone...short tons	(1)	(1)		
Miscellaneous		$568,717		$591,837
Total value, eliminating duplications		568,717		591,837

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

Mineral production of Florida, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Cement barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		(1 2)		[2] $193,110
Raw (sold by producers) short tons	(1)	(1)	(1)	(1)
Diatomite do	(1)	(1)	(1)	(1)
Ferro-alloys long tons			(1 3)	(1 3)
Fuller's earth short tons	(1)	(1)	(1)	(1)
Lime do	19,638	$185,286	22,843	215,472
Mineral waters gallons sold	(4)	(4)	(4)	(4)
Peat short tons	(1)	(1)	(1)	(1)
Phosphate rock long tons	2,707,335	8,773,680	2,678,784	7,893,457
Sand and gravel short tons	996,681	672,106	1,015,139	779,708
Stone do	[5] 1,349,160	[5] 1,223,438	[5] 1,444,100	[5] 1,462,730
Miscellaneous [6]		2,012,471		2,517,786
Total value, eliminating duplications		12,866,981		13,060,453

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

Mineral production of Georgia, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Asbestos short tons			(1)	(1)
Barite do	64,304	$315,329	86,589	$438,378
Bauxite long tons	(1)	(1)	(1)	(1)
Cement barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] 1,980,943		[2] 2,375,225
Raw (sold by producers) short tons	434,632	3,339,918	534,214	4,162,127
Coal do	(1 3)	(1 4)	(1 3)	(1 5)
Copper pounds	70	7		
Fuller's earth short tons	(1)	(1)	(1)	(1)
Gems and precious stones		(6)		(6)
Gold troy ounces	872	30,520	670	23,450
Graphite:				
Amorphous short tons			(1)	(1)
Crystalline pounds	(1)	(1)		
Iron ore—				
Shipped to furnaces, etc long tons	9,221	11,375	25,846	51,078
Sold for paint do			487	2,063
Kyanite short tons	(7)	(7)	(1)	(1)
Lime do	7,046	54,150	6,815	57,663
Manganese ore long tons	3,058	46,443	2,646	45,171
Manganiferous ore do	2,807	12,057	7,156	35,959
Mica:				
Scrap short tons	(1)	(1)	(1)	(1)
Sheet pounds	(1)	(1)	(1)	(1)
Mineral waters gallons sold	(6)	(6)	(6)	(6)
Ore (dry and siliceous) (gold and silver) short tons	841	(8)	730	(8)
Sand and gravel do	395,758	207,048	328,173	146,355
Silver troy ounces	71	46	58	39
Slate		(1)		(1)
Stone short tons	1,465,680	3,581,319	1,988,530	4,838,623
Talc and ground soapstone do	15,117	130,595	20,090	177,881
Miscellaneous [9]		1,888,671		2,279,349
Total value, eliminating duplications		11,598,421		14,633,361

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division; figures for 1939 are preliminary.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
[6] No canvass.
[7] Figures not available.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Includes minerals indicated by "1" above.

Mineral production of Idaho, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Antimony ore (concentrates) short tons	(1)	(1)	2,677	(1)
Arsenious oxide do	(1)	(1)	(2)	(2)
Bismuth pounds	(2)	(2)	(2)	(2)
Cement barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)	----------	[3] $127,516	----------	[3] $102,071
Raw (sold by producers) short tons	(1)	(1)	(1)	(1)
Coal do	(1 4)	(1 5)	(1 4)	(1 6)
Copper pounds	4,278,000	419,244	5,032,000	523,328
Diatomite short tons	(1)	(1)	(1)	(1)
Gems and precious stones	----------	(7)	----------	(7)
Gold troy ounces	103,513	3,622,955	116,662	4,083,170
Gypsum (crude) short tons	(1)	(1)	----------	----------
Lead do	92,177	8,480,284	90,981	8,552,214
Lime do	(1)	(1)	(1)	(1)
Manganiferous ore long tons	----------	----------	163	(1)
Mercury flasks (76 pounds)	----------	----------	(1)	(1)
Ores (crude), etc.:				
Copper short tons	165	(8)	1,416	(8)
Dry and siliceous (gold and silver) do	743,332	(8)	784,426	(8)
Lead do	272,904	(8)	125,964	(8)
Zinc do	----------	----------	144	(8)
Zinc-lead do	982,746	(8)	1,196,495	(8)
Phosphate rock long tons	66,014	296,595	95,451	431,938
Sand and gravel short tons	1,968,068	721,357	1,617,856	622,240
Silver troy ounces	18,993,676	12,278,740	17,222,370	11,690,336
Stone short tons	1,047,980	795,896	1,863,350	1,238,735
Tungsten ore (60-percent concentrates) do	154	(1)	228	(1)
Zinc do	44,030	4,226,880	47,549	4,945,096
Miscellaneous [9]	----------	769,139	----------	949,507
Total value, eliminating duplications	----------	31,738,606	----------	33,138,635

[1] Value included under "Miscellaneous."
[2] Figures not available.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] According to Bituminous Coal Division; figures for 1939 are preliminary.
[5] Value is estimated from various sources and includes selling expenses.
[6] Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
[7] No canvass.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Includes minerals indicated by "1" above.

Mineral production of Illinois, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Cement ... barrels	[1] 4,357,119	[1] $5,993,644	[1] 4,801,292	[1] $7,056,746
Clay:				
Products (other than pottery and refractories)	-----	[2] 5,491,268	-----	[2] 7,107,144
Raw (sold by producers) ... short tons	94,770	226,617	126,611	271,737
Coal ... do	[3] 41,912,085	[4] 71,837,000	[3] 46,450,000	[5] 76,178,000
Coke ... do	1,734,511	[6] 11,706,788	1,884,240	[6] 11,963,932
Fluorspar ... do	35,368	751,227	75,257	1,638,693
Fluorspar, optical ... ounces	5	5	(7)	25
Fuller's earth ... short tons	(8)	(8)	(8)	(8)
Iron, pig ... long tons	1,519,572	[6] 30,899,012	2,860,577	[6] 57,718,814
Lead ... short tons	175	16,100	308	28,952
Lime ... do	135,256	965,836	147,729	1,064,154
Mineral paints (zinc and lead pigments) ... do	(6 8)	(6 8)	(6 8)	(6 8)
Mineral waters ... gallons sold	(9)	(9)	(9)	(9)
Natural gas ... M cubic feet	1,169,000	616,000	2,746,000	1,450,000
Natural gasoline ... gallons	2,436,000	124,000	4,012,000	229,000
Ore (lead and zinc) ... short tons	(10)	(10)	(10)	(10)
Petroleum ... barrels	24,075,000	30,100,000	94,912,000	101,200,000
Pyrites ... long tons	(8)	(8)	13,950	(8)
Sand and gravel ... short tons	12,538,469	5,648,601	[11] 8,755,193	[11] 4,686,487
Sand and sandstone (ground) ... do	66,583	418,881	91,645	543,761
Sand-lime brick ... thousands of brick	-----	-----	(2 8)	(2 8)
Silver ... troy ounces	576	372	675	458
Stone ... short tons	[12] 8,528,440	[12] 7,335,844	8,420,120	7,820,589
Sulfuric acid (60° Baumé) [13] ... do	143,343	[6] 1,305,855	178,144	[6] 1,605,077
Tripoli ... do	8,141	117,107	11,134	148,310
Zinc ... do	-----	-----	334	34,736
Miscellaneous [14]	-----	2,754,664	-----	3,712,410
Total value, eliminating duplications	-----	130,155,083	-----	210,295,738

[1] Exclusive of natural cement, value for which is included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division; figures for 1939 are preliminary.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
[6] Value not included in total value for State.
[7] Quantity undetermined.
[8] Value included under "Miscellaneous."
[9] No canvass.
[10] No ore milled in northern Illinois; lead output of southern Illinois is byproduct of fluorspar milling.
[11] "Commercial." Value of "Government-and-contractor" included under "Miscellaneous."
[12] Exclusive of sandstone, value for which is included under "Miscellaneous."
[13] From zinc smelting.
[14] Includes minerals indicated by "[1]", "[8]", "[11]", and "[12]" above.

Mineral production of Indiana, 1938–39

Product	1938 Quantity	1938 Value	1939 Quantity	1939 Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		2 $4,088,658		2 $5,629,014
Raw (sold by producers) ... short tons	16,941	31,864	57,795	79,693
Coal ... do	3 14,758,484	4 23,968,000	3 16,650,000	5 24,642,000
Coke ... do	2,904,779	6 18,278,201	4,878,033	6 28,532,944
Gold ... troy ounces			4	140
Iron, pig ... long tons	1,807,808	6 37,025,980	3,375,325	6 68,164,618
Lime ... short tons	102,054	581,922	94,741	534,688
Mineral paints (zinc and lead pigments) ... do	(1 6)	(1 6)	(1 6)	(1 6)
Mineral waters ... gallons sold	(7)	(7)	(7)	(7)
Natural gas ... M cubic feet	1,299,000	734,000	791,000	452,000
Petroleum ... barrels	995,000	1,260,000	1,711,000	1,675,000
Pyrites ... long tons			4,403	(1)
Rubbing stones and whetstones ... short tons	53	9,007	(1)	(1)
Sand and gravel ... do	5,479,548	2,958,473	6,249,169	3,388,297
Sand-lime brick ... thousands of brick	(1 2)	(1 2)	(1 2)	(1 2)
Stone ... short tons	8 3,782,410	8 6,486,996	8 4,338,690	8 7,469,659
Miscellaneous 9		9,304,405		11,983,873
Total value, eliminating duplications		47,892,364		53,423,223

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 According to Bituminous Coal Division; figures for 1939 are preliminary.
4 Value is estimated from various sources and includes selling expenses.
5 Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
6 Value not included in total value for State.
7 No canvass.
8 Exclusive of dimension sandstone, value for which is included under "Miscellaneous."
9 Includes minerals indicated by "1" and "8" above.

Mineral production of Iowa, 1938–39

Product	1938 Quantity	1938 Value	1939 Quantity	1939 Value
Cement ... barrels	4,759,390	$7,327,048	4,717,295	$7,771,503
Clay:				
Products (other than pottery and refractories)		1 2,868,233		1 3,698,611
Raw (sold by producers) ... short tons	6,828	45,759	5,615	50,939
Coal ... do	2 3,103,187	3 7,963,000	2 3,050,000	4 7,503,000
Ferro-alloys ... long tons	(5 6)	(5 6)	(5 6)	(5 6)
Gypsum (crude) ... short tons	364,920	495,856	430,712	510,120
Iron, pig ... long tons	(5 6)	(5 6)	(5 6)	(5 6)
Mineral waters ... gallons sold	(7)	(7)	(7)	(7)
Peat ... short tons	(5)	(5)	(5)	(5)
Sand and gravel ... do	6,994,246	2,299,682	8 2,503,988	8 1,299,449
Stone ... do	3,369,750	3,782,480	6,400,590	4,385,234
Miscellaneous 9		1,142,004		2,176,129
Total value, eliminating duplications		24,794,058		25,483,936

1 Figures obtained through cooperation with Bureau of the Census.
2 According to Bituminous Coal Division; figures for 1939 are preliminary.
3 Value estimated from various sources and includes selling expenses.
4 Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
5 Value included under "Miscellaneous."
6 Value not included in total value for State.
7 No canvass.
8 "Commercial." Value of "Government-and-contractor" included under "Miscellaneous."
9 Includes minerals indicated by "5" and "8" above.

Mineral production of Kansas, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Asphalt (native) ... short tons	(1)	(1)	(1)	(1)
Cement ... barrels	[2] 3,217,497	[2] $4,949,018	[2] 3,746,370	[2] $5,614,112
Chats ... short tons	25,000	1,930	50,000	(1)
Clay:				
Products (other than pottery and refractories)	....	[3] 879,595	....	[3] 1,051,349
Raw (sold by producers) ... short tons	....	....	(1)	(1)
Coal ... do	[4] 2,654,141	[5] 5,263,000	[4] 2,920,000	[6] 5,490,000
Gypsum (crude) ... do	(1)	(1)	(1)	(1)
Lead ... do	15,239	1,401,988	13,697	1,287,518
Mineral paints (zinc and lead pigments) ... do	(1, 7)	(1, 7)	(1, 7)	(1, 7)
Mineral waters ... gallons sold	(8)	(8)	(8)	(8)
Natural gas ... M cubic feet	75,203,000	27,485,000	80,556,000	29,356,000
Natural gasoline ... gallons	55,988,000	1,603,000	62,175,000	1,999,000
Ores (crude), etc.:				
Zinc ... short tons	1,706,800	(9)	1,937,000	(9)
Zinc-lead ... do	2,044,500	(9)	1,764,300	(9)
Petroleum ... barrels	60,064,000	72,100,000	60,703,000	63,100,000
Pumice ... short tons	38,136	112,823	41,643	123,163
Pyrites ... long tons	17,757	(1)	9,838	(1)
Salt ... short tons	597,909	2,565,447	641,752	2,591,934
Sand and gravel ... do	2,962,831	1,117,053	1,934,759	822,305
Stone ... do	[10] 3,676,230	[10] 4,958,723	3,406,640	4,550,560
Zinc ... do	73,024	7,010,304	68,971	7,172,984
Miscellaneous [11]	....	2,460,741	....	2,797,911
Total value, eliminating duplications	....	129,675,438	....	123,391,521

1 Value included under "Miscellaneous."
2 Exclusive of natural cement, value for which is included under "Miscellaneous."
3 Figures obatined through cooperation with Bureau of the Census.
4 According to Bituminous Coal Division; figures for 1939 are preliminary.
5 Value is estimated from various sources and includes selling expenses.
6 Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
7 Value not included in total value for State. 8 No canvass.
9 Not valued as ore; value of recoverable metal content included under the metals.
10 Exclusive of dimension sandstone, value for which is included under "Miscellaneous."
11 Includes minerals indicated by "1", "2", and "10" above.

Mineral production of Kentucky, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Asphalt (native) ... short tons	(1)	(1)	(1)	(1)
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)	....	[2] $1,266,284	....	[2] $1,566,982
Raw (sold by producers) ... short tons	148,330	666,560	247,958	1,004,232
Coal ... do	[3] 38,545,218	[4] 70,094,000	[3] 42,805,000	[5] 74,481,000
Coke ... do	(1, 6)	(1, 6)	(1, 6)	(1, 6)
Fluorspar ... do	34,803	678,094	89,563	1,773,063
Iron, pig ... long tons	126,102	(1, 6)	231,494	(1, 6)
Lead ... short tons	101	9,292	87	8,178
Lime ... do	(1)	(1)	(1)	(1)
Mineral waters ... gallons sold	(7)	(7)	(7)	(7)
Natural gas ... M cubic feet	46,163,000	19,539,000	47,771,000	20,630,000
Natural gasoline ... gallons	7,040,000	364,000	7,785,000	347,000
Ores (lead and zinc) ... short tons	(8)	(8)	(8)	(8)
Petroleum ... barrels	5,821,000	7,570,000	5,621,000	5,900,000
Sand and gravel ... short tons	1,222,658	962,508	1,101,415	777,602
Stone ... do	[9] 3,361,600	[9] 2,987,494	4,802,280	4,480,098
Zinc ... do	322	30,912	909	94,536
Miscellaneous [10]	....	6,573,722	....	8,850,839
Total value, eliminating duplications	....	106,654,903	....	113,243,154

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 According to Bituminous Coal Division; figures for 1939 are preliminary.
4 Value is estimated from various sources and includes selling expenses.
5 Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
6 Value not included in total value for State.
7 No canvass. 8 Figures not available.
9 Exclusive of sandstone, value for which is included under "Miscellaneous."
10 Includes minerals indicated by "1" and "9" above.

Mineral production of Louisiana, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $547,478		[2] $741,692
Raw (sold by producers) ... short tons	(1)	(1)	(1)	(1)
Mineral waters ... gallons sold	(3)	(3)	(3)	(3)
Natural gas ... M cubic feet	283,899,000	47,991,000	294,370,000	53,835,000
Natural gasoline ... gallons	95,634,000	3,026,000	94,090,000	3,329,000
Petroleum ... barrels	95,208,000	110,100,000	93,646,000	98,000,000
Salt ... short tons	958,186	2,775,384	1,072,540	2,830,331
Sand and gravel ... do	2,248,657	1,241,455	2,145,793	1,195,049
Stone ... do	(1)	(1)	(1)	(1)
Sulfur ... long tons	294,235	(1)	446,242	(1)
Miscellaneous [4]		6,625,444		8,971,877
Total value, eliminating duplications		172,306,761		168,902,949

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

Mineral production of Maine, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $210,814		[2] $371,629
Raw (sold by producers) ... short tons			(1)	(1)
Feldspar (crude) ... long tons	13,764	68,047	18,109	74,165
Gems and precious stones		(3)		(3)
Lime ... short tons	(1)	(1)	(1)	(1)
Mica:				
Scrap ... do	(1)	(1)	(1)	(1)
Sheet ... pounds			(1)	(1)
Mineral waters ... gallons sold	(3)	(3)	(3)	(3)
Peat ... short tons	(1)	(1)	1,267	26,569
Sand and gravel ... do	3,802,704	968,766	3,312,164	888,646
Silica (quartz) ... do	91	278	644	1,725
Slate		(1)		215,951
Stone ... short tons	192,250	1,161,535	[4] 205,280	[4] 1,228,930
Miscellaneous [5]		1,139,198		962,056
Total value, eliminating duplications		3,548,638		3,769,671

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

Mineral production of Maryland, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Asbestos ... short tons	(1)	(1)	(1)	(1)
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $1,210,947		[2] $1,709,524
Raw (sold by producers) ... short tons	20,434	86,243	35,817	124,502
Coal ... do	[3] 1,281,413	[4] 2,705,000	[3] 1,468,000	[5] 2,995,000
Coke ... do	1,105,262	(1 6)	1,578,973	(1 6)
Feldspar (crude) ... long tons			(1)	(1)
Gold ... troy ounces	855	29,925	71	2,485
Iron, pig ... long tons	1,219,611	(1 6)	1,805,080	(1 6)
Lime ... short tons	62,479	446,013	59,504	396,201
Mineral waters ... gallons sold	(7)	(7)	(7)	(7)
Ore (dry and siliceous) (gold and silver) ... short tons	1,701	(8)	220	(8)
Potassium salts ... do	(1)	(1)	(1)	(1)
Sand and gravel ... do	2,177,162	1,848,211	3,311,029	2,827,268
Silica (quartz) ... do	377	6,000	515	8,010
Silver ... troy ounces	24	16	2	1
Slate		(1)		(1)
Stone ... short tons	[9] 947,390	[9] 1,167,518	1,024,130	1,327,830
Talc and ground soapstone ... do	(1)	(1)	(1)	(1)
Miscellaneous [10]		28,491,245		40,697,718
Total value, eliminating duplications		9,407,723		11,837,593

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 According to Bituminous Coal Division; figures for 1939 are preliminary.
4 Value is estimated from various sources and includes selling expenses.
5 Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
6 Value not included in total value for State.
7 No canvass.
8 Not valued as ore; value of recoverable metal content included under the metals.
9 Exclusive of crushed sandstone, value for which is included under "Miscellaneous."
10 Includes minerals indicated by "1" and "9" above.

Mineral production of Massachusetts, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories)		[1] $622,719		[1] $866,226
Raw (sold by producers) ... short tons	864	12,150	(2)	(2)
Coke ... do	1,019,302	(2 3)	1,057,158	(2 3)
Diatomite ... do			(2)	(2)
Iron, pig ... long tons	(2 3)	(2 3)	(2 3)	(2 3)
Lime ... short tons	91,453	741,975	111,734	1,005,485
Manganiferous ore ... long tons	230	(2)	649	(2)
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Peat ... short tons	(2)	(2)	(2)	(2)
Sand and gravel ... do	3,464,045	1,228,385	3,562,098	1,718,929
Sand and sandstone (ground) ... do	1,234	4,102	1,374	6,220
Sand-lime brick ... thousands of brick	[1] 15,047	[1] 143,764	(1 2)	(1 2)
Silica (quartz) ... short tons	140	840	442	2,652
Stone ... do	[5] 2,188,820	[5] 3,865,042	2,543,730	4,459,797
Miscellaneous [6]		7,056,024		8,320,578
Total value, eliminating duplications		6,666,281		8,179,860

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

Mineral production of Michigan, 1938–39

Product	1938 Quantity	1938 Value	1939 Quantity	1939 Value
Bromine pounds	12,430,679	$2,490,607	13,035,667	$2,680,591
Calcium chloride short tons	84,022	1,137,257	98,287	1,219,581
Cement barrels	7,192,511	8,767,859	8,327,479	10,891,978
Clay:				
Products (other than pottery and refractories)		[1] 1,444,472		[1] 2,550,934
Raw (sold by producers) short tons	(2)	(2)	(2)	(2)
Coal do	[3] 494,481	[4] 1,860,000	[3] 434,000	[5] 1,636,000
Coke do	1,742,787	[6] 10,135,722	2,430,688	[6] 12,408,881
Copper pounds	93,486,000	9,161,628	87,970,000	9,148,880
Gems and precious stones		(7)		(7)
Gypsum (crude) short tons	483,324	775,908	643,180	834,856
Iron:				
Ore—				
Sold to furnaces long tons	4,092,902	13,139,823	11,238,605	37,026,665
Sold for paint do	147	(2)	872	(2)
Pig do	558,782	[6] 9,806,994	1,138,964	[6] 18,872,150
Lime short tons	45,848	339,324	45,180	324,765
Magnesium pounds	4,819,617	(2)	10,650,121	(2)
Magnesium salts (natural):				
Carbonate do	(2)	(2)	(2)	(2)
Chloride do	(2)	(2)	(2)	(2)
Sulfate do	(2)	(2)	(2)	(2)
Manganiferous ore long tons	16,057	(2)		
Marl, calcareous short tons	(2)	(2)	(2)	(2)
Mineral waters gallons sold	(7)	(7)	(7)	(7)
Natural gas M cubic feet	10,165,000	6,387,000	10,726,000	7,411,000
Natural gasoline gallons	3,581,000	107,000	2,971,000	89,000
Ores (crude), etc.: Copper short tons	3,757,705	(8)	4,603,751	(8)
Peat do	5,117	26,838	6,190	28,600
Petroleum barrels	18,745,000	19,300,000	23,462,000	21,350,000
Salt short tons	2,078,612	6,151,154	2,408,872	6,726,912
Sand and gravel do	9,821,298	3,734,012	10,748,007	4,087,508
Sand-lime brick thousands of brick	[1] 10,222	[1] 118,464	[1] 19,351	[1] 166,133
Silver troy ounces	93,634	60,531	101,878	69,154
Stone short tons	[9] 7,900,370	[9] 4,059,590	11,138,280	5,890,728
Miscellaneous [10]		2,319,135		3,836,229
Total value, eliminating duplications		81,380,602		115,969,514

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] According to Bituminous Coal Division; figures for 1939 are preliminary.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
[6] Value not included in total value for State. [7] No canvass.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Exclusive of dimension limestone, value for which is included under "Miscellaneous."
[10] Includes minerals indicated by "2" and "9" above.

Mineral production of Minnesota, 1938–39

Product	1938 Quantity	1938 Value	1939 Quantity	1939 Value
Cement barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $1,003,631		[2] $1,013,688
Raw (sold by producers) short tons	(1)	(1)	2,010	5,253
Coke do	540,447	[3] 4,495,555	497,079	[3] 3,684,811
Flint lining for tube mills do	(1)	(1)	(1)	(1)
Gems and precious stones		(4)		(4)
Iron:				
Ore long tons	14,535,744	44,361,534	32,370,241	97,113,591
Pig do	135,931	(1 3)	167,869	(1 3)
Lime short tons	(1)	(1)	(1)	(1)
Manganiferous ore long tons	276,607	726,449	651,963	(1)
Marl, calcareous short tons	(1)	(1)	800	745
Mineral waters gallons sold	(4)	(4)	(4)	(4)
Peat short tons	(1)	(1)	(1)	(1)
Pebbles for grinding do	(1)	(1)	(1)	(1)
Sand and gravel do	8,486,147	1,586,836	8,501,211	1,942,430
Sand-lime brick thousands of brick	(1 2)	(1 2)	(1 2)	(1 2)
Stone short tons	941,050	1,914,056	1,405,740	2,339,774
Miscellaneous [5]		4,601,225		7,342,498
Total value, eliminating duplications		51,425,289		106,427,607

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

Mineral production of Mississippi, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories)		[1] $605,311		[1] $761,686
Raw (sold by producers)......short tons	(2)	(2)	(2)	(2)
Fuller's earth......do	(2)	(2)		
Mineral waters......gallons sold	(3)	(3)	(3)	(3)
Natural gas......M cubic feet	13,656,000	3,210,000	14,527,000	3,300,000
Petroleum......barrels			107,000	94,000
Sand and gravel......short tons	3,236,675	1,246,974	2,336,842	810,933
Stone......do			(2)	(2)
Miscellaneous [4]		147,262		225,537
Total value, eliminating duplications		5,209,547		5,192,156

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

Mineral production of Missouri, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Asphalt (native)......short tons	(1)	(1)	(1)	(1)
Barite......do	156,539	$1,150,630	171,642	$1,163,870
Cement......barrels	4,570,389	6,871,120	4,702,259	7,420,013
Chats......short tons	1,306,800	196,000	524,100	59,900
Clay:				
Products (other than pottery and refractories)		[2] 1,910,630		[2] 2,759,036
Raw (sold by producers)......short tons	258,718	904,766	384,665	1,172,029
Coal......do	[3] 3,436,118	[4] 6,814,000	[3] 3,275,000	[5] 6,124,000
Coke......do	(1 6)	(1 6)	(1 6)	(1 6)
Iron ore—				
Sold to furnaces, etc......long tons	20,671	31,514	36,638	53,839
Sold for paint......do	6,500	(1)	2,117	5,346
Lead......short tons	122,027	11,226,484	156,281	14,690,414
Lime......do	298,151	1,724,140	516,988	2,800,379
Mineral paints (zinc and lead pigments)......do	(1 6)	(1 6)	(1 6)	(1 6)
Mineral waters......gallons sold	(7)	(7)	(7)	(7)
Natural gas......M cubic feet	1,369,000	819,000	538,000	312,000
Ores (crude), etc.:				
Lead......short tons	3,668,400	(8)	5,127,000	(8)
Zinc......do	126,600	(8)	20,200	(8)
Zinc-lead......do	353,000	(8)	503,600	(8)
Petroleum......barrels	(1)	(1)	40,000	30,000
Pyrites......long tons	28,828	71,956	32,496	68,369
Sand and gravel......short tons	3,269,856	1,919,146	3,857,406	2,310,995
Sand and sandstone (ground)......do	(1)	(1)	(1)	(1)
Sand-lime brick......thousands of brick	(1 2)	(1 2)	(1 2)	(1 2)
Silver......troy ounces	292,000	188,768	213,400	144,853
Stone......short tons	3,332,480	4,458,781	[9] 3,958,470	[9] 4,589,986
Tripoli......do	(1)	(1)	(1)	(1)
Tungsten ore (60-percent concentrates)......do	1	(1)		
Zinc......do	10,226	981,696	15,096	1,569,984
Miscellaneous [10]		1,816,305		1,711,108
Total value, eliminating duplications		39,560,739		45,619,104

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division; figures for 1939 are preliminary.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
[6] Value not included in total value for State.
[7] No canvass.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Exclusive of sandstone, value for which is included under "Miscellaneous."
[10] Includes minerals indicated by "1" and "9" above.

Mineral production of Montana, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Arsenious oxide .... short tons	(1)	(1)	(1)	(1)
Asbestos .... do	----	----	(1)	(1)
Barite .... do	----	----	(1)	(1)
Bismuth .... pounds	(2)	(2)	(2)	(2)
Cement .... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)	----	[3] $154,684	----	[3] $203,727
Raw (sold by producers) .... short tons	(1)	(1)	(1)	(1)
Coal .... do	[4] 2,732,050	[5] 4,106,000	[4] 2,810,000	[6] 4,103,000
Copper .... pounds	154,426,000	15,133,748	195,654,000	20,348,016
Gems and precious stones	----	(7)	----	(7)
Gold .... troy ounces	203,313	7,115,955	264,173	9,246,055
Gypsum (crude) .... short tons	(1)	(1)	(1)	(1)
Lead .... do	9,327	858,084	16,555	1,556,170
Lime .... do	(1)	(1)	(1)	(1)
Manganese ore .... long tons	11,936	451,396	11,139	(1)
Manganiferous ore .... do	452	1,971	2,121	(1)
Mineral waters .... gallons sold	(7)	(7)	(7)	(7)
Natural gas .... M cubic feet	21,216,000	6,132,000	23,178,000	6,486,000
Natural gasoline .... gallons	1,768,000	113,000	2,161,000	154,000
Ores (crude), etc.:				
Copper .... short tons	1,607,713	(8)	2,253,270	(8)
Dry and siliceous (gold and silver) .... do	914,601	(8)	1,049,461	(8)
Lead .... do	10,574	(8)	23,096	(8)
Zinc .... do	76,809	(8)	146,705	(8)
Zinc-lead .... do	114,769	(8)	320,248	(8)
Petroleum .... barrels	4,946,000	5,190,000	5,960,000	5,860,000
Phosphate rock .... long tons	66,491	155,917	44,384	112,142
Pyrites .... do	(1)	(1)	(1)	(1)
Sand and gravel .... short tons	2,946,572	1,064,274	4,305,553	1,678,098
Silver .... troy ounces	6,403,962	4,139,935	9,087,571	6,168,533
Stone .... short tons	1,364,680	1,717,417	1,266,220	1,714,718
Tin (metallic equivalent) .... pounds	----	----	(1)	(1)
Tungsten ore (60-percent concentrates) .... short tons	----	----	23	(1)
Vermiculite .... do	(1)	(1)	(1)	(1)
Zinc .... do	8,844	849,024	34,799	3,619,096
Miscellaneous [9]	----	1,419,142	----	2,105,090
Total value, eliminating duplications	----	48,602,547	----	63,354,645

[1] Value included under "Miscellaneous."
[2] Figures not available.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] According to Bituminous Coal Division; figures for 1939 are preliminary.
[5] Value is estimated from various sources and includes selling expenses.
[6] Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
[7] No canvass.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Includes minerals indicated by "1" above.

Mineral production of Nebraska, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Cement .... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)	----	[2] $327,482	----	[2] $569,953
Raw (sold by producers) .... short tons	16,019	7,782	19,576	9,185
Mineral waters .... gallons sold	(3)	(3)	(3)	(3)
Petroleum .... barrels	----	----	2,000	2,000
Pumice .... short tons	(1)	(1)	(1)	(1)
Sand and gravel .... do	2,928,904	1,020,806	2,494,142	878,366
Stone .... do	[4] 510,240	[4] 780,664	427,580	660,732
Miscellaneous [5]	----	1,891,978	----	2,270,055
Total value, eliminating duplications	----	4,028,712	----	4,390,291

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

Mineral production of Nevada, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Andalusite ..... short tons	[1]	[1]	[2]	[2]
Antimony ore (concentrates) ..... do	31	$1,400	137	[2]
Barite ..... do	[2]	[2]	[2]	[2]
Bismuth ..... pounds	[1]	[1]	[1]	[1]
Boron minerals ..... short tons	------	------	300	$4,500
Clay:				
Products (other than pottery and refractories)	------	[2 3]	------	[2 3]
Raw (sold by producers) ..... short tons	------	------	[2]	[2]
Copper ..... pounds	92,338,000	9,049,124	133,194,000	13,852,176
Diatomite ..... short tons	[2]	[2]	[2]	[2]
Dumortierite ..... do	[1]	[1]	[2]	[2]
Fluorspar ..... do	2,909	[2]	3,520	[2]
Fuller's earth ..... do	5,984	57,499	[2]	[2]
Gems and precious stones	------	[4]	------	[4]
Gold ..... troy ounces	296,434	10,375,190	361,518	12,653,130
Graphite, amorphous ..... short tons	[2]	[2]	[2]	[2]
Gypsum (crude) ..... do	168,515	366,869	205,762	484,621
Kyanite ..... do	[1]	[1]	------	------
Lead ..... do	4,679	430,468	4,236	398,184
Lime ..... do	[2]	[2]	[2]	[2]
Magnesite ..... do	------	------	[2]	[2]
Magnesium oxide (hydrated) (brucite) ..... do	[2]	[2]	[2]	[2]
Manganese ore ..... long tons	43	416	------	------
Marl, calcareous ..... short tons	[2]	[2]	[2]	[2]
Mercury ..... flasks (76 pounds)	336	25,358	828	86,062
Mineral waters ..... gallons sold	[4]	[4]	[4]	[4]
Ores (crude), etc.:				
Copper ..... short tons	4,043,892	[5]	4,936,001	[5]
Dry and siliceous (gold and silver) ..... do	1,745,060	[5]	1,907,051	[5]
Lead ..... do	28,325	[5]	6,730	[5]
Lead-copper ..... do	------	------	219	[5]
Zinc ..... do	------	------	150	[5]
Zinc-lead ..... do	62,744	[5]	44,848	[5]
Pumice ..... do	[2]	[2]	[2]	[2]
Sand and gravel ..... do	1,995,562	684,254	1,329,810	453,047
Silver ..... troy ounces	4,355,471	2,815,658	4,316,029	2,929,668
Stone ..... short tons	344,760	246,319	[6] 34,260	[6] 40,207
Sulfur ore ..... long tons	------	------	43	343
Tungsten ore (60-percent concentrates) ..... short tons	1,461	[2]	2,091	[2]
Vanadium ores ..... do	7	[2]	------	------
Zinc ..... do	8,944	858,624	6,228	647,712
Miscellaneous [7]	------	2,120,102	------	3,121,229
Total value, eliminating duplications	------	27,031,281	------	34,670,879

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

Mineral production of New Hampshire, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Clay products (other than pottery and refractories)		[1] $278,206		[1] $321,751
Feldspar (crude) long tons	25,555	135,760	34,414	161,968
Fluorspar short tons	90	(2)		
Garnet, abrasive do	(2)	(2)	(2)	(2)
Gems and precious stones		(3)		(3)
Mica:				
Scrap short tons	(2)	(2)	105	1,592
Sheet pounds	(2)	(2)	43,670	3,738
Mineral waters gallons sold	(3)	(3)	(3)	(3)
Peat short tons	(2)	(2)	(2)	(2)
Sand and gravel do	2,495,207	243,040	2,067,994	219,296
Scythestones do	(2)	(2)	(2)	(2)
Silica (quartz) do	(2)	(2)		
Stone do	53,790	444,537	105,390	437,342
Miscellaneous [4]		45,063		41,652
Total value, eliminating duplications		1,146,606		1,187,339

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

Mineral production of New Jersey, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Cement barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $5,210,105		[2] $6,726,041
Raw (sold by producers) short tons	74,018	383,648	96,629	522,684
Coke do	1,007,394	(1 3)	1,003,197	(1 3)
Ferro-alloys long tons	(1 3)	(1 3)	(1 3)	(1 3)
Iron ore do	139,890	760,929	394,709	1,865,037
Lime short tons	19,940	145,076	22,636	148,605
Manganiferous residuum long tons	39,079	(1)	129,238	(1)
Marl, greensand short tons	6,576	152,000	6,466	150,500
Mineral waters gallons sold	(4)	(4)	(4)	(4)
Ore (zinc) short tons	528,595	(5)	606,504	(5)
Peat do	12,217	67,550	11,781	62,372
Sand and gravel do	3,215,406	2,519,575	4,319,297	3,361,955
Sand and sandstone (ground) do	63,968	338,195	88,946	577,811
Sand-lime brick thousands of brick	(1 2)	(1 2)	(1 2)	(1 2)
Stone short tons	2,583,220	2,678,766	2,806,020	3,036,516
Zinc [6] do	85,839	10,891,683	88,716	11,507,318
Miscellaneous [7]		7,892,232		8,935,091
Total value, elminating duplications		24,408,545		30,271,293

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metal.
[6] Value reported for zinc in New Jersey is estimated smelting value of recoverable zinc content of ore after freight, haulage, smelting, and manufacturing charges are added.
[7] Includes minerals indicated by "1" above.

Mineral production of New Mexico, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Arsenious oxide ... short tons	(1)	(1)	(1)	(1)
Asphalt (native) ... do	(2)	(2)		
Calcite (Iceland spar) ... pounds			(2)	(2)
Clay:				
Products (other than pottery and refractories)		3 $117,409		3 $162,003
Raw (sold by producers) ... short tons	13,908	37,786	7,767	19,686
Coal ... do	4 1,239,037	5 3,406,000	4 1,206,000	6 3,437,000
Copper ... pounds	40,878,000	4,006,044	92,284,000	9,597,536
Fluorspar ... short tons	4,066	(2)	(2)	(2)
Gems and precious stones		(7)		(7)
Gold ... troy ounces	43,050	1,506,750	36,979	1,294,265
Iron ore ... long tons	1,826	(2)		
Lead ... short tons	4,949	455,308	5,392	506,848
Lime ... do	(2)	(2)	(2)	(2)
Manganese ore ... long tons	560	(2)	339	(2)
Manganiferous ore ... do	6,093	(2)	31,999	(2)
Mica:				
Scrap ... short tons	770	7,998	(2)	(2)
Sheet ... pounds	(2)	(2)	(2)	(2)
Mineral waters ... gallons sold	(7)	(7)	(7)	(7)
Molybdenum ... pounds	(2)	(2)	1,269,182	(2)
Natural gas ... M cubic feet	50,706,000	7,715,000	60,284,000	8,778,000
Natural gasoline ... gallons	49,596,000	1,415,000	54,707,000	1,696,000
Ores (crude), etc.:				
Copper ... short tons	1,904,374	(8)	4,517,429	(8)
Dry and siliceous (gold and silver) ... do	108,689	(8)	111,202	(8)
Lead ... do	962	(8)	1,431	(8)
Lead-copper ... do	303	(8)	1,102	(8)
Zinc ... do	182,822	(8)	217,517	(8)
Zinc-lead ... do	217,707	(8)	128,694	(8)
Petroleum ... barrels	35,759,000	33,250,000	37,637,000	30,850,000
Potassium salts ... short tons	(2)	(2)	(2)	(2)
Pumice ... do	(2)	(2)	(2)	(2)
Salt ... do	(2)	(2)	(2)	(2)
Sand and gravel ... do	(2)	(2)	9 1,832,733	9 1,131,804
Silver ... troy ounces	1,229,860	795,061	1,400,878	950,899
Stone ... short tons	10 698,350	10 438,284	10 287,190	10 164,924
Tantalum ore ... pounds	(2)	(2)	(2)	(2)
Tin (metallic equivalent) ... do			(2)	(2)
Tungsten ore (60-percent concentrates) ... short tons	2	(2)		
Zinc ... do	28,236	2,710,656	29,356	3,053,024
Miscellaneous 11		7,707,657		8,279,776
Total value, eliminating duplications		63,568,953		69,921,765

1 Figures not available.
2 Value included under "Miscellaneous."
3 Figures obtained through cooperation with Bureau of the Census.
4 According to Bituminous Coal Division; figures for 1939 are preliminary.
5 Value is estimated from various sources and includes selling expenses.
6 Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
7 No canvass.
8 Not valued as ore; value of recoverable metal content included under the metals.
9 "Government-and-contractor." Value of "Commercial" included under "Miscellaneous."
10 Exclusive of sandstone in 1938 and of basalt in 1939, value for which is included under "Miscellaneous."
11 Includes minerals indicated by "2", "9", and "10" above.

Mineral production of New York, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Aluminum ... pounds	([1,2])	([1,2])	([1,2])	([1,2])
Cement ... barrels	[3] 5,720,922	[3] $7,893,270	[3] 6,853,796	[3] $9,866,102
Clay:				
Products (other than pottery and refractories)	----	[4] 4,434,918	----	[4] 6,883,109
Raw (sold by producers) ... short tons	([1])	([1])	([1])	([1])
Coke ... do	3,945,358	[2] 23,529,138	4,468,437	[2] 25,526,646
Diatomite ... do	([1])	([1])	([1])	([1])
Emery ... do	----	----	765	6,828
Feldspar (crude) ... long tons	([1])	([1])	([1])	([1])
Ferro-alloys ... do	72,174	[2] 7,699,520	163,808	[2] 18,388,766
Garnet, abrasive ... short tons	([1])	([1])	([1])	([1])
Gems and precious stones	----	([5])	----	([5])
Graphite:				
Artificial ... pounds	([1,2])	([1,2])	([1,2])	([1,2])
Crystalline ... do	([1])	([1])	([1])	([1])
Gypsum (crude) ... short tons	601,394	941,744	709,495	971,229
Iron:				
Ore—				
Sold to furnaces ... long tons	([1])	([1])	([1])	([1])
Sold for paint ... do	([1])	([1])	([1])	([1])
Pig ... do	1,222,832	[2] 25,450,764	2,210,223	[2] 45,275,716
Lead ... short tons	([1])	([1])	([1])	([1])
Lime ... do	39,439	302,360	42,225	314,457
Mica:				
Scrap ... do	----	----	([1])	([1])
Sheet ... pounds	----	----	([1])	([1])
Millstones	----	([1])	----	2,584
Mineral waters ... gallons sold	([5])	([5])	([5])	([5])
Natural gas ... M cubic feet	39,402,000	19,419,000	29,222,000	15,201,000
Natural gasoline ... gallons	27,000	2,000	34,000	1,000
Ores (crude), etc.:				
Zinc ... short tons	105,000	([6])	115,000	([6])
Zinc-lead ... do	280,600	([6])	305,000	([6])
Peat ... do	14,131	79,297	18,306	116,875
Petroleum ... barrels	5,045,000	9,550,000	5,098,000	10,650,000
Pyrites ... long tons	63,772	([1])	71,176	([1])
Salt ... short tons	1,717,064	5,467,077	2,041,492	5,855,422
Sand and gravel ... do	13,566,370	6,493,099	[7] 12,608,128	[7] 7,050,104
Sand-lime brick ... thousands of brick	([1,4])	([1,4])	([1,4])	([1,4])
Silica (quartz) ... short tons	([1])	([1])	([1])	([1])
Silver ... troy ounces	37,200	24,048	37,250	25,285
Slate	----	445,331	----	465,837
Stone ... short tons	10,061,250	10,527,452	10,703,690	10,111,032
Talc ... do	86,423	1,110,024	99,880	1,252,525
Zinc ... do	29,896	2,870,016	36,014	3,745,456
Miscellaneous [8]	----	30,239,794	----	35,784,826
Total value, eliminating duplications	----	73,217,430	----	78,383,851

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

Mineral production of North Carolina, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Aluminum ... pounds	(1 2)	(1 2)	(1 2)	(1 2)
Asbestos ... short tons			(1)	(1)
Bromine ... pounds	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[3] $3,324,461		[3] $4,595,857
Raw (sold by producers) ... short tons	(1)	(1)	11,365	166,010
Copper ... pounds	(1)	(1)	(1)	(1)
Feldspar (crude) ... long tons	56,795	295,800	76,738	397,631
Garnet, abrasive ... short tons	(1)	(1)	(1)	(1)
Gems and precious stones		(4)		(4)
Gold ... troy ounces	1,878	65,730	495	17,325
Kyanite ... short tons	(5)	(5)	(1)	(1)
Lead ... do	4	368		
Lime ... do	(1)	(1)	(1)	(1)
Manganese ore ... long tons			43	796
Manganiferous ore ... do			51	632
Mica:				
Scrap ... short tons	11,959	161,598	13,913	184,377
Sheet ... pounds	632,646	87,879	401,170	69,344
Millstones				(1)
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Olivine ... short tons	(5)	(5)	3,000	15,000
Ores (crude):				
Copper ... do	17,638	(6)	15,310	(6)
Dry and siliceous (gold and silver) ... do	8,219	(6)	1,430	(6)
Zinc-lead ... do	300	(6)		
Sand and gravel ... do	2,505,180	762,827	2,383,772	1,001,369
Silica (quartz) ... do	(1)	(1)	(1)	(1)
Silver ... troy ounces	5,500	3,556	3,961	2,689
Stone ... short tons	[7] 4,552,120	[7] 5,789,486	[7] 6,037,000	[7] 6,979,426
Talc and pyrophyllite ... do	27,460	241,337	36,772	283,789
Vermiculite ... do	(1)	(1)	1,400	14,400
Miscellaneous [8]		11,988,186		13,029,075
Total value, eliminating duplications		14,959,228		18,533,720

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Figures not available.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of marble in 1938 and of dimension sandstone in 1939, value for which is included under "Miscellaneous."
[8] Includes minerals indicated by "1" and "7" above.

Mineral production of North Dakota, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories)		(1 2)		(1 2)
Raw (sold by producers) ... short tons			(1)	(1)
Coal ... do	2,050,099	$2,380,000	2,131,252	$2,425,000
Mineral waters ... gallons sold	(3)	(3)	(3)	(3)
Natural gas ... M cubic feet	71,000	27,000	76,000	29,000
Sand and gravel ... short tons	2,581,765	151,824	1,464,738	128,279
Stone ... do	20,090	5,395	(1)	(1)
Miscellaneous		89,254		107,348
Total value, eliminating duplications		2,653,473		2,689,627

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

Mineral production of Ohio, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Bromine ... pounds	([1])	([1])	([1])	([1])
Calcium chloride ... short tons	([1])	([1])	([1])	([1])
Cement ... barrels	[2] 5,258,603	[2] $7,094,745	[2] 6,140,125	[2] $8,233,817
Clay:				
Products (other than pottery and refractories)	...	[3] 17,679,691	...	[3] 26,539,916
Raw (sold by producers) ... short tons	301,945	595,190	469,152	912,780
Coal ... do	[4] 18,590,618	[5] 33,073,000	[4] 19,632,000	[6] 32,196,000
Coke ... do	3,699,995	[7] 18,413,808	6,135,949	[7] 28,502,924
Ferro-alloys ... long tons	65,605	[7] 2,793,907	143,682	[7] 6,084,252
Grindstones ... short tons	([1])	([1])	7,524	246,119
Gypsum (crude) ... do	([1])	([1])	([1])	([1])
Iron, pig ... long tons	4,186,217	[7] 85,186,824	7,249,172	[7] 147,154,864
Lime ... short tons	836,589	6,658,853	1,106,250	8,907,195
Marl, calcareous ... do	([1])	([1])	([1])	([1])
Mineral paints (zinc and lead pigments) ... do	([1] [7])	([1] [7])	([1] [7])	([1] [7])
Mineral waters ... gallons sold	([8])	([8])	([8])	([8])
Natural gas ... M cubic feet	35,257,000	17,550,000	36,469,000	18,818,000
Natural gasoline ... gallons	7,382,000	377,000	7,445,000	351,000
Peat ... short tons	2,026	18,756	1,623	14,400
Petroleum ... barrels	3,298,000	3,860,000	3,156,000	3,600,000
Rubbing stones, scythestones, and whetstones short tons	255	64,396	([1])	([1])
Salt ... do	1,489,270	2,562,620	1,794,788	2,647,355
Sand and gravel ... do	7,942,506	5,635,217	8,660,485	6,595,483
Sand and sandstone (ground) ... do	28,540	177,876	36,950	223,965
Silica (quartz) ... do	([1])	([1])	([1])	([1])
Stone ... do	[9] 9,888,730	[9] 8,970,552	[9] 11,133,560	[9] 10,140,272
Sulfuric acid [10] ... do	([1] [7])	([1] [7])	([1] [7])	([1] [7])
Miscellaneous [11]	...	2,098,599	...	2,217,812
Total value, eliminating duplications	...	104,812,531	...	119,750,853

[1] Value included under "Miscellaneous."
[2] Exclusive of natural cement, value for which is included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] According to Bituminous Coal Division; figures for 1939 are preliminary.
[5] Value is estimated from various sources and includes selling expenses.
[6] Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
[7] Value not included in total value for State.
[8] No canvass.
[9] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[10] From zinc-roasting operation.
[11] Includes minerals indicated by "1", "2", and "9" above.

Mineral production of Oklahoma, 1938–39

Product	1938 Quantity	1938 Value	1939 Quantity	1939 Value
Asphalt (native) short tons	(1)	(1)	(1)	(1)
Cement barrels	(1)	(1)	(1)	(1)
Chats short tons	1, 504, 900	$216, 370	1, 663, 100	(1)
Clay:				
Products (other than pottery and refractories)		[2] 572, 289		[2] $720, 587
Raw (sold by producers) short tons	(1)	(1)	(1)	(1)
Coal do	[3] 1, 244, 732	[4] 2, 947, 000	[3] 1, 178, 000	[5] 2, 486, 000
Gypsum (crude) do	141, 341	231, 910	161, 748	207, 503
Lead do	21, 004	1, 932, 368	27, 720	2, 605, 680
Lime do	(1)	(1)	(1)	(1)
Mineral waters gallons sold	(6)	(6)	(6)	(6)
Natural gas M cubic feet	263, 164, 000	27, 391, 000	250, 875, 000	28, 103, 000
Natural gasoline gallons	468, 499, 000	14, 373, 000	436, 123, 000	15, 502, 000
Ores (crude), etc.:				
Zinc short tons	4, 249, 000	(7)	3, 465, 900	(7)
Zinc-lead do	3, 072, 400	(7)	5, 337, 000	(7)
Petroleum barrels	174, 994, 000	209, 500, 000	159, 913, 000	166, 300, 000
Pumice short tons	(1)	(1)	(1)	(1)
Salt do	(1)	(1)	(1)	(1)
Sand and gravel do	823, 814	354, 486	859, 060	400, 478
Stone do	[8] 1, 101, 320	[8] 1, 338, 858	1, 992, 660	1, 820, 409
Sulfuric acid [9] do	(1 10)	(1 10)	(1 10)	(1 10)
Tripoli do	(1)	(1)	(1)	(1)
Zinc do	112, 924	10, 840, 704	140, 379	14, 599, 416
Miscellaneous [11]		3, 636, 013		3, 945, 534
Total value, eliminating duplications		272, 860, 078		236, 176, 614

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 According to Bituminous Coal Division; figures for 1939 are preliminary.
4 Value is estimated from various sources and includes selling expenses.
5 Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses
6 No canvass.
7 Not valued as ore; value of recoverable metal content included under the metals.
8 Exclusive of dimension limestone, value for which is included under "Miscellaneous."
9 From zinc smelting.
10 Value not included in total value for State.
11 Includes minerals indicated by "1" and "8" above.

Mineral production of Oregon, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Arsenious oxide ..... short tons	(1)	(1)	(1)	(1)
Cement ..... barrels	(2)	(2)	(2)	(2)
Chromite ..... long tons			100	(2)
Clay:				
Products (other than pottery and refractories)		[3] $226,312		[3] $410,963
Raw (sold by producers) ..... short tons	(2)	(2)	(2)	(2)
Coal ..... do	(2 4)	(2 5)	(2 4)	(2 6)
Copper ..... pounds	76,000	7,448	96,000	9,984
Diatomite ..... short tons	(2)	(2)	(2)	(2)
Gems and precious stones		(7)		(7)
Gold ..... troy ounces	81,729	2,860,515	93,372	3,268,020
Lead ..... short tons	23	2,116	15	1,410
Lime ..... do	(2)	(2)		
Mercury ..... flasks (76 pounds)	4,610	347,917	4,592	477,293
Mineral waters ..... gallons sold	(7)	(7)	(7)	(7)
Ores (crude), etc.:				
Copper ..... short tons	9	(8)		
Dry and siliceous (gold and silver) ..... do	74,925	(8)	69,025	(8)
Lead ..... do	2	(8)		
Platinum metals (crude) ..... troy ounces	43	1,100	20	260
Pumice ..... short tons	(2)	(2)	(2)	(2)
Sand and gravel ..... do	2,079,026	926,661	3,144,917	1,233,320
Silica (quartz) ..... do	(2)	(2)	910	5,600
Silver ..... troy ounces	100,507	64,974	105,388	71,536
Stone ..... short tons	[9] 2,355,970	[9] 2,025,335	2,225,610	1,682,175
Miscellaneous [10]		1,074,030		1,475,879
Total value, eliminating duplications		7,536,408		8,636,440

1 Figures not available.
2 Value included under "Miscellaneous."
3 Figures obtained through cooperation with Bureau of the Census.
4 According to Bituminous Coal Division; figures for 1939 are preliminary.
5 Value is estimated from various sources and includes selling expenses.
6 Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
7 No canvass.
8 Not valued as ore; value of recoverable metal content included under the metals.
9 Exclusive of granite, value for which is included under "Miscellaneous."
10 Includes minerals indicated by "2" and "9" above.

Mineral production of Pennsylvania, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Cement ... barrels	[1] 21,082,966	[1] $28,242,913	[1] 24,870,343	[1] $34,332,649
Clay:				
Products (other than pottery and refractories)	------------	[2] 8,844,284	------------	[2] 11,351,849
Raw (sold by producers) ... short tons	422,372	1,096,795	667,140	1,675,019
Coal:				
Anthracite ... do	46,099,027	180,600.167	51,487.377	187,175,000
Bituminous ... do	[3] 77,704,537	[4] 160.965.000	[3] 92,190,000	[5] 188.990,000
Coke ... do	7,601,433	[6] 32,016,496	12,120,225	[6] 49,015,558
Copper [7] ... pounds	(8)	(8)	(8)	(8)
Feldspar (crude) ... long tons	(8)	(8)	(8)	(8)
Ferro-alloys ... do	188,697	[6] 19,624,173	288,078	[6] 29,609,712
Gems and precious stones	------------	(9)	------------	(9)
Gold [7] ... troy ounces	1,422	49,770	1,815	63,525
Iron:				
Ore—				
Sold to furnaces ... long tons	(8)	(8)	(8)	(8)
Sold for paint ... do	(8)	(8)	463	(8)
Pig ... do	4,684,017	[6] 101,266,844	8,979.649	[6] 186,302,533
Lime ... short tons	532,066	3,784,462	691,460	4,744,197
Mineral paints (zinc and lead pigments) ... do	(6 8)	(6 8)	(6 8)	(6 8)
Mineral waters ... gallons sold	(9)	(9)	(9)	(9)
Natural gas ... M cubic feet	76,547,000	29,544.000	93,882.000	35,268,000
Natural gasoline ... gallons	10,734,000	526,000	11,756,000	499,000
Peat ... short tons	(8)	(8)	(8)	(8)
Petroleum ... barrels	17,426.000	32,760.000	17,382,000	36,200,000
Sand and gravel ... short tons	5,721,011	5,759,996	6,779,592	6,752,222
Sand and sandstone (ground) ... do	(8)	(8)	(8)	(8)
Sand-lime brick ... thousands of brick	(2 8)	(2 8)	------------	------------
Silver [7] ... troy ounces	9,360	6,051	13,558	9,203
Slate	------------	2,501,477	------------	3,056,853
Soapstone ... short tons	(8)	(8)	(8)	(8)
Stone ... do	12,134.290	13,045,423	[10] 15,743,790	[10] 16,906,854
Sulfuric acid (60° Baumé) [11] ... do	221,563	[6] 2,018.439	254,758	[6] 2,295,370
Tripoli (rottenstone) ... do	164	3,608	(8)	(8)
Miscellaneous [12]	------------	11,465,201	------------	14,628,398
Total value, eliminating duplications	------------	472,773,327	------------	532,355,651

1 Exclusive of natural cement, value for which is included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 According to Bituminous Coal Division; figures for 1939 are preliminary.
4 Value is estimated from various sources and includes selling expenses.
5 Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
6 Value not included in total value for State.
7 Copper, gold, and silver were recovered from magnetite-pyrite-chalcopyrite ore, which is included as iron ore produced. Bureau of Mines not at liberty to publish figures.
8 Value included under "Miscellaneous."
9 No canvass.
10 Exclusive of dimension basalt, value for which is included under "Miscellaneous."
11 From zinc smelting.
12 Includes minerals indicated by "1," "8," and "10" above.

Mineral production of Rhode Island, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Clay products (other than pottery and refractories)	------------	(1 2)	------------	(1 2)
Coke ... short tons	(1 3)	(1 3)	(1 3)	(1 3)
Lime ... do	(1)	(1)	(1)	(1)
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Sand and gravel ... short tons	285,336	$193,172	383,557	$265,631
Stone ... do	[5] 262,910	[5] 601,355	320,780	558.944
Miscellaneous [6]	------------	1,343.598	------------	1,690.297
Total value, eliminating duplications	------------	911,599	------------	980,916

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

Mineral production of South Carolina, 1938–39

Product	1938 Quantity	1938 Value	1939 Quantity	1939 Value
Asbestos ... short tons	------	------	(1)	(1)
Barite ... do	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)	------	[2] $1,289,975	------	[2] $1,573,470
Raw (sold by producers) ... short tons	99,376	869,693	159,164	1,303,163
Copper ... pounds	(1)	(1)	------	------
Gold ... troy ounces	11,681	408,835	13,833	484,155
Kyanite ... short tons	(3)	(3)	------	------
Mica:				
Scrap ... do	(1)	(1)	------	------
Sheet ... pounds	(1)	(1)	------	------
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Ore (dry and siliceous) (gold and silver) ... short tons	59,930	(5)	114,514	(5)
Phosphate rock ... long tons	100	350	------	------
Sand and gravel ... short tons	464,312	305,299	546,428	313,758
Silver ... troy ounces	3,951	2,554	5,480	3,720
Stone ... short tons	[6] 987,280	[6] 1,315,999	[6] 1,339,030	[6] 1.732,795
Miscellaneous [7]	------	171 329	------	11,918
Total value, eliminating duplications	------	4,364,034	------	5,422,979

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 Figures not available.
4 No canvass.
5 Not valued as ore; value of recoverable metal content included under the metals.
6 Exclusive of limestone in 1938 and of unclassified stone in 1939, value for which is included under "Miscellaneous."
7 Includes minerals indicated by "1" and "6" above.

Mineral production of South Dakota, 1938–39

Product	1938 Quantity	1938 Value	1939 Quantity	1939 Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)	------	(1 2)	------	(1 2)
Raw (sold by producers) ... short tons	20,565	$155,821	31,528	$217,622
Coal ... do	48.058	65,000	49,495	69,000
Feldspar (crude) ... long tons	42,297	122,467	48,328	133,893
Gems and precious stones	------	(3)	------	(3)
Gold ... troy ounces	594,847	20,819,645	618,536	21,648,760
Gypsum (crude) ... short tons	(1)	(1)	(1)	(1)
Iron ore sold for paint ... long tons	------	------	300	(1)
Lime ... short tons	(1)	(1)	(1)	(1)
Lithium minerals ... do	(1)	(1)	1,740	34,300
Mica:				
Scrap ... do	(1)	(1)	(1)	(1)
Sheet ... pounds	------	------	(1)	(1)
Mineral waters ... gallons sold	(3)	(3)	(3)	(3)
Natural gas ... M cubic feet	10,000	3,000	10,000	3,000
Ores (crude), etc.:				
Dry and siliceous (gold and silver) ... short tons	1,586,181	(4)	1,632,778	(4)
Sand and gravel ... do	4,677,593	627,344	2,539,417	722,046
Sand-lime brick ... thousands of brick	(1 2)	(1 2)	(1 2)	(1 2)
Silver ... troy ounces	162,295	104,918	167,584	113,754
Stone ... short tons	320,740	899,190	408,730	998,444
Tantalum ore ... pounds	33,922	33,406	(1)	(1)
Tin (metallic equivalent) ... short tons	1	900	(5)	608
Miscellaneous [6]	------	751,668	------	869,804
Total value, eliminating duplications	------	23,583,359	------	24,811,231

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 No canvass.
4 Not valued as ore; value of recoverable metal content included under the metals.
5 1,210 pounds.
6 Includes minerals indicated by "1" above.

Mineral production of Tennessee, 1938–39

Product	1938 Quantity	1938 Value	1939 Quantity	1939 Value
Aluminum...pounds..	(1 2)	(1 2)	(1 2)	(1 2)
Barite...short tons..	29,898	$209,040	57,140	$372,348
Cement...barrels..	3,390,871	5,063,628	3,677,116	5,613,477
Clay:				
Products (other than pottery and refractories)..	......	[3] 1,499,108	......	[3] 2,107,917
Raw (sold by producers)...short tons..	52,356	347,035	61,867	425,008
Coal...do....	[4] 4,472,403	[5] 9,007,000	[4] 5,280,000	[6] 10,402,000
Coke...do....	81,623	[2] 508,771	79,448	[2] 527,535
Copper...pounds..	(1)	(1)	(1)	(1)
Ferro-alloys...long tons..	10,818	[2] 779,913	20,084	[2] 1,442,967
Fuller's earth...short tons..	(1)	(1)	(1)	(1)
Gold...troy ounces..	236	8,260	163	5,705
Iron:				
Ore—				
Sold to furnaces...long tons..	(1)	(1)	(1)	(1)
Sold for paint...do....	......	......	781	3,044
Pig...do....	(1 2)	(1 2)	(1 2)	(1 2)
Sinter from copper sulfide ore...do....	(1)	(1)	(1)	(1)
Lead...short tons..	(1)	(1)	(1)	(1)
Lime...do....	162,661	901,460	163,006	893,161
Manganese ore...long tons..	4,130	77,806	7,835	128,176
Manganiferous ore...do....	456	3,228	294	2,030
Mineral waters...gallons sold..	(7)	(7)	(7)	(7)
Natural gas...M cubic feet..	6,000	2,000	8,000	3,000
Ores (crude), etc.:				
Copper...short tons..	597,620	(8)	513,400	(8)
Dry and siliceous (gold and silver)...do....	......	......	20	(8)
Zinc...do....	896,700	(8)	1,065,900	(8)
Zinc-lead...do....	13,000	(8)	18,000	(8)
Petroleum...barrels..	(1)	(1)	50,000	55,000
Phosphate rock...long tons..	(1)	(1)	(1)	(1)
Pyrites...do....	(1)	(1)	(1)	(1)
Sand and gravel...short tons..	2,442,950	1,605,049	2,689,844	1,967,356
Silica (quartz)...do....	(1)	(1)	(1)	(1)
Silver...troy ounces..	38,333	24,781	31,994	21,717
Slate...	......	(1)	......	(1)
Stone...short tons..	[9] 2,599,840	[9] 4,237,351	[9] 5,626,210	[9] 8,312,977
Sulfuric acid [10]...do....	(1 2)	(1 2)	(1 2)	(1 2)
Tripoli...do....	(1)	(1)	(1)	(1)
Zinc...do....	(1)	(1)	(1)	(1)
Miscellaneous [11]...	......	32,655,754	......	37,574,261
Total value, eliminating duplications...	......	32,428,512	......	40,119,893

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] According to Bituminous Coal Division; figures for 1939 are preliminary.
[5] Value is estimated from various sources and includes selling expenses.
[6] Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
[7] No canvass.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Exclusive of dimension limestone, value for which is included under "Miscellaneous."
[10] From copper smelting.
[11] Includes minerals indicated by "1" and "9" above.

Mineral production of Texas, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Asphalt (native) short tons	123,382	$366,030	138,911	$333,818
Barite do	450	1,148		
Cement barrels	7,116,545	11,885,494	7,207,001	12,152,780
Clay:				
Products (other than pottery and refractories)		[1] 2,549,979		[1] 3,696,905
Raw (sold by producers) short tons	43,857	410,498	43,813	288,404
Coal:				
Bituminous do	[2] 32,466	[3] 76,000	(2 5)	(4 5)
Lignite do	846,219	679,000	814,022	875,000
Copper pounds	32,000	3,136	68,000	7,072
Fuller's earth short tons	37,998	358,980	38,338	359,058
Gems and precious stones		(6)		(6)
Gold troy ounces	439	15,365	324	11,340
Gypsum (crude) short tons	246,990	260,094	283.912	266,265
Helium cubic feet	[7] 6,099,960	[7] 64,259	[7] 6,281,800	[7] 75,262
Iron ore long tons			(5)	(5)
Lead short tons	342	31,464	227	21,338
Lime do	49,352	429,664	62,048	524,748
Mercury flasks (76 pounds)	(5)	(5)	(5)	(5)
Mineral waters gallons sold	(6)	(6)	(6)	(6)
Natural gas M cubic feet	882,473,000	133,486,000	979,427,000	141,535,000
Natural gasoline gallons	685,920,000	19,781,000	770,047,000	25,807,000
Ores (crude), etc.:				
Copper short tons	70	(8)	657	(8)
Dry and siliceous (gold and silver) do	130,923	(8)	141,132	(8)
Lead do	9	(8)	6	(8)
Petroleum barrels	475,850,000	539,150,000	483,528,000	478,330,000
Salt (sodium chloride) short tons	324,449	624,096	352,008	604,633
Sand and gravel do	7,647,981	3,966,148	7,622,309	3,670,423
Sand-lime brick thousands of brick	(1 5)	(1 5)		
Silver troy ounces	1,433,008	926,389	1,341,945	910,896
Sodium sulfate (natural) short tons	(5)	(5)	(5)	(5)
Stone do	3,256,240	2,625,281	3,771,750	3,320,508
Sulfur long tons	1,331,014	(5)	1,784,952	28,498,473
Tripoli short tons			(5)	(5)
Miscellaneous [9]		22,457,440		650,939
Total value, eliminating duplications		740,147,465		701,939,862

[1] Figures obtained through cooperation with Bureau of the Census.
[2] According to Bituminous Coal Division; figures for 1939 are preliminary.
[3] Value is estimated from various sources and includes selling expenses.
[4] Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
[5] Value included under "Miscellaneous."
[6] No canvass.
[7] Figures cover fiscal year ended June 30 of year stated.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Includes minerals indicated by "5" above.

Mineral production of Utah, 1938–39

Product	1938 Quantity	1938 Value	1939 Quantity	1939 Value
Arsenious oxide .... short tons	(1)	(1)	(1)	(1)
Asphalt (native) .... do	28, 650	$655, 644	37, 364	$1, 059, 034
Bismuth .... pounds	(2)	(2)	(2)	(2)
Bitumen, natural sulfonated .... short tons	(1)	(1)	(1)	(1)
Cement .... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)	----------	[3] 610, 883	----------	[3] 668, 717
Raw (sold by producers) .... short tons	21, 419	90, 790	29, 468	111, 414
Coal .... do	[4] 2, 946, 951	[5] 6, 875, 000	[4] 3, 340, 000	[6] 7, 114, 000
Coke .... do	140, 181	(1 7)	197, 526	(1 7)
Copper .... pounds	216, 252, 000	21, 192, 696	343, 780, 000	35, 753, 120
Fluorspar .... short tons	370	(1)	385	(1)
Gems and precious stones	----------	(8)	----------	(8)
Gold .... troy ounces	200, 630	7, 022, 050	277, 751	9, 721, 285
Gypsum (crude) .... short tons	43, 144	45, 823	58, 146	65, 269
Iron:				
Ore .... long tons	169, 947	(1)	262, 087	(1)
Pig .... do	(1 7)	(1 7)	(1 7)	(1 7)
Lead .... short tons	65, 657	6, 040, 444	67, 634	6, 357, 596
Lime .... do	25, 748	184, 390	38, 437	268, 557
Manganese ore .... long tons	----------	----------	50	(1)
Manganiferous ore .... do	----------	----------	262	1, 550
Molybdenum .... pounds	3, 256, 053	(1)	4, 957, 484	(1)
Natural gas .... M cubic feet	4, 277, 000	937, 000	4, 854, 000	1, 033, 000
Natural gasoline .... gallons	623, 000	28, 000	500, 000	26, 000
Ores (crude), etc.:				
Copper .... short tons	12, 032, 385	(9)	19, 602, 472	(9)
Dry and siliceous (gold and silver) .... do	560, 361	(9)	838, 897	(9)
Lead .... do	94, 883	(9)	77, 072	(9)
Lead-copper .... do	----------	----------	4, 951	(9)
Zinc .... do	83	(9)	----------	----------
Zinc-lead .... do	560, 948	(9)	570, 705	(9)
Zinc-lead-copper .... do	----------	----------		
Petroleum .... barrels	(1)	(1)	4, 000	4, 000
Potassium salts .... short tons	(1)	(1)	(1)	(1)
Salt (sodium chloride) .... do	61, 959	192, 495	68, 100	202, 244
Sand and gravel .... do	2, 775, 005	1, 263, 722	2, 218, 678	1, 100, 013
Silver .... troy ounces	9, 682, 732	6, 259, 544	10, 758, 657	7, 302, 846
Sodium sulfate (natural) .... short tons	(1)	(1)	(1)	(1)
Stone .... do	[10] 709, 430	[10] 390, 249	[10] 700, 610	[10] 444, 856
Sulfur .... long tons	(1)	(1)	(1)	(1)
Sulfuric acid [11] .... short tons	(1 7)	(1 7)	(1 7)	(1 7)
Tungsten ore (60-percent concentrates) .... do	7	(1)	3	(1)
Uranium and vanadium ores .... do	1, 300	88, 764	2, 237	(1)
Zinc .... do	33, 658	3, 231, 168	34, 526	3, 590, 704
Miscellaneous [12]	----------	7, 046, 700	----------	9, 355, 393
Total value, eliminating duplications	----------	59, 236, 355	----------	80, 221, 937

[1] Value included under "Miscellaneous."
[2] Figures not available.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] According to Bituminous Coal Division; figures for 1939 are preliminary.
[5] Value is estimated from various sources and includes selling expenses.
[6] Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
[7] Value not included in total value for State.
[8] No canvass.
[9] Not valued as ore; value of recoverable metal content included under the metals.
[10] Exclusive of granite, value for which is included under "Miscellaneous."
[11] From copper smelting.
[12] Includes minerals indicated by "1" and "10" above.

Mineral production of Vermont, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Asbestos ... short tons	9,348	$211,971	(1)	(1)
Clay:				
Products (other than pottery and refractories)		(1 2)		(1 2)
Raw (sold by producers) ... short tons			(1)	(1)
Garnet, abrasive ... do			(1)	(1)
Lime ... do	58,149	415,846	63,316	$452,045
Magnesite ... do			(1)	(1)
Mica, scrap ... do			(1)	(1)
Mineral waters ... gallons sold	(3)	(3)	(3)	(3)
Sand and gravel ... short tons	1,103,395	530,686	529,248	238,232
Slate		1,729,655		1,948,315
Stone ... short tons	264,480	3,148,950	232,770	3,412,005
Talc ... do	35,126	329,084	39,393	378,492
Miscellaneous		73,360		543,145
Total value, eliminating duplications		6,439,552		6,972,234

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

Mineral production of Virginia, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Aplite ... short tons	(1)	(1)	(2)	(2)
Asbestos ... do			(2)	(2)
Barite ... do			(2)	(2)
Cement ... barrels	(2)	(2)	(2)	(2)
Clay:				
Products (other than pottery and refractories)		[3] $1,885,876		[3] $2,818,947
Raw (sold by producers) ... short tons	(2)	(2)	(2)	(2)
Coal ... do	[4] 12,283,036	[5] 24,054,000	[4] 13,230,000	[6] 24,608,000
Coke ... do	133,905	[7] 645,630	165,317	[7] 783,512
Copper ... pounds	(2)	(2)		
Feldspar (crude) ... long tons	9,766	52,037	18,544	100,299
Ferro-alloys ... do	(2 7)	(2 7)	(2 7)	(2 7)
Gold ... troy ounces	2,943	103,005	364	12,740
Gypsum (crude) ... short tons	(2)	(2)	(2)	(2)
Iron:				
Ore ... long tons	(2)	(2)	(2)	(2)
Pig ... do	(2 7)	(2 7)	(2 7)	(2 7)
Kyanite ... short tons	(1)	(1)	(2)	(2)
Lead ... do	(2)	(2)	(2)	(2)
Lime ... do	161,687	1,014,607	166,542	990,796
Manganese ore ... long tons	2,242	37,815	1,661	31,795
Manganiferous ore ... do	1,670	15,502	4,584	27,004
Marl calcareous ... short tons	7,456	7,667	8,869	9,311
Mica:				
Scrap ... do	2,174	22,758	(2)	(2)
Sheet ... pounds	(2)	(2)	(2)	(2)
Millstones		(2)		(2)
Mineral waters ... gallons sold	(8)	(8)	(8)	(8)
Natural gas ... M cubic feet			60,000	48,000
Ores (crude), etc.:				
Copper ... short tons	145	(9)		
Dry and siliceous (gold and silver) ... do	17,680	(9)	3,350	(9)
Zinc-lead ... do	631,611	(9)	650,231	(9)
Phosphate rock ... long tons	(2)	(2)	(2)	(2)
Pyrites ... do	(2)	(2)	(2)	(2)
Salt ... short tons	(2)	(2)	(2)	(2)
Sand and gravel ... do	2,796,569	2,186,111	2,639,790	1,425,708
Sand and sandstone (ground) ... do	(2)	(2)	(2)	(2)
Silica (quartz) ... do	(2)	(2)	(2)	(2)
Silver ... troy ounces	502	325	1,780	1,208
Slate		369,060		(2)
Stone [10] ... short tons	5,474,690	5,606,470	5,813,630	5,879,447
Talc and ground soapstone [10] ... do	(2)	(2)	(2)	(2)
Titanium minerals:				
Ilmenite ... do	(2)	(2)	(2)	(2)
Rutile ... do	(2)	(2)	(2)	(2)
Zinc ... do	(2)	(2)	(2)	(2)
Miscellaneous [11]		9,264,842		11,678,638
Total value, eliminating duplications		42,370,169		43,582,537

[1] Figures not available.
[2] Value included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] According to Bituminous Coal Division; figures for 1939 are preliminary.
[5] Value is estimated from various sources and includes selling expenses.
[6] Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
[7] Value not included in total value for State.
[8] No canvass.
[9] Not valued as ore; value of recoverable metal content included under the metals.
[10] Soapstone used as dimension stone included in figures for stone.
[11] Includes minerals indicated by "2" above.

Mineral production of Washington, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Arsenious oxide ..... short tons	(1)	(1)	(1)	(1)
Cement ..... barrels	(2)	(2)	(2)	(2)
Clay:				
Products (other than pottery and refractories)		3 $955,294		3 $1,030,025
Raw (sold by producers) ..... short tons	38,993	62,274	28,637	53,634
Coal ..... do	4 1,566,973	5 4,939,000	4 1,690,000	6 5,256,000
Copper ..... pounds	12,034,000	1,179,332	17,996,000	1,871,584
Diatomite ..... short tons	1,072	16,684	1,707	24,814
Gems and precious stones		(7)		(7)
Gold ..... troy ounces	74,175	2,596,125	90,420	3,164,700
Iron ore ..... long tons	3,333	(2)	10,747	44,188
Lead ..... short tons	4,284	394,128	3,718	349,492
Lime ..... do	34,025	348,332	47,485	484,667
Magnesite ..... do	(2)	(2)	(2)	(2)
Magnesium sulfate (natural) ..... pounds	(2)	(2)	(2)	(2)
Manganese ore ..... long tons			10	(2)
Mercury ..... flasks (76 pounds)	(2)	(2)		
Mineral waters ..... gallons sold	(7)	(7)	(7)	(7)
Molybdenum ..... pounds	4,380	(2)		
Natural gas ..... M cubic feet	117,000	91,000	63,000	59,000
Olivine ..... short tons	(1)	(1)		
Ores (crude), etc.:				
Copper ..... do	373,120	(8)	597,957	(8)
Dry and siliceous (gold and silver) ..... do	278,847	(8)	266,857	(8)
Lead ..... do	538	(8)	400	(8)
Zinc-lead ..... do	249,184	(8)	259,350	(8)
Peat ..... do	543	7,630	(2)	(2)
Pulpstones ..... do	(2)	(2)	(2)	(2)
Sand and gravel ..... do	6,015,812	2,861,309	11,918,217	6,048,619
Sand-lime brick ..... thousands of brick	(2 3)	(2 3)	(2 3)	(2 3)
Silver ..... troy ounces	380,938	246,263	442,063	300,067
Stone ..... short tons	9 2,321,210	9 1,849,051	2,329,020	2,020,445
Talc and ground soapstone ..... do	174	894	190	1,225
Tungsten ore (60-percent concentrates) ..... do	303	(2)	100	(2)
Zinc ..... do	11,402	1,094,592	10,131	1,053,624
Miscellaneous[10]		4,525,096		9,827,939
Total value, eliminating duplications		21,167,004		31,590,023

[1] Figures not available.
[2] Value included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] According to Bituminous Coal Division; figures for 1939 are preliminary.
[5] Value is estimated from various sources and includes selling expenses.
[6] Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
[7] No canvass.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Exclusive of marble, value for which is included under "Miscellaneous."
[10] Includes minerals indicated by "2" and "9" above.

Mineral production of West Virginia, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Bromine ... pounds	830,346	$134,021	858,059	$140,910
Calcium chloride ... short tons	11,803	77,268	12,473	83,583
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)	------------	[2] 2,114,974	------------	[2] 3,000,116
Raw (sold by producers) ... short tons	31,658	68,687	46,758	93,426
Coal ... do	[3] 93,288,172	[4] 179,356,000	[3] 107,938,000	[5] 189,971,000
Coke ... do	1,500,247	[6] 4,820,199	1,686,070	[6] 4,699,840
Ferro-alloys ... long tons	(1 6)	(1 6)	(1 6)	(1 6)
Grindstones and pulpstones ... short tons	1,460	82,879	2,703	168,510
Iron, pig ... long tons	496,905	(1 6)	761,812	(1 6)
Lime ... short tons	163,064	1,003,559	249,987	1,461,002
Manganese ore ... long tons	163	2,470	26	380
Marl, calcareous ... short tons	(1)	(1)	(1)	(1)
Mineral waters ... gallons sold	(7)	(7)	(7)	(7)
Natural gas ... M cubic feet	134,342,000	55,910,000	159,226,000	63,194,000
Natural gasoline ... gallons	50,398,000	2,063,000	52,272,000	2,017,000
Petroleum ... barrels	3,684,000	5,600,000	3,580,000	6,000,000
Salt ... short tons	129,568	721,490	144,727	773,988
Sand and gravel ... do	1,654,546	1,803,474	1,968,852	2,036,020
Sand and sandstone (ground) ... do	(1)	(1)	(1)	(1)
Stone ... do	[8] 3,194,980	[8] 4,391,563	[8] 3,808,140	[8] 4,477,8[illegible]8
Sulfuric acid [9] ... do	(1 6)	(1 6)	(1 6)	(1 6)
Miscellaneous [10]	------------	15,504,037	------------	26,437,932
Total value, eliminating duplications	------------	254,995,309	------------	275,562,954

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 According to Bituminous Coal Division; figures for 1939 are preliminary.
4 Value is estimated from various sources and includes selling expenses.
5 Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
6 Value not included in total value for State.
7 No canvass.
8 Exclusive of unclassified stone, value for which is included under "Miscellaneous."
9 From zinc smelting.
10 Includes minerals indicated by "1" and "8" above.

Mineral production of Wisconsin, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay products (other than pottery and refractories)	------------	[2] $406,811	------------	[2] $494,323
Coke ... short tons	(1 3)	(1 3)	(1 3)	(1 3)
Iron ore ... long tons	625,378	1,886,477	1,173,828	3,526,980
Lead ... short tons	320	29,440	388	36,472
Lime ... do	55,993	483,111	64,290	541,787
Marl, calcareous ... do	(1)	(1)	(1)	(1)
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Molybdenum ... pounds	------------	------------	(1)	(1)
Ores (crude), etc.: Zinc-lead ... short tons	58,700	(5)	213,400	(5)
Pyrites ... long tons	(1)	(1)	(1)	(1)
Sand and gravel ... short tons	6,273,424	2,799,926	7,024,722	2,616,204
Sand and sandstone (ground) ... do	(1)	(1)	(1)	(1)
Sand-lime brick ... thousands of brick	(1 2)	(1 2)	(1 2)	(1 2)
Silica (quartz) ... short tons	(1)	(1)	(1)	(1)
Stone ... do	3,097,230	3,880,935	3,182,780	3,564,045
Sulfuric acid [6] ... do	(1 3)	(1 3)	------------	------------
Zinc ... do	2,073	199,008	5,904	614,016
Miscellaneous [7]	------------	5,111,565	------------	4,993,973
Total value, eliminating duplications	------------	10,636,741	------------	12,704,942

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

Mineral production of Wyoming, 1938–39

Product	1938		1939	
	Quantity	Value	Quantity	Value
Cement............barrels..	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)...	....	(1 2)	....	[2] $182,185
Raw (sold by producers)............short tons..	58,911	$530,834	76,133	777,722
Coal............do....	[3] 5,203,877	[4] 9,851,000	[3] 5,383,000	[5] 10,766,000
Feldspar (crude)............long tons..	1,168	4,343	6,726	25,008
Gems and precious stones............	....	(6)	....	(6)
Gold............troy ounces..	798	27,930	583	20,405
Gypsum (crude)............short tons..	(1)	(1)	(1)	(1)
Iron ore............long tons..	275,995	(1)	587,892	(1)
Mica, scrap............short tons..	(1)	(1)	(1)	(1)
Mineral waters............gallons sold..	(6)	(6)	(6)	(6)
Natural gas............M cubic feet..	26,678,000	4,853,000	26,614,000	4,901,000
Natural gasoline............gallons..	30,024,000	1,364,000	30,961,000	1,575, 00
Ores (crude), etc.:				
Dry and siliceous (gold and silver)....short tons..	581	(7)	57	(7)
Petroleum............barrels..	19,022,000	18,000,000	21,454,000	18,150,000
Potassium salts............short tons..	(1)	(1)	....	....
Sand and gravel............do....	1,893,612	781,283	1,675,120	746,022
Silver............troy ounces..	328	212	75	51
Sodium sulfate (natural)............short tons..	(1)	(1)	(1)	(1)
Stone............do....	252,170	346,018	690,860	668,069
Tantalum ore............pounds..	(1)	(1)	(1)	(1)
Vermiculite............short tons..	(1)	(1)	(1)	(1)
Miscellaneous [8]............	....	1,605,743	....	1,614,006
Total value, eliminating duplications............	....	37,364,363	....	39,425,468

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division; figures for 1939 are preliminary.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value is estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Includes minerals indicated by "1" above.

EFFECT OF INTERNATIONAL SITUATION ON UNITED STATES TRADE IN MINERALS

By J. S. McGrath

SUMMARY OUTLINE

Stimulation of import trade by national defense program.—The position of the United States with respect to its dependence on foreign sources of supply for certain strategic and critical minerals as listed and defined by the Army and Navy Munitions Board in March 1940 was improved considerably during the year through effective administration of the Strategic Materials Act (Public No. 117—76th Congress), which became law in June 1939. Certain restrictions inserted in this act, however, retarded stock-pile purchases to such a degree that in June 1940 the Metals Reserve Co. was created by the Reconstruction Finance Corporation to acquire and carry a reserve supply of strategic and critical minerals, principally tin and manganese, in connection with the national defense program. During 1940 the Procurement Division of the Treasury Department—the agency responsible for administering the purchasing and stock-piling features of the Strategic Materials Act—and the Metals Reserve Co. endeavored to coordinate their activities directly concerned with the procurement features of the national defense program.

The rapidly changing conditions in world markets since May 1940 and the continual revisions of estimated requirements of mineral raw materials necessary to meet unprecedented and in certain instances unanticipated industrial demands prompted direct negotiations between the Government of the United States on one hand and foreign governments and producers on the other; these negotiations have resulted in contracts for the purchase of certain minerals essential in the present emergency.

In September 1940 the Metals Reserve Co. contracted with the National Resources Commission of China for the purchase of tungsten ore, the total value of which will approximate $30,000,000; the ore will be delivered over a period of years at prices established by existing market conditions at the time of delivery. In November 1940 the same agency contracted with tin-ore producers of Bolivia for annual delivery to the United States during the next 5 years of tin concentrates equivalent to 18,000 tons of refined metallic tin a year; the Bolivian Government has guaranteed the performance of this contract. To refine the Bolivian concentrates the Reconstruction Finance Corporation agreed to underwrite the construction of a tin smelter to be built at Texas City, Tex., by the Tin Processing Corporation of New York, a subsidiary of N. V. Billiton Maatschappij, Netherlands East Indies. The plant will be owned by the United States Government and operated for its account. The smelter will have an annual capacity of 50,000 tons of tin concentrates or 18,000 tons of fine tin.

Although the chief concern of United States Government purchasing agencies is the procurement of strategic materials of which this country has inadequate domestic reserves, in December 1940 the Metals Reserve Co. announced that it had contracted to purchase 100,000 tons of copper produced in Latin America. Early in 1941 a contract for an additional 100,000 tons involving the same foreign producers was negotiated, with delivery beginning in March 1941. In January 1941 the Metals Reserve Co. also contracted for 300,000 short tons of Chilean sodium nitrate.

Control of exports essential to procurement program.—As the national defense program expanded during the year it became increasingly clear that to insure domestic industries against serious shortages of vital raw materials some method of export control had to be applied whenever a deficiency could be anticipated. The need for such control was foreseen, and on July 2, 1940, H. R. 9850, "an act to expedite the strengthening of the national defense," became law. This act provides legal authority for the control, by a licensing scheme, of exports of munitions, materials, and machinery essential to national defense from the United States.

Although the control of exports is principally a matter of national defense and as such is a function of the Administrator of Export Control, War Department, the Department of State actually issues the licenses under which all controlled items may be exported. Seven Presidential proclamations and two Executive orders were issued between July 2, 1940, and January 10, 1941, specifying commodities of which the export was subjected to control through the issuance of licenses. This list of controlled mineral products, comprising ore, metals, nonmetallic minerals, fuels, chemicals, semifabricates, and manufactures, was virtually all-inclusive by the beginning of 1941. These proclamations and Executive orders are registered at the National Archives, Washington, D. C., under Presidential Proclamations Nos. 2413, 2417, 2423, 2428, 2441, 2449, 2453, and Executive Orders Nos. 8607 and 8617.

Alternative sources of strategic minerals.—Dislocation in ocean traffic that extended throughout 1940, shortage of carriers, and transport difficulties incident to the delivery of essential raw materials to the United States, which interrupted the flow of Turkish and Greek chromite and Russian manganese ore, may, if extended to the Pacific Ocean, reduce or entirely cut off delivery of such supplies as Chinese tungsten, Malayan and Netherlands East Indian tin, and Indian mica. The present and potential difficulties in this direction have prompted the United States to focus attention on sources of such essential minerals in the Western Hemisphere.

Latin America as potential source of supply.—Latin America has important mineral resources, but situation of the deposits, transportation difficulties, and lack of capital have retarded their development.

Most of these Latin American mineral commodities are produced principally, if not entirely, for export. Without a foreign market these minerals would find only limited use within the countries that produce them, therefore the volume of foreign trade has a profound effect on the internal economies of most Latin American countries. Closer collaboration between the United States and Latin America so far as the term affects the mineral industries is predicated on recognition of this condition of fact; permanent solution is by no means a simple matter. Latin America is not industrialized as the term is generally understood. Of the mineral resources regarded as basic to modern industry—coal, iron, and petroleum—only petroleum has been developed to any significant extent. South America ranks last among the continents in production of coal. Iron is found to some extent in most Latin American countries, but the deposits have remained largely undeveloped because of their inaccessibility, lack of adequate transportation facilities, and the absence of conveniently situated coal deposits. Consequently nearly all of the minerals (including petroleum) produced in the several countries, must be exported, and before September 1939 countries of destination were principally in Europe.

To illustrate the dependence of certain countries on foreign trade in minerals, several examples are cited. In 1938 mineral products exported from Chile represented 79.4 percent of the total exports in value, while agricultural and related products comprised 17 percent and manufactures 3.6 percent; copper constituted 57.4 percent and nitrates 22.4 percent of the value of all mineral products exported. The influence of the two mineral commodities, copper and nitrates, on Chile's economic welfare is evident. In the same year the value of Bolivia's mineral exports (chiefly tin, tungsten, antimony, and precious metals) was over 96 percent of the total value of all exports. In 1938 the exportation of crude petroleum from Venezuela represented 90 percent of the total value of all exports from that country. In 1938, 26 percent of Colombia's export trade was in crude petroleum; and 60.1 percent of Peru's export trade was in mineral products, chiefly petroleum (33.9 percent), copper (16.9 percent), bismuth, gold, and other mineral concentrates (8.1 percent). To a minor degree the remainder of the mineral-producing countries of Latin America are similarly situated; that is, their principal source of revenue is in the sale abroad of minerals of which in many instances the United States normally has exportable surpluses. No real solution of this problem had been achieved by the end of 1940, but definite progress was made and negotiations were under way between the Government of the United States and several countries of Latin America whereby the latter may ultimately market their entire output of certain minerals in this country under arrangements that will be acceptable to all parties concerned.

With particular reference to the strategic minerals produced in Latin America, opportunities exist for negotiations whereby immediate and mutual benefits can be derived by the United States and the Latin American countries involved. In 1940 the United States imported 1,282,079 long tons of ferro-grade manganese ore, of which approximately 24 percent originated in Latin America, chiefly in Brazil and Cuba. Domestic production last year was about 6 percent of apparent consumption in the United States. It is reliably reported that if rail facilities in Brazil are improved and ocean shipping space is available about half of the United States requirements for 1941 may be obtained from Brazil alone. Cuba can supply 10 to 15 percent of our needs, and Chile may be able to reduce this country's dependence on other foreign sources of supply even further.

In 1940 the United States imported 2,138 metric tons of tungsten ore, of which about 35 percent originated in Latin America. The United States produced about 65 percent of its apparent consumption of tungsten, and under the impetus of prevailing demand this figure may be increased. However, if the United States acquires the entire output of Bolivia and Argentina it is believed that no serious deficit will develop in 1941.

In 1940 about 96 percent of the antimony imported into the United States originated in Latin America; 90 percent was supplied by Mexico and Bolivia and the remainder by Peru and Argentina.

The only Latin American source that contributed to imports of chromite by the United States in 1940 was Cuba, which supplied about 11 percent of the total imports. However, Brazil has the largest deposits of chromite in South America, and although the output has been limited to only a few thousand tons a year it is believed that with mine development, improved transport facilities, and favorable prices an annual production of possibly 100,000 tons can be attained.

Until the smelter that the Reconstruction Finance Corporation is erecting in Texas is completed and operating, tin concentrates available in Bolivia and Argentina cannot materially reduce dependence of the United States on far eastern sources of supply; even with these smelting facilities available, this country's dependence would be reduced only to a limited extent. However, the output of ore in both Bolivia and Argentina can be increased to some extent, and if the entire production becomes available to the United States the position of this country will be less vulnerable than in the past. Electrical-grade mica, quartz crystals, and industrial diamonds of Brazil are vital in the national defense program, and there are indications that Brazil's entire output of these materials may be contracted for by the United States before the end of 1941.

PART II. METALS

GOLD AND SILVER

By Chas W. Henderson

SUMMARY OUTLINE

Gold production (mine report) in the United States (Territories included) increased in 1940 for the eleventh consecutive year and set a new high annual record. In the 7 years 1934–40, during which gold was valued at $34.95 per fine ounce in 1934 and at $35 in 1935–40 in terms of United States currency (compared with $20.67+ from 1837 to 1932, inclusive), the annual domestic output has more than doubled; it totaled 5,984,163 fine ounces in 1940 compared with 2,628,775 fine ounces in 1933, when the average weighted price was $25.56 per fine ounce. The increase in 1940 over 1939, however, was only 5 percent compared with 10 percent in 1939 over 1938. Although final figures on the total output of gold in the world in 1940 are not yet available, preliminary data indicate that the world output increased about 3 percent over 1939 to 41,560,000 ounces—the highest in history. The Union of South Africa continued to be the principal gold-producing country, followed, in order, by the United States (including Territories), Canada, and U. S. S. R.; these four nations produced approximately 73 percent of the total world output of gold in 1940.

The mine output of recoverable silver in the United States (Territories included) in 1940 was 71,824,746 fine ounces, a 10-percent increase over 1939, resulting from the rise in production of copper, zinc-lead, and lead ores caused by the advance in base-metal prices. Approximately 70 percent of the total world output of silver in 1940—estimated at 275,654,000 fine ounces—came from Mexico, United States, Canada, and Peru, listed in order of quantity produced.

DOMESTIC REFINERY PRODUCTION

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

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

Gold and silver produced in the United States, 1936–40, and approximate distribution of source, by States and Territories, in 1940

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

State or Territory	Gold [1]		Silver [2]	
	Fine ounces	Value	Fine ounces	Value
1936	4,357,394	$152,508,800	63,812,176	$49,422,530
1937	4,804,540	168,158,900	71,941,794	55,646,978
1938	5,089,811	178,143,400	62,665,335	40,510,924
1939	5,611,171	196,391,000	65,119,513	44,202,279
1940:				
Alabama	5	200	3	2
Alaska	756,964	26,493,700	173,141	123,122
Arizona	299,345	10,477,100	6,129,788	4,358,960
California	1,443,889	50,536,100	2,224,590	1,581,931
Colorado	369,075	12,917,600	9,378,408	6,669,090
Georgia	966	33,800	632	449
Idaho	144,980	5,074,300	17,477,054	12,428,127
Illinois			544	387
Indiana	5	200		
Michigan			90,218	64,155
Missouri			145,190	103,246
Montana	273,369	9,567,900	12,152,044	8,641,453
Nevada	379,868	13,295,400	5,102,102	3,628,162
New Mexico	39,210	1,372,400	1,576,102	1,120,784
New York			35,743	25,417
North Carolina	1,683	58,900	6,390	4,544
Oregon	113,715	3,980,000	191,820	136,405
Pennsylvania	1,977	69,200	14,077	10,010
Philippine Islands	1,140,126	39,904,400	1,299,199	923,875
South Carolina	12,872	450,500	7,907	5,623
South Dakota	587,160	20,550,600	170,680	121,373
Tennessee	177	6,200	38,947	27,696
Texas	303	10,600	1,294,966	920,865
Utah	352,331	12,331,600	11,686,321	8,310,273
Virginia	494	17,300	313	223
Washington	83,880	2,935,800	389,481	276,964
Wyoming	711	24,900	74	53
	6,003,105	210,108,700	69,585,734	49,483,189

[1] Gold valued at $35 per fine ounce.
[2] Silver valued as follows: 1936, $0.7745; 1937, $0.7735; 1938, $0.646+; 1939, $0.678787+; 1940, $0.7111+.

The quantity of gold reclaimed in 1939 from old jewelry, dental waste, scrap, and other material received at private refineries and the United States mints and assay offices was 895,096 ounces and that sold for industrial use 1,108,256 ounces; the difference (213,160 ounces) represents the quantity of new gold used in the arts and industries during the year. Secondary silver recovered in 1939 from silverware, photographic film, and other sources totaled 24,972,260 ounces and that issued for the industrial arts 69,585,265 ounces, indicating that 44,613,005 fine ounces of new silver were required for industry.

Gold and silver produced in the United States, 1792–1940

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

Period	Gold		Silver	
	Fine ounces	Value [1]	Fine ounces	Value [2]
1792–1847	1,187,170	$24,537,000	309,500	$404,500
1848–72	58,279,778	1,204,750,000	118,568,200	157,749,900
1873–1940	201,981,810	4,641,950,700	3,538,095,665	2,663,884,894
	261,448,758	5,871,237,700	3,656,973,365	2,822,039,294

[1] Gold valued in 1934 and thereafter at $35 per fine ounce; prior thereto at $20.67+ per fine ounce. Dollar figures are rounded.
[2] Silver valued in 1934 and thereafter at Government's average buying price for domestic product: In 1934 and 1938 at $0.64+ per fine ounce, in 1935 at $0.71875, in 1936 at $0.7745, in 1937 at $0.7735, in 1939 at $0.678787+, and in 1940 at $0.7111+.

The average commercial value per fine ounce of silver for the total recorded domestic production is $0.772.

PRICES OF GOLD AND SILVER

Gold.—Under the Gold Reserve Act of 1934 the value of gold was fixed by Presidential proclamation on January 31, 1934, at $35 per fine troy ounce and has remained at that figure through 1940. From January 18, 1837,[1] through 1932, the price was $20.67+ per ounce, and in 1933 the legal coinage value was continued at $20.67+. The average weighted price per fine ounce in 1933, as computed by the Bureau of Mines, was $25.56 and in 1934, $34.95. A complete account of regulations pertaining to gold and silver in 1933–34 is given in the chapter on Gold and Silver in Minerals Yearbook, 1934 (pp. 25–46), issued by the Bureau of Mines.

Silver.—The Government price for newly mined domestic silver was maintained throughout 1938 and to June 30, 1939, at $0.646464646+ per fine ounce. The act of Congress approved July 6, 1939, fixed the price of domestic silver mined after July 1, 1939, at $0.711+ per ounce. The annual average prices [2] used for domestic silver from 1932 to 1939 are as follows: 1932, $0.282; 1933, $0.350; 1934, $0.646464646+; 1935, $0.71875; 1936, $0.7745; 1937, $0.7735; 1938, $0.646464646+; 1939, $0.678787878+; 1940, $0.711111111+.

The following table, copied from the Annual Report of the Director of the Mint for the Fiscal Year Ended June 30, 1940, shows the price of silver in London and in New York in 1939 and the first half of 1940.

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

Price of silver in London and in New York, 1939–40

[From the Report of the Director of the Mint]

Month	London price per ounce, 0.925 fine			Average monthly exchange, New York on London	United States equivalent, per fine ounce, of London price, at current rate of exchange	Average monthly New York price of fine bar silver, per ounce (mean of bid and asked quotations)
	Highest	Lowest	Average			
1939	*Pence*	*Pence*	*Pence*	*Dollars*	*Dollar*	*Dollar*
January	21 1/8	19 15/16	20.3050	4.6694	0.42706	0.43062
February	20 3/4	19 15/16	20.3698	4.6857	.42963	.43062
March	20 5/8	19 7/8	20.2801	4.6854	.42802	.43062
April	20 3/16	19 15/16	20.0312	4.6805	.42233	.43062
May	20 3/8	19 15/16	20.1226	4.6813	.42442	.43062
June	20	18	19.5048	4.6824	.41140	.42267
July	18 3/16	16 1/16	16.9519	4.6815	.35579	.35268
August	20 1/16	16 5/8	17.7187	4.6108	.36703	.36263
September	23 1/2	19 3/4	22.1781	3.9951	.39912	.37268
October	23 1/2	21 1/4	22.7358	4.0105	.41073	.36038
November	23 1/2	23 1/16	23.3778	3.9247	.41329	.35062
December	23 1/2	22 1/2	23.2631	3.9301	.41171	.35268
1940						
January	22 5/8	21 1/16	21.8920	3.9639	.39089	.35062
February	21 13/16	20 3/16	20.9345	3.9633	.37375	.35062
March	21 5/16	20 1/16	20.7632	3.7591	.35158	.35062
April	21 1/4	20 1/2	20.7131	3.5259	.32897	.35062
May	23 1/2	20 7/8	21.8777	3.2736	.32261	.35261
June	23 1/2	21 1/8	22.6875	3.6016	.36807	.35137
Average, calendar year 1939			20.4090	4.4354	.40776	.39395
Average, fiscal year 1939–40			21.2578	3.9367	.37446	.35484

UNITED STATES AND WORLD MONETARY STOCKS

According to figures published in the Federal Reserve Bulletin, the gold reserves of the United States increased $4,351,000,000 in 1940 and totaled $21,995,000,000 at the end of the year. The reserves continued to increase in 1941, although at a lower rate than in 1940, and were shown by the daily statement of the United States Treasury, June 2, 1941, to be 644,998,521.7 fine ounces valued at $22,574,948,258.76. The Treasury silver holdings on December 31, 1940, approximated 3,135,000,000 fine ounces.

Gold reserves (including stabilization funds) held by central banks and governments in the world at the end of 1939 totaled approximately $29,122,000,000. Adding $1,400,000,000 for new gold produced in 1940 raises the total reserves of the world (52 countries) to about $30,522,000,000.

IMPORTS AND EXPORTS

Value of gold and silver imported into and exported from the United States, 1939–40, by classes

	Imports	Exports	Excess of imports over exports
1939			
Gold:			
Contained in ore and base bullion	$92,763,736	$340,957	$92,422,779
Bullion refined	3,476,102,792	167,106	3,475,935,686
United States coin	752		752
Foreign coin	5,791,560		5,791,560
	3,574,658,840	508,063	3,574,150,777
Silver:			
Contained in ore and base bullion	23,311,788	185,996	23,125,792
Bullion refined	54,598,730	8,312,856	46,285,874
United States coin	294,328	66,738	227,590
Foreign coin	7,102,249	6,064,202	1,038,047
	85,307,095	14,629,792	70,677,303
1940			
Gold:			
Contained in ore and base bullion	110,935,025	103,922	110,831,103
Bullion refined	4,115,289,974	1,016,218	4,114,273,756
United States coin	9,057	6,347	2,710
Foreign coin	523,233,147	3,868,412	519,364,735
	4,749,467,203	4,994,899	4,744,472,304
Silver:			
Contained in ore and base bullion	21,069,295	4,030	21,065,265
Bullion refined	36,916,258	3,343,184	33,573,074
United States coin	217,964	7,790	210,174
Foreign coin	230,349	319,381	(—)89,032
	58,433,866	3,674,385	54,759,481

DOMESTIC SUPPLY

The domestic supply of new gold comes chiefly from dry and siliceous ore and from placer gravel. These two sources yielded 90 percent of the domestic gold (excluding Philippine Islands and Puerto Rico) in 1915, 80 percent in 1930, 87 percent in 1931, 93 percent in 1932, 1933, and 1934, 91 percent in 1935, 88 percent in 1936, 85 percent in 1937, 90 percent in 1938, 88 percent in 1939, and 87 percent in 1940. The proportionate output of gold from copper ore was 7 percent in 1915, 16 percent in 1930, 10 percent in 1931, 4 percent in 1932, 5 percent in 1933 and 1934, 7 percent in 1935, 10 percent in 1936, 12 percent in 1937, 8 percent in 1938, 10 percent in 1939, and 11 percent in 1940. These sources represented 96 to 98 percent of the gold supply in 1915 and 1930–40.

In 1915 dry and siliceous ore yielded in rounded figures 36 percent of the total silver; copper ore, 26 percent; lead ore, 27 percent; and zinc-lead ore, 9 percent. In 1939 dry and siliceous ores yielded 47 percent and in 1940, 41 percent; copper ore, 29 and 29 percent; lead ore, 5 and 4 percent; and zinc-lead ore (including zinc-copper and zinc-lead copper ores), 19 and 24 percent.

WORLD PRODUCTION OF GOLD AND SILVER

According to the Bureau of the Mint, the world output of gold and silver from 1493 to 1939 is 1,334,725,710 fine ounces of gold, valued at $30,494,725,785, and 16,979,933,601 fine ounces of silver, valued at $15,358,454,596.

The following tables show the world output of gold and silver from 1936 to 1940.

World production of gold, 1936–40, by countries, in fine ounces [1]

[Compiled by L. P. Lounsbery]

Country	1936	1937	1938	1939	1940
North America:					
United States:					
Continental [2]	3,759,645	4,112,160	4,245,368	4,620,567	4,862,979
Puerto Rico	483	17	9	35	----------
Canada	3,748,028	4,096,213	4,725,117	5,094,379	5,322,857
Central America and West Indies:					
Costa Rica	12,625	16,920	17,994	13,261	(3)
Cuba	[4] 2,140	3,707	3,889	3,851	1,251
Dominican Republic (exports)	8,901	7,102	5,275	6,304	6,914
Guatemala	1,824	4,180	5,466	5,058	4,447
Honduras	20,966	24,170	21,879	[4] 27,000	[4] 23,000
Nicaragua	23,077	24,242	44,301	100,182	164,355
Panama	12,651	5,098	4,867	2,736	(3)
Salvador [5]	15,071	15,310	12,065	16,424	51,195
Other countries [4]	42,700	39,300	48,300	(3)	(3)
Mexico	753,967	846,400	923,819	841,642	883,117
Newfoundland	16,114	22,470	24,246	20,316	21,786
	8,418,000	9,217,000	10,083,000	10,802,000	11.409,000
South America:					
Argentina	12,217	10,449	8,423	12,249	(3)
Bolivia [6]	13,833	14,251	9,255	7,884	[7] 11,735
Brazil [6]	223,351	203,643	216,630	290,096	318,935
Chile	248,799	272,704	294,001	302,667	341,000
Colombia	389,495	442,222	520,717	570,122	631,900
Ecuador	78,685	59,500	74,042	85,352	85,000
Guiana:					
British	32,234	35,993	38,482	38,473	35,745
French	45,558	47,422	40,638	37,606	[4] 38,000
Netherlands (Surinam)	14,258	12,756	14,154	14,812	15,921
Peru	152,409	205,350	260,326	272,362	288,167
Uruguay	----------	----------	657	1,608	1,762
Venezuela	109,996	116,519	114,985	146,608	146,792
	1,321,000	1,421,000	1,592,000	1,780,000	1,927,000
Europe:					
Bulgaria	----------	50	200	(3)	(3)
Czechoslovakia	16,248	9,930	10,000	10,000	(3)
Finland	4,919	4,822	3,858	4,822	(3)
France	85,682	66,423	87,354	(3)	(3)
Germany	7,584	8,028	8,650	(3)	(3)
Austria	----------	140			
Hungary	836	5,159	5,655	5,079	(3)
Italy	3,697	3,103	5,016	(3)	(3)
Norway	42	96	55	(3)	(3)
Portugal	3,282	4,366	6,186	(3)	(3)
Rumania	160,014	277,043	157,924	211,496	130,760
Spain	4,019	(3)	(3)	(3)	(3)
Sweden	158,342	193,226	234,122	216,149	197,995
Switzerland	965	964	1,125	1,447	(3)
U. S. S. R. [4]	5,327,000	5,359,000	5,236,000	(3)	(3)
United Kingdom	1	60	2,428	(3)	(3)
Yugoslavia	84,106	87,578	78,318	33,662	(3)
	5,857,000	6,024,000	5,841,000	5,588,000	[8] 5,500,000
Asia:					
Burma	1,439	1,004	1,209	(3)	(3)
China	(3)	(3)	(3)	(3)	(3)
Manchuria [6]	119,150	118,829	(3)	(3)	(3)
Chosen	562,316	734,585	948,447	975,000	(3)
Cyprus (exports)	20,991	23,650	29,245	16,393	(3)
India, British	331,946	330,744	321,138	314,515	289,000
Indochina	9,002	9,870	8,745	8,070	4,340
Japan	713,685	723,375	[4] 740,000	[4] 836,000	(3)
Malay States:					
Federated	37,779	33,828	40,209	40,283	35,689
Straits Settlements	----------	----------	5	8	6
Unfederated	761	519	581	880	479

See footnotes at end of table.

World production of gold, 1936–40, by countries, in fine ounces—Continued

Country	1936	1937	1938	1939	1940
Asia—Continued.					
Netherlands Indies	71,664	55,621	76,443	81,183	(3)
Philippine Islands	597,266	716,967	903,265	1,040,146	1,099,058
Sarawak	23,372	19,214	18,520	17,261	12,285
Siam	11,470	13,768	13,804	(3)	(3)
Taiwan	41,608	123,073	145,000	(3)	(3)
Turkey	------------	------------	514	(3)	(3)
	2,697,000	3,006,000	3,447,000	4,640,000	3,652,000
Africa:					
Bechuanaland	16,746	17,577	19,111	17,219	18,015
Belgian Congo	389,281	419,664	455,264	494,642	(3)
Cameroons, French	11,027	14,211	15,542	(3)	(3)
Egypt	278	1,226	2,162	3,877	(3)
Eritrea	1,608	(3)	(3)	(3)	(3)
Ethiopia	25,700	(3)	(3)	(3)	(3)
French Equatorial Africa	22,088	21,490	40,028	(3)	(3)
French West Africa (exports)	114,424	128,346	127,220	(3)	(3)
Gold Coast	428,144	559,212	674,927	782,271	[4] 886,000
Kenya Colony	38,463	54,774	70,500	77,000	77,243
Liberia (exports)	[7] 1,567	2,457	1,902	6,536	(3)
Madagascar	15,111	13,471	13,770	(3)	(3)
Morocco, French	1,500	4,630	1,410	(3)	(3)
Nigeria	33,364	26,466	24,815	25,794	25,617
Nyasaland	30	2	5	(3)	(3)
Portuguese East Africa	8,223	11,129	9,609	11,064	11,432
Rhodesia:					
Northern	4,452	4,228	1,092	4,645	(3)
Southern	797,061	804,219	814,078	795,613	826,485
Sierra Leone	37,966	35,717	30,012	33,657	32,676
South-West Africa	4,065	2,804	1,796	1,619	1,358
Sudan	7,659	7,388	8,866	7,510	(3)
Swaziland	276	2,410	1,246	983	1,080
Tanganyika	69,675	75,281	81,857	[4] 150,000	(3)
Uganda	13,231	16,947	20,502	15,115	11,060
Union of South Africa	11,336,214	11,734,575	12,161,392	12,821,507	14,047,000
	13,378,000	13,972,000	14,609,000	15,483,000	16,831,000
Oceania:					
Australia:					
New South Wales	60,739	68,607	88,707	87,189	(3)
Northern Territory	7,705	11,563	12,378	16,586	22,423
Queensland	121,174	127,281	151,432	147,248	(3)
South Australia	7,681	6,962	5,292	3,930	(3)
Victoria	113,940	145,799	144,243	156,522	(3)
Western Australia	852,422	1,000,647	1,167,791	1,214,238	1,191,481
Fiji	16,955	24,917	92,362	110,000	115,000
New Guinea	220,974	217,152	236,133	246,214	275,000
New Zealand	164,575	168,487	152,050	178,955	179,000
Papua	20,719	22,153	33,249	28,164	35,000
Tasmania	17,600	20,276	22,200	19,984	(3)
	1,604,000	1,814,000	2,106,000	2,209,000	2,241,000
	33,275,000	35,454,000	37,678,000	40,502,000	41,560,000

1 Prepared with the cooperation of the Office of the Director of the Mint. All figures for 1940 preliminary and subject to revision. No official statistics are issued by Government of U. S. S. R., consequently figures released by the various authorities vary widely and are irreconcilable. This table records only official production and export figures. In some countries accurate figures are not possible to obtain, due to clandestine trade in gold.
2 Refinery production.
3 Data not available. Estimate included in total.
4 Approximate production.
5 Imports into the United States.
6 Purchases by the State Central Bank.
7 Exports.
8 Conjectural figure published by the American Bureau of Metal Statistics (New York), Annual Issue.

World production of silver, 1936–40, by countries, in fine ounces [1]

Country	1936	1937	1938	1939	1940
North America:					
United States [2]	63,350,774	71,298,930	61,688,834	63,871,972	68,286,535
Canada	18,334,487	22,977,751	22,219,195	23,163,629	23,815,715
Central America and West Indies:					
Honduras	3,104,507	3,210,337	3,335,070	4,118,864	3,892,770
Other countries [3]	495,000	390,000	965,000	681,000	(4)
Mexico	77,463,901	84,680,875	81,018,809	75,870,575	82,640,074
Newfoundland	1,249,472	1,447,637	1,645,590	1,421,060	1,494,066
	163,998,000	184,006,000	170,872,000	169,127,000	180,829,000
South America:					
Argentina	512,322	2,122,000	2,636,361	3,125,756	3,242,200
Bolivia	10,723,333	9,454,022	6,373,660	7,241,312	5,626,380
Brazil	23,887	25,238	25,585	27,075	24,694
Chile	1,431,383	1,854,649	1,414,086	1,180,902	1,515,563
Colombia	151,501	167,971	192,880	242,628	260,310
Ecuador	96,310	98,500	89,111	103,331	105,000
Guiana, British	4,240	4,740	5,060	(4)	(4)
Peru	19,915,101	17,453,331	20,552,816	18,802,075	18,450,250
	32,858,000	31,180,000	31,290,000	30,728,000	29,229,000
Europe:					
Bulgaria (estimated)	2,200	6,500	13,000	(4)	(4)
Czechoslovakia	1,088,718	1,103,444	1,190,326	(4)	(4)
Finland	(4)	57,900	57,900	(4)	(4)
France	476,860	563,860	[3] 565,000	(4)	(4)
Germany	6,541,551	6,774,161	7,010,000	(4)	(4)
Austria	29,061	9,774			
Greece [3]	310,000	375,000	335,000	(4)	(4)
Hungary	3,783	50,965	46,632	(4)	(4)
Italy	616,000	715,000	812,481	(4)	(4)
Norway	228,270	282,904	250,776	295,787	(4)
Poland	60,507	64,237	62,244	(4)	(4)
Portugal	12,905	11,337	16,742	(4)	(4)
Rumania	594,757	615,944	819,876	712,731	500,204
Spain	[5] 900,000	[5] 600,000	(4)	(4)	(4)
Sweden	939,541	946,261	1,123,861	1,122,865	(4)
U. S. S. R.[3]	6,590,000	7,230,000	8,022,000	(4)	(4)
United Kingdom	76,872	71,439	108,985	70,818	(4)
Yugoslavia	1,948,174	2,242,546	2,524,123	2,293,634	(4)
	20,474,000	21,721,000	23,459,000	23,163,000	[6] 22,000,000
Asia:					
Burma	5,952,000	6,180,000	5,920,000	6,175,000	(4)
China [6]	150,000	201,000	(4)	(4)	(4)
Chosen	1,891,137	2,672,978	(4)	(4)	(4)
Cyprus (exports)	125,704	132,968	199,719	103,953	(4)
Federated Malay States	3,300	3,000	3,500	(4)	(4)
Hong Kong	----	----	111,070	(4)	(4)
India, British	25,345	24,642	22,295	22,745	(4)
Indochina	5,594	3,537	2,411	1,672	(4)
Japan	9,765,572	9,902,000	10,100,000	(4)	(4)
Netherlands Indies	662,654	500,095	579,297	618,026	(4)
Philippine Islands	491,701	719,771	1,167,612	1,327,842	1,396,010
Sarawak	----	----	1,660	700	(4)
Taiwan	12,936	(4)	(4)	(4)	(4)
Turkey [5]	300,000	380,000	350,000	575,000	(4)
	19,386,000	20,735,000	21,323,000	21,893,000	23,396,000
Africa:					
Algeria	45,236	72,177	90,000	85,000	(4)
Bechuanaland	1,378	1,499	1,127	813	1,207
Belgian Congo	2,781,521	2,961,855	3,117,014	2,085,000	(4)
Gold Coast [6]	14,000	19,000	23,000	(4)	(4)
Kenya Colony	5,721	7,549	11,200	[3] 12,000	13,626
Morocco French	88,254	241,549	208,980	(4)	(4)
Nigeria	153,000	102,120	(4)	(4)	(4)
Portuguese East Africa	1,337	1,474	1,808	2,319	1,901
Rhodesia:					
Northern	229,151	83,861	88,237	80,137	(4)
Southern	145,072	152,038	166,417	173,556	186,080
Sierra Leone	1,537	1,568	(4)	(4)	(4)
South-West Africa	135,000	385,500	673,500	587,000	460,000
Tanganyika	9,254	11,696	16,473	(4)	(4)
Tunisia	44,979	58,354	61,149	(4)	(4)
Uganda	924	1,379	1,981	1,376	1,015
Union of South Africa	1,075,626	1,100,641	1,135,374	1,182,516	1,292,000
	4,732,000	5,202,000	5,648,000	4,663,000	[5] 4,600,000

See footnotes at end of table.

World production of silver, 1936–40, by countries, in fine ounces—Continued

Country	1936	1937	1938	1939	1940
Oceania:					
Australia:					
New South Wales	8,557,803	9,780,499	9,558,550	[3] 9,500,000	(4)
Queensland	3,084,008	3,264,994	3,533,490	3,885,963	(4)
South Australia	1,560	955	503	541	(4)
Victoria	7,964	5,443	5,898	6,285	(4)
Western Australia	76,798	180,562	271,346	287,439	285,000
Fiji	1,185	3,463	12,380	(4)	(4)
New Guinea [6]	97,000	96,000	104,000	[5] 175,015	[5] 170,000
New Zealand	432,973	443,981	357,709	390,342	418,500
Tasmania	906,458	1,060,785	1,219,550	1,278,116	(4)
	13,166,000	14,837,000	15,063,000	15,537,000	[5] 15,600,000
	254,614,000	277,681,000	267,655,000	265,111,000	275,654,000

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

MINE REPORT

METHOD OF COLLECTING STATISTICS

The first table in this report presents the official refinery figures for production of gold and silver in the United States from 1936 to 1940, as agreed upon by the Bureau of the Mint and the Bureau of Mines. These figures record the output of gold and silver bullion from domestic ore in marketable form as metals, either refined or unrefined.

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

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

Gold and silver produced in the United States, 1905–40, in fine ounces, according to mint and mine returns, in terms of recovered metals

Year	Mint		Mine	
	Gold	Silver	Gold	Silver
1905–35	105,062,800	1,762,274,813	104,785,467	1,754,133,405
1936	4,357,394	63,812,176	4,405,118	61,647,455
1937	4,804,540	71,941,794	4,834,062	72,128,397
1938	5,089,811	62,665,335	5,170,743	62,873,450
1939	5,611,171	65,119,513	5,672,485	65,565,024
1940	6,003,105	69,585,734	5,984,163	71,824,746
	130,928,821	2,095,399,365	130,852,038	2,088,172,477

Compared with the mine reports, the mint reports for the 36 years show a total excess of gold of 76,783 ounces (a difference of 0.06 percent) and a total excess of silver of 7,226,888 ounces (a difference of 0.34 percent).

UNITS OF MEASUREMENT

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

MINES PRODUCING

LEADING GOLD PRODUCERS

The output of the 30 largest gold producers in the United States (Philippine Islands and Puerto Rico excluded) in 1940, none of which

Largest producers of gold in the United States in 1940, in order of output [1]

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

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

produced less than 19,000 ounces, was 2,439,394 fine ounces (50 percent of the total). Five of the companies, working placer mines with floating connected-bucket dredges, recovered 519,457 ounces of gold; the rest of the output of the largest producers came from lode mines. The total output of lode mines and placers producing less than 19,000 ounces each was 2,430,555 ounces.

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

LEADING SILVER PRODUCERS

The output of silver from the 49 leading silver-producing companies in 1940, none of which produced less than 200,000 ounces, was 55,947,996 ounces—79 percent of the total mine output of the United States (Philippine Islands and Puerto Rico excluded); the remaining 14,401,296 ounces (placer production excluded) came from about 5,000 lode mines, many of which derive a substantial net income from the silver content.

Largest producers of silver in the United States in 1940, in order of output

Rank	Operator	State	Mining district	Source of silver
1	Sunshine Mining Co	Idaho	Evolution	Dry and siliceous ore.
2	Anaconda Copper Mining Co.	Montana	Summit Valley or Butte.	Copper ore, zinc-lead ore.
3	New Jersey Zinc Co., Empire Zinc Division.	Colorado	Battle Mountain	Copper ore.
4	Phelps Dodge Corporation	Arizona	Ajo, Copper Mountain, Verde, Warren.	Do.
5	United States Smelting, Refining & Mining Co.	Utah	West Mountain, Tintic.	Zinc-lead ore, lead ore, dry and siliceous ore.
6	Utah Copper Co	do	West Mountain	Copper ore.
7	Tintic Standard Mining Co	do	Tintic	Dry and siliceous ore, lead ore.
8	Bunker Hill & Sullivan Mining & Concentrating Co.	Idaho	Yreka	Zinc-lead ore, dry and siliceous ore.
9	Federal Mining & Smelting Co.	do	Hunter, Lelande, Yreka.	Zinc-lead ore.
10	American Metal Co. (Presidio mine).	Texas	Shafter	Dry and siliceous ore.
11	Polaris Mining Co	Idaho	Evolution	Do.
12	Silver King Coalition Mines Co.	Utah	Uintah	Zinc-lead ore, lead ore.
13	Hecla Mining Co	Idaho	Lelande	Do.
14	Park City Consolidated Mines Co.	Utah	Blue Ledge	Zinc-lead ore.
15	Coeur d'Alene Mines Corporation.	Idaho	Evolution	Dry and siliceous ore.
16	Emperius Mining Co	Colorado	Creede	Dry and siliceous ore, lead ore.
17	Triumph Mining Co	Idaho	Warm Springs	Zinc-lead ore.
18	Desert Silver, Inc	Nevada	Silver Peak	Dry and siliceous ore.
19	Magma Copper Co	Arizona	Pioneer	Copper ore, zinc-copper ore.
20	Anaconda Copper Mining Co. (Flathead mine).	Montana	Hog Heaven	Dry and siliceous ore, lead ore.
21	Blackhawk Consolidated Mines Co.	New Mexico	Mogollon	Dry and siliceous ore.
22	Combined Metals Reduction Co.	Nevada	Pioche	Zinc-lead ore, dry and siliceous ore.
23	New Park Mining Co	Utah	Blue Ledge	Zinc-lead ore.
24	Basin Montana Tunnel Co	Montana	Cataract	Do.
25	L. D. Foreman (Hecla tailings).	do	Bryant	Dry and siliceous ore.
26	Combined Metals Reduction Co. (Park-Bingham group).	Utah	West Mountain	Dry and siliceous ore, lead ore, zinc-lead ore.
27	Park Utah Consolidated Mines Co.	do	Snake Creek	Dry and siliceous ore, zinc-lead ore.
28	Montana Silver Queen Mining Co.	Montana	Montana (Neihart)	Dry and siliceous ore.

Largest producers of silver in the United States in 1940, in order of output—Contd.

Rank	Operator	State	Mining district	Source of silver
29	Anaconda Copper Mining Co. (Emma and Ophir).	Montana	Summit Valley or Butte	Zinc-lead ore.
30	Ground Hog Unit, American Smelting & Refining Co.	New Mexico	Central	Zinc-lead ore, lead ore, copper ore.
31	Shattuck Denn Mining Corporation.	Arizona	Warren	Copper ore.
32	Cactus Mines Co	California	Mojave	Dry and siliceous ore.
33	Lessees of the Tonopah Mining Co. of Nevada.	Nevada	Tonopah	Do.
34	International Smelting & Refining Co.	Utah	Ophir	Dry and siliceous old tailings.
35	Chief Consolidated Mining Co.	do	Tintic	Dry and siliceous ore, lead ore, zinc-lead ore.
36	Lava Cap Gold Mining Corporation.	California	Grass Valley-Nevada City.	Dry and siliceous ore.
37	American Smelting & Refining Co. (Trench mill).	Arizona	Harshaw	Zinc-lead ore.
38	Combined Metals Reduction Co. (Calumet mine).	Utah	Rush Valley	Lead ore, zinc-lead ore.
39	Veta Mines, Inc	Colorado	Upper San Miguel	Dry and siliceous ore.
40	Summit King Mines, Ltd	Nevada	Sand Springs	Do.
41	Reymert Mining Co	Arizona	Pioneer	Do.
42	Walker Mining Co	California	Genesee	Copper ore.
43	Philipsburg Mining Co	Montana	Flint Creek	Dry and siliceous ore.
44	Shenandoah-Dives Mining Co	Colorado	Animas	Zinc-lead ore.
45	St. Joseph Lead Co	Missouri	Southeastern Missouri	Lead ore.
46	Golden Queen Mining Co	California	Mojave	Dry and siliceous ore.
47	Rip Van Winkle Mining Co	Nevada	Merrimac	Zinc-lead ore.
48	Sullivan Mining Co	Idaho	Hunter	Do.
49	Iron King Mining Co	Arizona	Big Bug	Do.

NUMBER OF MINES

The following table indicates the number of mines that produced gold and silver in 1939 and 1940. The placers are those in which gold and silver in natural alloy and, in a few placers, platinum are recovered from gravel and sand, whether by hand washing, sluicing, hydraulicking, drifting (in frozen ground or ancient buried river channels), or dredging. The lode mines are those yielding gold and silver from ore as distinguished from gravel, mainly from underground workings, and include those that yield ore mined chiefly for copper, lead, or zinc but that contribute the precious metals as byproducts. In addition to the producing mines enumerated here many properties were being prospected and developed, and many other mining claims were being held by assessment work only.

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

Number of mines in the United States producing gold and silver, 1939–40, by States [1]

State	Lode		Placer		Total	
	1939	1940	1939	1940	1939	1940
Alabama	1	2			1	2
Alaska	73	73	1,114	1,069	1,187	1,142
Arizona	976	1,024	142	276	1,118	1,300
California	1,028	1,030	749	836	1,777	1,866
Colorado	758	691	583	439	1,341	1,130
Georgia	8	7	17	14	25	21
Idaho	362	378	465	548	827	926
Illinois [2]	2	3			2	3
Indiana			1	1	1	1
Maryland	3				3	
Michigan [2]	2	2			2	2
Missouri [2]	1	3			1	3
Montana	594	687	282	285	876	972
Nevada	891	895	104	115	995	1,010
New Mexico	214	164	168	179	382	343
New York [2]	[3] 1	1			[3] 1	1
North Carolina	13	9	4	3	17	12
Oregon	116	112	201	192	317	304
Pennsylvania	1	1			1	1
South Carolina	5	5	1	1	6	6
South Dakota	18	11	80	81	98	92
Tennessee [2]	[3] 4	3			[3] 4	3
Texas	7	6			7	6
Utah	175	191	11	21	186	212
Virginia [2]	4	3	2		6	3
Washington	88	83	84	88	172	171
Wyoming	9	9	28	28	37	37
	[3] 5,354	5,393	4,036	4,176	[3] 9,390	9,569

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

MINE PRODUCTION

SUMMARY

The following table gives the mine production of gold and silver in 1939 and 1940, by States, in terms of recovered metals, as calculated by the Bureau of Mines from reports from the producing mines. The annual percentage gains in gold production in the years following the 69-percent increase in the price of gold are as follows: 1934 over 1933, 19 percent; 1935 over 1934, 18 percent; 1936 over 1935, 19 percent; 1937 over 1936, 9 percent; 1938 over 1937, 7 percent; 1939 over 1938, 10 percent; and 1940 over 1939, 5 percent. The total gain in 1940 over 1933 was 128 percent. The output of silver increased 10 percent in 1940 over 1939 and was 208 percent above that in 1933.

Mine production of gold and silver in the United States, 1939–40, by regions and States, in terms of recovered metals

Region and State	Gold: Fine ounces 1939	Gold: Fine ounces 1940	Gold: Increase or decrease (percent)	Gold: Value (at $35 per ounce) 1939	Gold: Value (at $35 per ounce) 1940	Silver: Fine ounces 1939	Silver: Fine ounces 1940	Silver: Increase or decrease (percent)	Silver: Value 1939 (at $0.67878+ per ounce)	Silver: Value 1940 (at $0.71111+ per ounce)
Western States and Alaska:										
Alaska	676, 737	755, 97C	+12	$23, 685, 795	$26, 458, 950	201, 054	191, 679	−5	$136, 473	$136, 305
Arizona	316, 453	294, 807	−7	11, 075, 855	10, 318, 245	7, 824, 004	7, 075, 215	−10	5, 310, 839	5, 031, 264
California	1, 435, 264	1, 455, 671	+1	50, 234, 240	50, 948, 485	2, 599, 139	2, 359, 776	−9	1, 764, 264	1, 678, 063
Colorado	366, 852	367, 336	(1)	12, 839, 820	12, 856, 760	8, 496, 488	9, 710, 709	+14	5, 767, 313	6, 905, 393
Idaho	116, 662	146, 480	+26	4, 083, 170	5, 126, 800	17, 222, 370	17, 552, 240	+2	11, 690, 336	12, 481, 593
Montana	264, 173	272, 602	+3	9, 246, 055	9, 541, 070	9, 087, 571	12, 361, 050	+36	6, 168, 533	8, 790, 080
Nevada	361, 518	383, 933	+6	12, 653, 130	13, 437, 655	4, 316, 029	5, 175, 928	+20	2, 929, 668	3, 680, 660
New Mexico	36, 979	35, 943	−3	1, 294, 265	1, 258, 005	1, 400, 878	1, 407, 839	(1)	950, 899	1, 001, 130
Oregon	93, 372	113, 402	+21	3, 268, 020	3, 969, 070	105, 388	219, 112	+108	71, 536	155, 813
South Dakota	618, 536	586, 662	−5	21, 648, 760	20, 533, 170	167, 584	175, 514	+5	113, 754	124, 810
Texas	324	312	−4	11, 340	10, 920	1, 341, 945	1, 326, 150	−1	910, 896	943, 040
Utah	277, 751	355, 494	+28	9, 721, 285	12, 442, 290	10, 758, 657	12, 172, 299	+13	7, 302, 846	8, 655, 857
Washington	90, 420	82, 136	−9	3, 164, 700	2, 874, 760	442, 063	365, 175	−17	300, 067	259, 680
Wyoming	583	740	+27	20, 405	25, 900	75	114	+52	51	81
	4, 655, 624	4, 851, 488	+4	162, 946, 840	169, 802, 080	63, 963, 245	70, 092, 800	+10	43, 417, 475	49, 843, 769
Eastern States:										
Alabama	3	5	+67	105	175		3			2
Georgia	670	961	+43	23, 450	33, 635	58	630	+986	39	448
Maryland	71		−100	2, 485		2		−100	1	
New York						37, 250	35, 720	−4	25, 285	25, 401
North Carolina	495	1, 943	+293	17, 325	68, 005	3, 961	6, 480	+64	2, 689	4, 608
Pennsylvania	1, 815	1, 840	+1	63, 525	64, 400	13, 558	13, 064	−4	9, 203	9, 290
South Carolina	13, 833	13, 076	−5	484, 155	457, 660	5, 480	8, 047	+47	3, 720	5, 722
Tennessee	163	173	+6	5, 705	6, 055	31, 994	38, 610	+21	21, 717	27, 456
Virginia	364	458	+26	12, 740	16, 030	1, 780	271	−85	1, 208	193
	17, 414	18, 456	+6	609, 490	645, 960	94, 083	102, 825	+9	63, 862	73, 120
Central States:										
Illinois						675	4, 766	+606	458	3, 389
Indiana	4	5	+25	140	175					
Michigan						101, 878	88, 657	−13	69, 154	63, 045
Missouri						213, 400	260, 314	+22	144, 853	185. 112
	4	5	+25	140	175	315, 953	353, 737	+12	214, 465	251, 546
Philippine Islands	[2] 999, 408	[2] 1, 114, 201	+11	34, 979, 280	38, 997, 035	[2] 1, 191, 739	[2] 1, 275, 383	+7	808, 938	906, 939
Puerto Rico	[2] 35	[2] 13	−63	1, 225	455	[2] 4	[2] 1	−75	3	1
	999, 443	1, 114, 214	+11	34, 980, 505	38, 997, 490	1, 191, 743	1, 275, 384	+7	808, 941	906, 940
	5, 672, 485	5, 984, 163	+5	198, 536, 975	209, 445, 705	65, 565, 024	71, 824, 746	+10	44, 504, 743	51, 075, 375

[1] Less than 0.5 percent.

[2] United States refineries' receipts.

Gold and silver produced in the Western States of the United States, 1848–1940, and in Alaska, 1880–1940, in terms of recovered metals

[Original research, 1848-1903, by Chas. W. Henderson; 1904-40, by western offices]

State	Period	Gold		Silver (fine ounces)
		Fine ounces	Value [1]	
Arizona	1860-1940	9,858,897	$232,556,550	261,189,778
California	1848-1940	98,853,966	2,161,992,462	100,878,000
Colorado	1858-1940	37,916,726	820,962,374	710,648,867
Idaho	1863-1940	7,479,342	164,916,373	452,902,547
Montana	1862-1940	16,434,043	359,644,717	700,815,985
Nevada	1859-1940	24,409,043	532,878,181	574,876,092
New Mexico	1848-1940	2,120,935	47,566,918	63,948,259
Oregon	1852-1940	5,524,223	121,310,848	4,813,624
South Dakota	1876-1940	19,437,306	461,902,919	9,175,505
Texas	1885-1940	7,735	204,670	31,417,729
Utah	1864-1940	8,701,728	204,785,520	669,904,666
Washington	1860-1940	1,797,549	41,669,538	10,820,860
Wyoming	1867-1940	77,413	1,817,783	74,486
Total, Western States	1848-1940	232,618,906	5,152,208,853	3,591,466,398
Alaska	1880-1940	24,456,563	568,994,307	19,371,146
Total, Western States and Alaska	1848-1940	257,075,469	5,721,203,160	3,610,837,544

[1] Gold valued per fine ounce as follows: Prior to 1933, $20.67+; 1933, $25.56; 1934, $34.95; 1935-40, $35.

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

The best index of lode mining is the quantity and metallic content of ore mined rather than the number of mines or operators. The following tables give details of classes of ore, metal yield in fine ounces of gold and silver to the ton, and gold and silver output by classes of ore and by methods of recovery, embracing all ores that produced gold and silver in the United States (excluding the Philippine Islands and Puerto Rico) in 1940. The individual State chapters from which these tables were compiled contain additional tables and text on the subject and may be found elsewhere in this volume.

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

Siliceous (silica [3] in excess of iron) gold, gold-silver, and silver ores

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

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

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

Ore produced in the United States and average recovery in fine ounces of gold and silver per ton in 1940 [1]

State	Gold ore			Gold-silver ore			Silver ore		
	Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton	
		Gold	Silver		Gold	Silver		Gold	Silver
Western States:									
Arizona	783,234	0.166	0.27	104,235	0.131	5.47	40,979	0.021	14.58
California	4,137,232	.172	.29	66,865	.292	8.85	10,553	.026	10.10
Colorado	1,367,102	.214	.54	75,472	.095	3.35	86,163	.012	10.66
Idaho	354,785	.190	.61	63,727	.098	4.15	460,481	.001	23.43
Montana	803,173	.208	.57	120,538	.093	7.31	104,812	.029	14.99
Nevada	1,694,451	.141	.40	242,300	.162	7.88	107,249	.053	11.89
New Mexico	33,490	.146	.48	91,965	.155	8.43	1,559	.008	8.44
Oregon	99,295	.409	1.41	6,023	.198	10.45			
South Dakota	1,667,289	.352	.11						
Texas							146,811	.002	9.01
Utah	376,859	.146	.31	176,369	.136	6.00	241,895	.021	7.68
Washington	202,502	.137	.55	677	.233	9.22	967	.021	19.59
Wyoming	783	.023	(2)						
Total, Western States	11,520,195	.202	.35	948,171	.144	6.72	1,201,469	.014	15.37
Alaska	4,885,023	.044	.02						
Eastern States	144,877	.110	.07						
	16,550,095	.154	.25	948,171	.144	6.72	1,201,469	.014	15.37

[1] Illinois, Michigan, Missouri, Philippine Islands, and Puerto Rico excluded.
[2] Less than 0.005 per ton.

Ore produced in the United States and average recovery in fine ounces of gold and silver per ton in 1940—Continued

State	Copper ore			Lead ore			Lead-copper ore		
Western States:									
Arizona	20,284,826	0.006	0.22	8,813	0.102	7.76	44	0.159	30.68
California	446,392	.037	.65	8,199	.227	11.43	11		8.27
Colorado	334,312	.091	20.24	10,199	.182	28.62	1,037	.043	16.04
Idaho	4,931	.121	3.60	164,508	.004	5.27	232		90.08
Montana	3,287,803	.004	1.84	29,454	.103	8.93	71	.070	23.56
Nevada	6,158,388	.010	.06	7,080	.158	33.25	9		24.89
New Mexico	6,606,471	.002	.06	1,901	.266	7.05			
Oregon	146	.041	18.47	5	1.200	33.80			
South Dakota				81	.037	3.33			
Texas	3			122	.025	31.03			
Utah	26,301,745	.008	.08	65,072	.118	16.32	8,510	.007	20.17
Washington	689,325	.075	.32	100		2.03			
Wyoming	30		1.27						
Total, Western States	64,114,372	.008	.32	295,534	.060	9.81	9,914	.012	21.44
Alaska									
Eastern States	[3] 725,885	[4] .003	[5] .08	8,709		.06			
	64,840,257	.008	.32	304,243	.058	9.53	9,914	.012	21.44

State	Zinc ore			Zinc-lead, zinc-copper, and zinc-lead-copper ores [6]			Total ore		
Western States:									
Arizona				350,044	0.041	3.32	21,572,175	0.013	0.33
California				181	.011	3.24	4,669,433	.161	.49
Colorado	27			283,453	.060	2.56	2,157,765	.162	4.50
Idaho	101	0.010	0.78	1,507,922	.007	3.55	2,556,687	.034	6.86
Montana	[7] 174,181	.001	.13	579,209	.021	5.37	5,099,241	.041	2.42
Nevada	1,968	.001	.07	126,814	.018	5.71	8,338,259	.041	.62
New Mexico	123,126			231,391	.001	.95	7,089,903	.005	.20
Oregon							105,469	.397	1.96
South Dakota							1,667,370	.352	.11
Texas							146,936	.002	9.03
Utah	26			768,870	.053	7.51	27,939,346	.013	.44
Washington				273,227		.03	1,166,798	.068	.31
Wyoming							813	.022	.05
Total, Western States	299,429	(8)	.08	4,121,111	.024	4.15	82,510,195	.038	.85
Alaska							4,885,023	.044	.02
Eastern States	1,878,988			916,356		.04	[3] 3,674,815	.005	.03
	2,178,417	(8)	.01	5,037,467	.019	3.40	91,070,033	.037	.77

[3] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.
[4] The quantity from which this average is derived is 2,115 ounces, which includes 1,840 ounces from magnetite-pyrite-chalcopyrite ore from Pennsylvania.
[5] The quantity from which this average is derived is 56,367 ounces, which includes 13,064 ounces from magnetite-pyrite-chalcopyrite ore from Pennsylvania.
[6] Includes zinc-lead-copper ore from 1 mine in Utah. Bureau of Mines not at liberty to publish figures. Zinc-copper ore from Arizona.
[7] Includes 163,923 tons of slag fumed containing no gold or silver.
[8] Less than 0.0005 per ton.

Mine production of gold in the United States in 1940, by States and sources, in fine ounces, in terms of recovered metals[1]

State	Placers	Dry and siliceous ore	Copper ore	Lead ore	Lead-copper ore	Zinc ore	Zinc-lead, zinc-copper, and zinc-lead-copper ores [2]	Total
Alabama		5						5
Alaska	541,873	214,097						755,970
Arizona	6,241	144,461	128,720	895	7		14,483	294,807
California	704,952	732,188	16,669	1,860			2	1,455,671
Colorado	17,000	301,046	30,331	1,854	45		17,060	367,336
Georgia	428	533						961
Idaho	60,409	74,121	597	658		1	10,694	146,480
Indiana	5							5
Montana	64,147	181,469	11,708	3,036	5	142	12,095	272,602
Nevada	37,912	283,278	59,325	1,118		1	2,299	383,933
New Mexico	2,928	19,152	13,202	505			156	35,943
North Carolina	7	1,834	102					1,943
Oregon	71,577	41,813	6	6				113,402
Pennsylvania			[3] 1,840					1,840
South Carolina	17	13,059						13,076
South Dakota	229	586,430		3				586,662
Tennessee			173					173
Texas		309		3				312
Utah	275	83,838	223,156	7,690	58		40,477	355,494
Virginia		458						458
Washington	2,747	27,860	51,529					82,136
Wyoming	722	18						740
	1,511,469	2,705,969	537,358	17,628	115	144	97,266	4,869,949

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

Mine production of silver in the United States in 1940, by States and sources, in fine ounces, in terms of recovered metals[1]

State	Placers	Dry and siliceous ore	Copper ore	Lead ore	Lead-copper ore	Zinc ore	Zinc-lead, zinc-copper, and zinc-lead-copper ores [2]	Total
Alabama		3						3
Alaska	74,748	116,931						191,679
Arizona	1,108	1,378,318	4,463,702	68,376	1,350		1,162,361	7,075,215
California	64,170	1,909,275	291,914	93,739	91		587	2,359,776
Colorado	3,638	1,907,172	6,765,877	291,905	16,630		725,487	9,710,709
Georgia	20	610						630
Idaho	17,796	11,269,475	17,762	867,066	20,898	79	5,359,164	17,552,240
Illinois							[3] 4,766	4,766
Michigan			88,657					88,657
Missouri				260,314				260,314
Montana	11,655	2,911,653	6,039,027	262,996	1,673	23,236	3,110,810	12,361,050
Nevada	13,022	3,863,620	339,810	235,396	224	132	723,724	5,175,928
New Mexico	263	804,335	369,968	13,404			219,869	1,407,839
New York							35,720	35,720
North Carolina	1	1,257	5,222					6,480
Oregon	12,795	203,452	2,696	169				219,112
Pennsylvania			[4] 13,064					13,064
South Carolina	9	8,038						8,047
South Dakota	21	175,223		270				175,514
Tennessee			38,081	529				38,610
Texas		1,322,364		3,786				1,326,150
Utah	31	3,032,785	2,132,727	1,061,774	171,646		5,773,336	12,172,299
Virginia		271						271
Washington	720	136,804	218,861	203			8,587	365,175
Wyoming	73	3	38					114
	200,070	29,041,589	20,787,406	3,159,927	212,512	23,447	17,124,411	70,549,362

[1] Philippine Islands and Puerto Rico excluded.
[2] Includes zinc-lead-copper ore from 1 mine in Utah; zinc-copper ore from Arizona.
[3] Includes 713 ounces from galena concentrates containing silver, a byproduct of fluorspar ores.
[4] Magnetite-pyrite-chalcopyrite ore.

Gold and silver produced in the United States from ore, old tailings, etc., in 1940, by States and by methods of recovery, in terms of recovered metals [1]

State	Total ore, old tailings, etc., treated (short tons)	Ore, old tailings, etc., to amalgamation and cyanidation mills and bullion recovered				Ore and old tailings to concentrating mills (short tons)	Concentrates smelted (from amalgamation and cyanidation and concentrating mills combined)			Crude ore to smelters			Ore leached, old tailings and slag smelted, etc.		
		Ore (short tons)	Old tailings, etc. (short tons)	Gold (fine ounces)	Silver (fine ounces)		Short tons	Gold (fine ounces)	Silver (fine ounces)	Short tons	Gold (fine ounces)	Silver (fine ounces)	Short tons	Gold (fine ounces)	Silver (fine ounces)
Alaska	4,885,023	4,877,373		175,702	32,841	7,289	4,937	37,906	83,998	361	489	92			
Arizona	21,572,175	746,456		73,023	125,330	15,941,271	862,160	101,451	2,658,647	1,685,544	114,092	4,290,130	[2] 3,198,904		
California	4,669,433	3,304,393	846,157	580,281	931,362	489,709	52,697	161,344	1,091,484	25,380	8,903	235,093	3,794	191	37,667
Colorado	2,157,765	1,225,741		196,735	67,509	550,732	79,624	108,533	2,333,341	381,292	45,068	7,306,221			
Idaho	2,556,687	142,457		21,969	15,642	2,368,572	336,004	55,618	16,783,767	45,658	8,484	735,035			
Montana	5,099,241	555,385		82,538	182,737	4,101,902	662,832	54,596	9,810,936	278,031	71,321	2,355,722	[3] 163,923		
Nevada	8,338,259	1,399,654	442,218	224,044	2,126,541	6,293,384	318,088	70,758	1,160,769	197,438	50,768	1,843,673	5,565	451	31,923
New Mexico	7,089,903	112,784		12,698	680,751	6,877,449	276,738	12,804	426,184	99,670	7,513	300,641			
Oregon	105,469	20,736	3,174	6,820	959	73,289	5,442	29,895	167,015	8,225	5,097	38,258	45	13	85
South Dakota	1,667,370	1,667,265		583,483	171,861		1,584	2,729	2,628	105	221	1,004			
Texas	146,936	144,558		291	1,113,806		469	18	180,997	2,378	3	31,347			
Utah	27,939,346	298,087		17,562	532	27,215,217	1,011,416	263,903	8,212,922	426,042	73,754	3,958,814			
Washington	1,166,798	147,000		12,722	39,837	972,848	65,371	53,834	245,428	46,950	12,833	79,190			
Wyoming	813	783		11	1		3	7	2	30		38			
Eastern States [4]	3,316,729	144,726		15,587	9,565	3,151,361	57,596	2,157	87,957	20,642	260	5,273			
	90,711,947	14,787,398	1,291,549	2,003,466	5,499,274	68,043,023	3,734,961	955,553	43,246,075	3,217,746	398,806	21,180,531	3,372,231	655	69,675

[1] Illinois, Michigan, Missouri, Philippine Islands, and Puerto Rico excluded.
[2] Ore leached containing no gold or silver.
[3] Slag fumed containing no gold or silver.
[4] All tonnage figures exclude ore and concentrates containing no gold or silver; include magnetite-pyrite-chalcopyrite ore from Pennsylvania.

Gold and silver produced at amalgamation and cyanidation mills in the United States and percentage of gold and silver recovered from all sources, 1936–40 [1]

Year	Bullion and precipitates recovered (fine ounces)				Percent of gold and silver from all sources [1]							
	Amalgamation		Cyanidation		Amalgamation		Cyanidation		Smelting [2]		Placers	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1936	1,025,040	437,091	711,396	2,518,288	27.1	0.7	18.8	4.1	30.2	95.0	23.9	0.2
1937	1,040,593	368,394	793,204	3,039,172	25.3	.5	19.3	4.3	30.8	95.0	24.6	.2
1938	984,620	223,058	962,788	4,275,154	23.1	.4	22.6	7.0	26.4	92.4	27.9	.2
1939	985,717	243,786	1,043,675	4,556,336	21.1	.4	22.3	7.1	28.0	92.2	28.6	.3
1940	959,452	248,112	1,044,014	5,251,162	19.7	.3	21.4	7.5	27.9	91.9	31.0	.3

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

Gold and silver produced at amalgamation and cyanidation mills in the United States in 1940, by States [1]

State	Amalgamation			Cyanidation			Percent of gold and silver from all sources in State			
	Ore, old tailings, concentrates, etc., treated (short tons)	Bullion recovered (fine ounces)		Ore, old tailings, concentrates, sands, slimes, etc., treated (short tons)	Bullion and precipitates recovered		Amalgamation		Cyanidation	
		Gold	Silver		Gold	Silver	Gold	Silver	Gold	Silver
Alaska	4,877,373	172,989	32,744	5,259	2,713	97	22.88	17.08	0.36	0.05
Arizona	4,162	882	321	742,801	72,141	125,009	.30	(2)	24.47	1.77
California	2,429,974	339,707	97,618	2,175,892	240,574	833,744	23.34	4.14	16.53	35.33
Colorado	940,866	74,705	17,803	658,744	122,030	49,706	20.34	.18	33.22	.51
Idaho	127,152	19,741	11,035	15,305	2,228	4,607	13.48	.06	1.52	.03
Montana	89,361	9,664	2,178	466,024	72,874	180,559	3.55	.02	26.73	1.46
Nevada	121,010	23,131	24,741	1,730,446	200,913	2,101,800	6.02	.48	52.33	40.61
New Mexico	20,264	314	325	92,520	12,384	680,426	.87	.02	34.45	48.33
Oregon	4,721	2,819	556	19,639	4,001	403	2.49	.25	3.53	.18
South Dakota	1,479,905	313,964	60,254	1,619,604	269,519	111,607	53.52	34.33	45.94	63.59
Texas				144,089	291	1,113,806			93.27	83.99
Utah	520	25	14	297,567	17,537	518	.01	(2)	4.93	(2)
Washington	1,418	568	161	145,582	12,154	39,676	.69	.04	14.80	10.86
Wyoming	783	11	1				1.49	.88		
Eastern States	10,630	932	361	134,096	14,655	9,204	5.05	.35	79.41	8.95
	10,108,139	959,452	248,112	8,247,568	1,044,014	5,251,162	19.70	.35	21.44	7.48

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

PLACERS

Dredging.—Placer gold is obtained largely from gravels handled by connected-bucket floating dredges, which recovered approximately 60 percent of the total output from placers in the United States (Philippine Islands and Puerto Rico excluded) in 1940 and 59 percent in 1939. The quantity of gold recovered by dredges from the inception of the industry as a commercial factor in 1896 to the end of 1940 is recorded as 17,517,997 ounces, originating by States as follows: California, 10,837,697 ounces; Alaska, 4,601,109 (including the production from two Becker-Hopkins single-dipper dredges and some gold by hydraulicking); Montana, 625,956; Idaho, 523,302; Colorado, 430,050; Oregon, 421,274; and other States, 78,609. The output in 1940 was 904,149 ounces from 122 dredges, of which California produced 414,966 ounces from 46 dredges; Alaska, 354,806 from 49 dredges; Idaho, 41,262 from 12 dredges; Montana, 39,012 from 7 dredges; Oregon, 24,951 from 6 dredges; and Colorado, 4,975 from 1 dredge.

Connected-bucket floating gold dredges operated in the United States, 1939–40, by companies and districts

ALASKA

Company	Address	District	Number of dredges	
			1939	1940
Standard Mines, Inc.[1]	Ferry	Bonnifield		1
Triple X Placers Co.[1]	do	do	1	1
Alluvial Golds, Inc	Fairbanks	Circle	1	1
C. J. Berry Dredging Co	Miller House	do	1	1
Gold Placers, Inc	Fairbanks	do	1	1
Alaska Placer Co. (formerly North Star Dredging Co.).	Council	Council	1	1
Camp Creek Dredging Co	do	do	1	1
Council Dredging Co	do	do	1	1
Inland Dredging Co	do	do	1	1
Ophir Gold Dredging Co	do	do		1
United States Smelting, Refining & Mining Co., Fairbanks Department.	Fairbanks	Fairbanks	6	8
Arctic Circle Exploration, Inc	Candle	Fairhaven	2	2
Dry Creek Dredging Co.[2]	Deering	do		1
Forsgren Dredging Co	do	do	1	1
Boundary Dredging Co	Boundary	Fortymile	1	1
Wade Creek Dredging Co. (dredge operated by North American Mines, Inc. in 1939).	Fairbanks	do	1	1
Bristol Bay Mining Co	San Francisco	Goodnews Bay	1	1
American Creek Operating Co., Inc	Fairbanks	Hot Springs	1	1
North American Dredging Co	Flat	Iditarod	1	1
J. E. Riley Investment Co	do	do	1	1
Ganes Creek Dredging Co. (formerly Holky Dredging Co.).	Takotna	Innoko	1	1
Moss & Larson Mining Co. (formerly Savage & Matheson).	do	do	1	1
W. F. Puntila	do	do	1	1
Nels J. Vibe	Ophir	do	1	1
Castleton & Keenan (Kougarok Consolidated Placers, Inc.).	Nome	Kougarok	1	1
Fox Bar Dredging Co	do	do	1	1
Dime Creek Dredging Co. (Wallace Porter)	Haycock	Koyuk	1	1
Ungalik Syndicate	Nome	do	1	1
Alaska Sunset Mines, Inc	do	Nome	1	
Osborn Creek Dredging Co	do	do	1	1
Tolbert Scott (formerly Spruce Creek Dredging Co.).	do	do	1	1
United States Smelting, Refining & Mining Co., Nome Department.	do	do	3	3
Bartholomae Oil Corporation	Teller	Port Clarence	1	1
Casa de Paga Gold Co.[2]	Nome	Solomon	1	1
Lee Brothers Dredging Co	do	do	1	2
Slack & Mahan	do	do	1	
Livengood Placers, Inc	Livengood	Tolovana		1
Nome Creek Mining Co. (formerly Deadwood Mining Co.)[3]	Fairbanks	do	1	1
New York Alaska Gold Dredging Co	Nyac	Tuluksak-Aniak	2	2
			44	49

CALIFORNIA

Etna Gold Dredging Co	Callahan	Callahan	1	1
Yuba Consolidated Gold Fields	San Francisco	do	1	1
Gold Hill Dredging Co.[4]	do	Camanche	1	2
Lancha Plana Gold Dredging Co	Camanche	do	1	1
Wallace Dredging Co	San Francisco	do	1	
Cosumnes Gold Dredging Co	do	Cosumnes River	1	1
Lancha Plana Gold Dredging Co	Camanche	do		1

See footnotes at end of table.

Connected-bucket floating gold dredges operated in the United States, 1939–40, by companies and districts—Continued

CALIFORNIA—Continued

Company	Address	District	Number of dredges	
			1939	1940
Capital Dredging Co	San Francisco	Folsom	2	2
Natomas Co	Sacramento	do	7	7
French Gulch Dredging Co	San Francisco	French Gulch		1
Yreka Gold Dredging Co	do	Greenhorn and Klamath River.	1	1
Cal Oro Gold Dredging Co	do	Greenhorn	1	1
Callahan & Bates	Merced Falls	Hunter Valley	1	
Roaring River Gold Dredging Co	San Francisco	Igo	1	
Thurman Gold Dredging Co	Redding	do		1
Arroyo Seca Gold Dredging Co	San Francisco	Ione	1	1
Lancha Plana Gold Dredging Co	Camanche	do	1	1
California Gold Dredging Co	San Francisco	Jenny Lind	1	1
C. J. Thompson	Linden	do	1	
Junction City Mining Co	Junction City	Junction City	1	1
La Grange Gold Dredging Co	San Francisco	La Grange	1	1
Tuolumne Gold Dredging Corporation	La Grange	do	1	1
C. R. & T. D. Harris	Lewiston	Lewiston	1	1
Lewiston Gold Dredging Co	do	do	1	
Gold Hill Dredging Co	San Francisco	Ophir	1	
Oro Bell Dredging Co	Berkeley	do	1	
Roseville Gold Dredging Co	San Francisco	do		1
Gold Hill Dredging Co	do	Oroville	1	1
Yuba Consolidated Gold Fields	do	do	2	4
Williams Bar Dredging Co	Marysville	Smartville	1	1
Merced Dredging Co	San Francisco	Snelling	1	1
San Joaquin Mining Co	do	do	1	1
Snelling Gold Dredging Co	Snelling	do	2	2
Yuba Consolidated Gold Fields	San Francisco	do	2	1
Carrville Gold Co	Duluth, Minn.	Trinity Center	1	1
Yuba Consolidated Gold Fields	San Francisco	Yuba River	6	6
			47	46

COLORADO

Company	Address	District	1939	1940
Timberline Dredging Co	Denver	Beaver Creek	1	1
Blue River Co	Breckenridge	Breckenridge	1	
			2	1

IDAHO

Company	Address	District	1939	1940
Fisher-Baumhoff Co	Centerville	Boise Basin	2	2
The Grimes Co	Pioneerville	do	1	1
Idaho-Canadian Dredging Co	Idaho City	do	1	1
H. & H. Mines	Elk City	Elk City		1
Fisher & Higgins	Salmon	Eureka		1
Northwest Goldfields	Harvard	Hoodoo		1
Mount Vernon Gold Mining Co	Elk City	Orogrande	1	1
Quartz Creek Dredging Co	Pierce	Pierce	1	1
Baumhoff-Fisher Co	Warren	Warren	1	
Warren Dredging Co	do	do	1	2
Snake River Mining Co	Sunbeam	Yankee Fork		1
			8	12

MONTANA

Company	Address	District	1939	1940
Winston Bros. Co	Helena	Clancey	1	1
Star Pointer Exploration Co	Bearmouth	First Chance	1	1
Porter Bros. Corporation	Helena	Helena	1	1
Perry-Schroeder Mining Co	do	Missouri River	1	1
Homer Wilson	Harrison	Norris	1	1
Pioneer Placer Dredging Co	Gold Creek	Pioneer	1	1
Gold Creek Mining Co	Deer Lodge	Washington	1	1
			7	7

See footnotes at end of table.

Connected-bucket floating gold dredges operated in the United States, 1939–40, by companies and districts—Continued

NEVADA

Company	Address	District	Number of dredges 1939	Number of dredges 1940
Manhattan Gold Dredging Co	Manhattan	Manhattan	1	1

OREGON

Company	Address	District	1939	1940
Western Dredging Co	San Francisco	Canyon	1	1
Murphy-Murray Dredging Co	Rogue River	Gold Hill		1
Pleasant Creek Mining Corporation [5]	Grants Pass	do	1	1
Porter & Co	Baker	Granite	1	1
The Sumpter Valley Dredging Co	Portland	Sumpter	1	1
Timms Gold Dredging Co	Galena	Susanville	1	1
			5	6

[1] Single-dipper dredge.
[2] Nome district in 1939.
[3] Circle district in 1939.
[4] Consolidated with Comanche Gold Dredging Co. and continued operation under Gold Hill Dredging Co. from October 13, 1939.
[5] Ownership in litigation.

Gold produced in the United States by connected-bucket floating dredges, 1936–40, in fine ounces

Year	Dredges	California	Alaska	Other States [1]	Total
1936	103	276,324	255,803	63,993	596,120
1937	105	322,961	255,568	65,614	644,143
1938	115	375,296	278,442	82,686	736,424
1939	114	370,264	304,995	112,472	787,731
1940	122	414,966	354,806	134,377	904,149

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

Other placer-mining methods.—From 1932 through 1940 dragline and power-shovel excavators operated in connection with dry-land and floating amalgamating and sluicing plants have been widely used in placer mining. In 1940 approximately 30 percent of the total output of placer gold, including that of Alaska and excluding that of the Philippine Islands, was recovered at these plants, and 10 percent was produced by old-established mining methods, such as hydraulicking, drift mining, sluicing, and rocking.

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

PRODUCTION IN PHILIPPINE ISLANDS

Gold production in the Philippine Islands in 1940 continued to increase, as it has each year since 1927, reaching an all-time high of 1,114,201 fine ounces valued at $38,997,035—an increase of 11 percent over 1939, the previous record year, when 999,408 fine ounces valued at $34,979,280 were produced. The total value of gold output from 1907 to 1940, inclusive, is computed at $229,581,441. The annual value from 1931 to 1940 was as follows:

Mine production of gold in the Philippine Islands, 1931–40

Year	Gold (fine ounces)	Value [1]	Year	Gold (fine ounces)	Value [1]
1931	182,008	$3,762,433	1936 [2]	621,968	$21,768,880
1932	244,298	5,050,084	1937 [2]	716,967	25,093,845
1933	325,039	8,308,009	1938 [2]	903,265	31,614,275
1934	340,314	11,893,975	1939 [3]	999,408	34,979,280
1935	451,818	15,813,630	1940 [3]	1,114,201	38,997,035

[1] Gold valued per fine ounce as follows: Prior to 1933, $20.67; 1933, $25.56; 1934, $34.95; 1935–40, $35.
[2] Division of Statistics, Department of Agriculture and Commerce, Manila.
[3] United States refineries' receipts.

The largest producers of gold, in approximate order of output in 1940, included: Benguet Consolidated Mining Co., Balatoc Mining Co., Philippine Smelting Co. (custom smelter), Masbate Consolidated Mining Co., Itogon Mining Co., Antamok Goldfields Mining Co., I. X. L. Mining Co., Baguio Gold Mining Co., Mindanao Mother Lode Mines, Inc., Surigao Consolidated Mining Co., Inc., Atok Gold Mining Co., Suyoc Consolidated Mining Co., North Camarines Gold Mining Co., Inc., Coco Grove, Inc., and Pan Philippine Corporation. Most of these, as well as other important operations, were controlled by three large operating groups—Benguet Consolidated Mining Interests, Marsman & Co., Inc., and Soriano Mining Interests.

Important dredging operations were: Coco Grove, Inc., with two Bucyrus-Erie bucket-line dredges, each with a capacity of 185,000 cubic yards a month; Mindanao Mining Co. with one dragline floating dredge, having a capacity of 100,000 cubic yards a month; and Tambis Gold Dredging Co. with a 7-cubic foot floating connected-bucket type dredge, having a capacity of 36,000 cubic yards a month.

All of the silver produced in 1940 (1,275,383 fine ounces valued at $906,939), as well as 2,246 tons of recoverable copper and 991 tons of recoverable lead at United States refineries, were byproducts of gold-mining operations. Some copper concentrates and copper smelting ore with very low content of gold and silver have been shipped direct to Japan since October 1937.

COPPER

By T. H. Miller, H. M. Meyer, and Allan F. Matthews

SUMMARY OUTLINE

Substantially increased rates of production in the United States and British Empire countries, further dislocation of markets, and Government-influenced prices at moderate levels—all in response to war conditions—characterized the world copper industry in 1940. Smelter output in 1940 is estimated at the record high of 2,930,000 short tons—a 20-percent gain over 1939—of which approximately 86 percent came from the United States, Chile, Northern Rhodesia, Canada, the U. S. S. R., the Belgian Congo, and Japan. The greatest tonnage advance over 1939 was achieved by the United States. Of Chile's 1940 copper exports, 87 percent went to the United States and 5 percent each to Japan and Italy. Northern Rhodesia spurted ahead of a steadily increasing Canadian output to become the world's third largest source of copper. Copper Cartel restrictions were inoperative after the outbreak of war.

The domestic copper situation in 1940 was in many ways a peculiar one. In the first part of the year, American producers dejectedly watched their European markets dwindle and wondered where they were going to dispose of their metal. By the end of the year the same producers were straining to meet the demand of American fabricators and were even reconciled to an influx of foreign copper to ease their load. According to smelter returns, domestic production of copper in 1940 was 28 percent higher than in 1939 and was the sixth most active year in the history of the Nation. The larger outputs were during the World War years 1916–18 and the boom years 1928–29. The United States supplied approximately 35 percent of the world copper output in 1940 and easily maintained, by a wide margin, its position as the foremost producer. Arizona, Utah, and Montana contributed 73 percent of the United States total in 1940, and Nevada, New Mexico, and Michigan supplied an additional 22 percent. Electrolytic refineries, which are responsible for the principal output, operated at 90 percent of rated capacity. Early in 1941, brass manufacturers were considering an outlay of $37,000,000 to expand the capacity of their plants by 79 percent. The quantity of new copper withdrawn on domestic account in 1940 was 41 percent larger than in 1939 and established an all-time record. In 1940, for the first time since 1932, when the 4-cent tariff was placed on foreign copper, imports exceeded exports. Imports of unmanufactured copper were the highest on record and came principally from Chile and the Belgian Congo but also from Canada, Mexico, Peru, and British South Africa. United States exports of copper in 1940 went chiefly to Japan, United Kingdom, and the U. S. S. R., and in smaller quantities to France and Italy.

Salient statistics of the copper industry in the United States, 1925–29 (average) and 1937–40, in short tons

	Average (1925-29)	1937	1938	1939	1940
New copper produced—					
From domestic ores, as reported by—					
Mines	885,826	841,998	557,763	728,320	878,086
Ore produced:					
Copper ore	59,505,871	[1] [2] 61,513,148	[1] [2] 37,794,938	[1] 55,239,098	(3)
Average yield of copper, percent	1.44	1.29	1.34	1.25	(3)
Smelters	892,730	834,661	562,328	712,675	909,084
Percent of world total	51	32	25	29	(3)
Refineries	890,767	822,253	552,574	704,873	927,239
From foreign ores, matte, etc., refinery reports	317,287	244,561	239,842	304,642	386,317
Total new refined, domestic and foreign	1,208,054	1,066,814	792,416	1,009,515	1,313,556
Secondary copper recovered from old scrap only	347,512	408,900	267,300	286,900	333,890
Copper content of copper sulfate produced by refiners	4,601	5,855	4,978	4,868	5,643
Total production, new and old and domestic and foreign	1,560,167	1,481,569	1,064,694	1,301,283	1,653,089
Imports (unmanufactured) [4]	391,212	279,875	252,164	336,297	491,342
Refined [4]	59,236	7,487	1,802	16,264	68,337
Exports of metallic copper [5]	522,616	346,229	421,012	427,517	427,650
Refined (ingots, bars, rods, etc.)	482,868	310,396	385,223	396,406	377,108
Stocks at end of year	307,200	393,000	414,000	355,500	334,500
Refined copper	86,100	179,000	181,000	95,500	91,500
Blister and materials in solution	221,100	214,000	233,000	260,000	243,000
Withdrawals from total supply on domestic account:					
Total new copper	778,123	694,906	406,994	714,873	1,008,785
Total new and old copper	1,288,700	1,227,000	767,000	1,215,000	1,541,000
Price, average ... cents per pound	14.7	12.1	9.8	10.4	11.3
World smelter production, new copper	1,761,000	2,585,000	2,250,000	[6] 2,443,000	(3)

[1] Includes old tailings.
[2] Exclusive of Alaska, figures for which the Bureau of Mines is not at liberty to publish.
[3] Figures not yet available.
[4] Data include copper imported for immediate consumption plus material entering the country under bond.
[5] Total exports of copper, exclusive of ore, concentrates, composition metal, and unrefined copper. Exclusive also of "Other manufactures of copper," for which figures of quantity are not recorded.
[6] Approximate.

Despite the reversal in the American copper-supply situation during 1940—from plenty to want—there was surprisingly little change in producers' stocks and in prices. Stocks at smelters and refineries at the end of 1940 were only 6 percent less than at the close of 1939. They decreased in January, then increased until the end of July, and decreased again gradually during the remainder of the year. Prices held within the relatively narrow limits of 10.5 to 12.5 cents a pound. The high was quoted only during the first 2 weeks of 1940, and the low was reached in July. A new daily sales record was made on September 7, when 113,106 short tons were purchased. The price of copper, delivered to Connecticut points, reached 12 cents on September 24 and remained there throughout the remainder of the year.

Stability of the price at such a moderate level is attributed mainly to pointed suggestions by officials of the price agencies of the Federal defense organization. There was talk during 1940 of relaxing the 4-cent copper tariff, varying it on a sliding scale with price and consumption levels, but nothing specific was done. Subsidization of Michigan mines and small mines in Arizona was suggested; and in June 1941 Leon Henderson, Administrator of the Office of Price Administration and Civilian Supply, stated "If we can get any considerable amount from Michigan, we will allow what price is necessary." No fixed restrictions were placed on copper consumption in 1940, but by the spring of 1941 consideration was being given to the institution of some modified form of priority. Exports of copper, brass, and bronze from the United States were placed under license control on February 3, 1941.

Government purchasing.—When it became apparent in the last quarter of 1940 that production in the United States was not adequate to meet the needs of industry, the Metals Reserve Co. (a subsidiary of the Reconstruction Finance Corporation) began making arrangements to buy Latin American copper. Receipts were to form a buffer stock pile, and manufacturers who were unable to obtain their copper requirements from domestic refiners were to be permitted to draw upon the Government stocks. Deliveries from the stock pile to domestic consumers were begun in March 1941.

The first Government contracts were announced on December 19, 1940, and totaled 100,000 short tons, distributed as follows: 57,000 tons from Anaconda Copper Mining Co., 28,000 from Kennecott Copper Corporation, 10,000 from American Metal Co., Ltd. (sales agent for the Cerro de Pasco Co.), and 5,000 from Phelps Dodge Corporation. Contracts made public in February 1941 covered an additional 135,000 short tons and included 73,000 tons from Anaconda Copper Mining Co., 49,000 from Kennecott Copper Corporation, 10,000 from American Metal Co., Ltd., and 3,000 from Phelps Dodge Corporation. The Anaconda metal will come principally from Chile but also from Mexico, the Kennecott metal from Chile, the American Metal copper from Peru, and the Phelps Dodge metal from Mexico. The price was set at 10 cents a pound, f. a. s. New York, on condition that if at any time the cost of freight and insurance exceeded one-half cent a pound such excess would be borne by the Metals Reserve Co., or 9½ cents a pound, f. a. s. Chilean ports. By April 30, 1941, the Metals Reserve Co. had arranged to buy 500,499 tons of copper; of this quantity, 106,722 tons had been delivered, 195,617 tons were on order or afloat, and there were 198,160 tons for which the purchase contract had not yet been executed. These figures indicate that the Government has been active in acquiring the full annual production of the Latin American countries.[1] These purchases are believed to be making an important contribution to Western Hemisphere economics.

John A. Church, consulting mining engineer, of New York, was appointed consultant on copper and zinc to the Industrial Materials Department of the Advisory Commission to the Council of National Defense in October 1940 and later, in 1941, served in the same capacity with the Production Division of the Office of Production Management.

[1] Engineering and Mining Journal Metal and Mineral Markets, vol. 12, No. 20, May 15, 1941, pp. 1 and 3.

British copper situation.—In 1913 the British Empire produced 98,000 short tons of copper, and consumption approximated 170,000 tons. Rapid development of deposits in Northern Rhodesia and Canada, however, permitted a jump in production from 99,000 short tons in 1925 to 212,000 in 1930, 458,000 in 1935, 658,000 in 1938, and 685,000 in 1939.[2] Consumption was reported at 422,000 short tons in 1937 and 366,000 in 1938.

The absence of official data at this time makes it impossible to obtain an accurate perspective of the British copper situation in the war year 1940. But rather than omit discussion of this important phase, an appraisal is given upon the basis of information published in reputable mining journals. It should be kept clearly in mind that the figures in this paragraph, though believed to approximate the facts, are estimates, and the reader must wait for post-war editions of Minerals Yearbook to procure official data. The total copper production of the British Empire in 1940 is estimated at 840,000 short tons, about 86 percent of which was shipped to Great Britain and the remainder fabricated in the Colonies. Exports to the United Kingdom from the United States, Belgian Congo, and Chile, reshipments from France to the United Kingdom, and exports from the United States to British India and Hong Kong raise the total amount of new copper made available to the British Empire in 1940 to approximately 1,000,000 short tons. Of this amount, about 880,000 tons were shipped to the United Kingdom, but an unknown proportion of it was sunk before it could reach its destination. So far as possible, the above figures do not include copper recovered from scrap or that included in ammunition, machinery, and other finished products sent from the United States to Great Britain.

German-Japanese copper situation.—Germany proper has a meager copper production of little more than 33,000 short tons yearly compared with an annual apparent consumption that averaged (including Austria and Czechoslovakia) 266,000 short tons in 1924–28, 219,000 tons in 1929–33, and 308,000 tons in 1934–38. The deficit was filled by imports, principally from the Western Hemisphere and Africa. Germany stock-piled large supplies of copper in 1938 and 1939 and in spite of judicious use of scrap, substitutes, and confiscated metal probably had to draw on these stocks in 1940. If Germany commandeered the total copper output of the Continent of Europe (exclusive of U. S. S. R.), it would have available about 190,000 short tons annually, an amount that is doubtless well below its wartime requirements. Acquisition of the Russian deposits, however, would bring Germany's potential annual new supply to about 350,000 short tons.

Japan is the seventh largest world producer of copper; its output in 1939 was 114,600 short tons, but this was considerably short of its needs. Imports have increased progressively from 51,800 short tons in 1934 to 110,000 tons in 1938, according to the American Bureau of Metal Statistics. The Japanese experienced some difficulty in buying copper on the world market during 1940, and most foreign sources may be closed to that country in 1941. Japan continued in 1940 to buy large quantities of American copper in spite of reports

[2] Some of these tonnages are a little higher than those given in a corresponding section of Minerals Yearbook, 1940. In the previous discussion, certain minor copper-producing colonies were not considered.

of discriminatorily high prices. Chile reserved the right to suspend contracts with Japanese interests when the copper was needed in America, and in October 1940 Canada banned shipments to Japan.

Market dislocations.—As six of the seven world powers were at war during part or all of 1940, it was natural that there would be profound disruption in copper markets, even in addition to those shuffled in 1939. The United States sent no copper to Germany in 1940, and by the middle of the year shipments to France, Italy, and Sweden had been suspended. The American copper diverted from these normal markets augmented the tonnages sent to the United Kingdom and the U. S. S. R. Chile, suffering from the closure of most of its usual European markets, shipped to Italy and France early in 1940 but by the end of the year was sending the bulk of its copper exports to the United States. Northern Rhodesia and Canada sent even larger proportions of their output to the United Kingdom. Belgian Congo sent no copper to the mother country after its invasion in May 1940 and diverted it principally to the United States and United Kingdom.

DOMESTIC PRODUCTION

Statistics on copper production may be compiled on a mine, smelter, or refinery basis. Mine data are most accurate for showing the geographic distribution of production; smelter figures are better for showing the actual recovery of metal and are fairly accurate for showing the source of production; and refinery statistics give precise information regarding metal recovery but indicate only in a general way the source of crude materials treated. The chapter on Copper in Mineral Resources of the United States, 1930, part 1, contains a discussion of the differences among the three sets of figures.

Copper produced from domestic ores, as reported by mines, smelters, and refineries, 1936–40, in pounds

Year	Mine	Smelter	Refinery
1936	1,229,030,719	1,222,819,396	1,290,924,195
1937	1,683,996,000	1,669,322,278	1,644,505,129
1938	1,115,525,160	1,124,656,539	1,105,148,323
1939	1,456,639,000	1,425,349,488	1,409,745,816
1940	1,756,172,000	1,818,167,516	1,854,478,996

PRIMARY COPPER

Smelter production.—The recovery of copper by United States smelters from ores of domestic origin totaled 1,818,167,516 pounds in 1940—a 28-percent increase over 1939. Domestic smelter output constituted 51 percent of world production during 1925–29. The proportion dropped sharply in the succeeding years until 1934, when it was only 17 percent. From then it increased until it reached 32 percent in 1936 and 1937, declined to 25 percent in 1938, and rose again to 29 percent in 1939. The proportion for 1940 is estimated at 31 percent.

The figures for smelter production are based upon confidential returns from all smelters handling copper-bearing materials produced in the United States. For Michigan the sum of furnace-refined copper and copper cast into anodes for electrolytic refining is included.

The figures for blister represent the fine-copper content. Some casting and electrolytic copper produced direct from ore or matte is included in the smelter production. Metallic and cement copper recovered by leaching is included in smelter production.

The precise quantity, in pounds, of copper produced by smelters in the United States and its value are shown by years for 1845–1930 in the Copper chapter of Mineral Resources of the United States, 1930, part 1.

Copper produced in the United States from domestic ores, 1936–40, by States

[Smelter output, in pounds fine]

State	1936	1937	1938	1939	1940
Alabama	14,293	18,820			
Alaska	30,421,557	42,215,119	33,492,746	304,000	128,001
Arizona	414,144,129	580,493,036	420,351,310	[1] 525,410,905	574,533,050
California	10,327,582	10,615,215	1,680,754	8,490,872	13,091,643
Colorado	19,181,339	21,826,209	30,563,654	25,548,762	26,372,851
Georgia			70		25,917
Idaho	2,924,763	4,804,162	5,611,392	4,632,415	7,379,389
Michigan	91,105,431	84,751,478	75,281,469	89,402,464	91,486,806
Missouri	464,418	695,569	625,844	1,020,000	1,638,000
Montana	215,433,377	280,662,270	156,249,794	203,512,107	258,141,139
Nevada	146,154,075	149,963,847	93,655,642	[1] 128,844,525	157,241,576
New Mexico	6,974,705	63,573,985	43,913,133	74,083,586	140,968,734
North Carolina	(2)	(2)	(2)	(2)	(2)
Oregon	566,388	870,102	88,670	95,557	202,527
Pennsylvania	(2)	(2)	(2)	(2)	(2)
South Carolina		136	7,893	66	
South Dakota					12,037
Tennessee	(2)	(2)	(2)	(2)	(2)
Texas	55,336	316,102	35,740	66,000	66,000
Utah	261,202,190	404,168,742	229,876,860	326,117,467	497,463,560
Virginia		953	43,279	741	
Washington	201,944	124,422	12,494,297	16,756,007	21,022,000
Wyoming	42	75	155		4,018
Undistributed	23,647,827	24,222,036	20,683,837	21,064,014	28,390,268
	1,222,819,396	1,669,322,278	1,124,656,539	1,425,349,488	1,818,167,516

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

Copper produced (smelter output) in the United States, 1936–40, and total 1845–1940

[Values rounded]

Year	Short tons	Value
1936	611,410	$112,499,000
1937	834,661	201,988,000
1938	562,328	110,216,000
1939	712,675	148,236,000
1940	909,084	205,453,000
Total 1845–1940	27,498,478	8,252,020,000

Mine production.—The figures for mine production are based upon reports supplied to the Bureau of Mines by all domestic mines that produce copper. Details of the method of collecting the statistics and reasons for the discrepancy between mine-, smelter-, and refinery-production figures are given in the Copper chapter of Mineral Resources of the United States, 1930, part 1.

Mine production is more accurate than either refinery or smelter production for showing the distribution of domestic production by States and districts. It also indicates the production by calendar years more exactly, because additional time is required for smelting and refining. Mine production in 1940 was 1,756,172,000 pounds—an increase of 21 percent over that in 1939 and less than 1 percent below the average for 1925–29.

Production by States and districts.—The following tables show mine and smelter production by States for 1939 and 1940 and by districts for 1936–40. In 1940 Arizona, Utah, and Montana led in production, with 73 percent of the smelter total compared with 74 percent in 1939. If the output of Nevada, New Mexico, and Michigan is added to the above, 95 percent of the production of the country is represented, the same as in 1939. Arizona's proportion of the total dropped from 37 percent in 1939 to 32 percent in 1940. Utah's rose from 23 to 27 percent, and Montana's and Nevada's remained unchanged at 14 and 9 percent, respectively. New Mexico's proportion of the total increased from 5 to 8 percent, while Michigan's share dropped from 6 to 5 percent. A comparison of present production with that of the past century shows that Arizona supplied 32 percent of the country's output in 1940 and about the same (33 percent) during 1845–1940. Proportionate decreases for Montana and Michigan (14 and 5 percent in 1940 compared with 22 and 17 percent, respectively, in 1845–1940) were offset mainly by Utah's large increase—27 percent in 1940 and 12 percent in 1845–1940. Gains also have been made in recent years by Nevada and New Mexico, whose respective proportions were 9 and 8 percent in 1940 compared with 5 and 3 percent during 1845–1940.

Copper produced in the United States, according to smelter and mine returns, by States, 1939–40 and 1845–1940 in short tons

State	1939		1940			1845–1940, smelter output	
	Smelter returns	Mine returns	Smelter returns		Mine returns	Total quantity	Percent of total
			Percent of total	Quantity			
Alaska	152	128	0.01	64	55	676,688	2.46
Arizona	[1] 262,706	262,112	31.60	287,266	281,169	9,085,937	33.04
California	4,246	4,180	.72	6,549	6,438	570,456	2.08
Colorado	12,774	13,215	1.45	13,186	12,152	265,032	.96
Georgia			(7)	13	13	(2)	(2)
Idaho	2,316	2,516	.41	3,689	3,349	87,939	.32
Michigan	44,701	43,985	5.03	45,743	45,198	4,590,633	16.70
Missouri	510		.09	819	685	(2)	(2)
Montana	101,756	97,827	14.20	129,070	126,391	5,954,044	21.65
Nevada	[1] 64,422	66,597	8.65	78,621	78,454	1,372,959	4.99
New Mexico	37,042	46,142	7.75	70,484	69,848	936,455	3.41
North Carolina	(3)	(3)	(3)	(3)	(3)	(2)	(2)
Oregon	48	48	.01	101	88	11,451	.04
Pennsylvania	(3)	(3)	(3)	(3)	(3)	(2)	(2)
South Carolina	(4)				(4)	(2)	(2)
South Dakota			(7)	6	6	(2)	(2)
Tennessee	(3)	(3)	(3)	(3)	(3)	[5] 259,508	.94
Texas	33	34	(7)	33	30	(2)	(2)
Utah	163,059	171,890	27.36	248,732	231,864	3,397,091	12.35
Virginia	(4)					(2)	(2)
Washington	8,378	8,998	1.16	10,511	9,612	39,609	.15
Wyoming			(7)	2	2	15,865	.06
Undistributed	10,532	10,648	1.56	14,195	12,732	[6] 234,811	.85
	712,675	728,320	100.00	909,084	878,086	27,498,478	100.00

[1] Revised figures.
[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 1929–40 are confidential and are included under "Undistributed."
[6] Includes Tennessee for 1929–40.
[7] Less than 0.01 percent.

In 1940, for the fifth consecutive year, the Bingham (Utah) district was the largest copper producer in the United States, and its output was nearly double that of the second-ranking district—Butte, Mont. The Globe-Miami district (Arizona) again was third in 1940, and the Central (New Mexico) district climbed into fourth place from eighth position in 1939.

Details of mine production, by districts and companies, in 1940 are available in other chapters of this volume dealing with the production of gold, silver, copper, lead, and zinc in the various States.

Mine production of copper in the principal districts,[1] 1936–40, in terms of recovered copper, in short tons

District or region	State	1936	1937	1938	1939	1940
Bingham	Utah	124,453	203,421	106,049	167,856	228,505
Butte	Montana	109,004	143,879	76,855	97,266	125,442
Globe-Miami	Arizona	55,668	88,509	44,528	62,400	70,406
Central (including Santa Rita)	New Mexico	2,213	29,464	16,557	42,344	64,991
Ely (Robinson)	Nevada	57,580	56,706	38,501	51,590	63,840
Bisbee (Warren)	Arizona	39,842	55,991	47,518	54,617	55,254
Ajo	do	48,020	55,375	43,180	49,871	51,566
Lake Superior	Michigan	47,984	47,464	46,743	43,985	45,198
Yavapai County (mostly Jerome district).	Arizona	50,327	43,403	29,437	38,203	38,201
Ray (Mineral Creek)	do	7	17,308	15,029	21,583	31,729
Pioneer	do	16,224	17,104	17,167	17,958	18,450
Cope	Nevada	12,557	16,588	6,563	14,065	13,542
Copper Mountain (Morenci-Metcalf).	Arizona	6	6,822	11,148	15,878	13,503
Red Cliff (Battle Mountain)	Colorado	7,966	9,458	12,013	11,921	10,552
Chelan Lake	Washington	----------	----------	5,931	8,786	9,288
Plumas County	California	4,239	4,939	602	4,029	5,293
Lordsburg	New Mexico	408	1,904	3,173	3,184	3,278
Coeur d'Alene region	Idaho	1,315	1,944	1,883	2,068	2,680
San Pedro	New Mexico	2	44	44	336	1,394
Tintic	Utah	856	1,331	1,177	1,413	1,295
San Juan Mountains	Colorado	721	1,142	1,819	981	1,209
Ophir	Utah	407	391	437	2,070	1,095
Bunker Hill	Arizona	623	1,396	1,626	246	8
Copper River [2]	Alaska	[3] 18,850	[3] 17,336	[3] 14,549	(4)	(4)
Swain County [2]	North Carolina	(5)	(5)	(5)	(5)	(5)
Lebanon (Cornwall mine) [2]	Pennsylvania	(5)	(5)	(5)	(5)	(5)
Ducktown [2]	Tennessee	(5)	(5)	(5)	(5)	(5)

[1] Districts producing 1,000 short tons or more in any year of the period, 1936–40.
[2] Not listed in order of output.
[3] Includes a small quantity produced elsewhere in Alaska.
[4] Negligible.
[5] Bureau of Mines not at liberty to publish figures.

Quantity and estimated recoverable content of copper-bearing ores.—The following tables list the quantity and estimated recoverable copper content of the ore produced by United States mines in 1939; figures for 1940 are not yet available. Of the total copper produced from copper ores in the United States in 1939, 81 percent was obtained from ores concentrated before smelting and 16 percent from direct-smelting ores. Ore concentrated in 1939 included 5,018,377 tons treated by combined leaching and flotation. In addition to the above, 2,114,407 tons of copper ore were treated by straight leaching. The percentages for 1939 are to be compared with 79 percent obtained from concentrated ore and 18 percent from direct-smelting ores in 1938.

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

Copper ore, old tailings, etc., sold or treated in the United States in 1939, with copper, gold, and silver content in terms of recovered metals

State	Ore, old tailings, etc., sold or treated (short tons)	Copper produced		Gold produced (fine ounces)	Silver produced (fine ounces)	Value of gold and silver per ton of ore
		Pounds	Percent			
Alaska	165	9,137	2.77	316	73	$67.33
Arizona	[4] 17,468,926	[1] 484,565,989	1.39	139,527	4,820,469	.47
California	367,477	8,145,000	1.11	12,962	195,972	1.60
Colorado	342,499	24,169,380	3.53	22,653	6,114,224	14.43
Idaho	1,416	226,600	8.00	600	44,278	36.06
Michigan	4,603,751	87,970,000	.96		101,878	[2] .42
Montana	2,253,270	[1] 189,893,069	4.21	7,636	4,697,920	1.53
Nevada	4,936,001	132,291,600	1.34	68,028	280,654	.52
New Mexico	4,517,429	[1] 87,035,342	.96	9,426	381,875	.13
Texas	657	32,170	2.45		2,209	2.28
Utah	19,602,472	[1] 323,450,271	.83	159,653	1,514,899	.34
Washington	597,957	17,841,078	1.49	48,064	192,237	3.03
Eastern States	[3] 547,078	21,295,000	1.95	2,052	48,631	.19
	[3] 55,239,098	[1] 1,376,924,636	1.25	470,917	18,395,319	.52

[1] Excludes copper recovered from precipitates as follows: Arizona, 35,357,650 pounds; Montana, 4,004,361 pounds; New Mexico, 3,237,257 pounds; and Utah, 7,923,790 pounds.
[2] Calculated only on ore that yielded silver.
[3] Includes copper concentrates from pyritiferous magnetite ore from Pennsylvania.
[4] Includes 142 tons of tank cleanings, the copper from which is included with precipitates.

Copper ore, old tailings, etc., concentrated in the United States in 1939, with content in terms of recovered copper

State	Ore, old tailings, etc., concentrated (short tons)	Concentrates produced (short tons)	Copper produced (pounds)	Copper from ore, etc. (percent)
Arizona	[1] 13,542,200	585,824	[2] 265,897,463	0.98
California	367,041	17,379	8,054,200	1.10
Colorado	1,012	151	63,300	3.13
Michigan	4,603,751	68,386	87,970,000	.96
Montana	2,197,863	382,759	186,057,329	4.23
Nevada	4,906,452	230,629	119,665,400	1.22
New Mexico	4,458,285	145,577	82,969,345	.93
Utah	19,601,000	514,994	323,311,231	.82
Washington	597,127	40,509	17,581,327	1.47
Eastern States	[3] 435,295	44,453	17,700,000	[4] 1.98
	50,710,026	2,030,661	1,109,269,595	1.09

[1] Includes 5,018,377 tons of copper ore treated by combined leaching and flotation but excludes 2,114,407 tons of copper ore treated by straight leaching.
[2] Includes copper from copper ore treated by combined leaching and flotation but excludes 50,700,903 pounds of electrolytic copper from copper ore treated by straight leaching.
[3] Pyritiferous magnetite yielding copper concentrates not included with copper ore.
[4] Obtained by including copper concentrates for Pennsylvania and copper ore for other Eastern States.

Copper ore, old tailings, etc., smelted in the United States in 1939, with content in terms of recovered copper and copper produced from all sources, in terms of recovered copper

State	Ore, old tailings, etc. smelted: Short tons	Ore, old tailings, etc. smelted: Copper produced (pounds)	Ore, old tailings, etc. smelted: Percent of copper	Copper from all sources including old slags, smelter cleanings, and precipitates (pounds)
Alaska	165	9,137	2.77	256,000
Arizona	1,812,177	167,967,623	4.63	[1] 524,224,000
California	436	90,800	10.41	8,360,000
Colorado	341,487	24,106,080	3.53	26,430,000
Idaho	1,416	226,600	8.00	[2] 5,032,000
Michigan	----	----	----	87,970,000
Montana	55,407	3,835,740	3.46	[1] 195,654,000
Nevada	29,549	12,626,200	21.36	133,194,000
New Mexico	59,144	4,065,997	3.44	[1] 92,284,000
Oregon	----	----	----	96,000
Texas	657	32,170	2.45	68,000
Utah	1,472	139,040	4.72	[3] 343,780,000
Washington	830	259,751	15.65	17,996,000
Eastern States	93,415	3,595,000	1.92	21,295,000
	2,396,155	216,954,138	4.61	1,456,639,000

[1] Considerable copper was recovered from mine-water precipitates.
[2] Mostly recovered from ores classed as dry and siliceous silver ores and zinc-lead ore.
[3] Considerable copper was recovered from mine-water precipitates and from ores classed as dry and siliceous and zinc-lead ore.

Copper ores produced in the United States, 1935–39, and average yield in copper, gold, and silver

Year	Smelting ores: Short tons	Smelting ores: Yield in copper (percent)	Concentrating ores [1]: Short tons	Concentrating ores [1]: Yield in copper (percent)	Total: Short tons [1]	Total: Yield in copper (percent)	Total: Yield per ton in gold (ounce)	Total: Yield per ton in silver (ounce)	Total: Value per ton in gold and silver
1935	[1] 1,612,200	5.42	[2] 17,065,419	1.57	19,112,054	1.89	0.0119	0.664	$0.93
1936	[1] 2,388,635	5.05	36,116,692	1.31	38,514,245	1.54	.0099	.453	.70
1937	[1 3] 2,763,184	4.30	[3] 58,737,922	1.15	[3] 61,513,148	1.29	.0081	.327	.53
1938	[1 3] 2,028,000	4.49	[3] 34,374,026	1.17	[3] 37,794,938	1.34	.0090	.414	.58
1939	[1] 2,396,155	4.61	50,710,168	1.09	55,239,098	1.25	.0085	.333	.52

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

REFINERY PRODUCTION

The refinery output of copper in the United States in 1940 was made by the 10 plants listed in the following table. The table also includes a refinery idle since 1933—Quincy Smelting Works in Michigan—and a plant in Arizona 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.

Copper refineries in the United States, 1940

Location	Company	Process
Arizona: Inspiration	Inspiration Consolidated Copper Co.[1]	Electrolytic.
Maryland: Baltimore	American Smelting & Refining Co	Do.
Michigan: Hancock	Quincy Smelting Works [2]	Furnace.
Houghton	Copper Range Co	Do
Hubbell	Calumet & Hecla Consolidated Copper Co	Do.
Montana: Great Falls	Anaconda Copper Mining Co	Electrolytic.
New Jersey: Barber	American Smelting & Refining Co	Do.
Carteret	U. S. Metals Refining Co	Do.
Perth Amboy	International Smelting & Refining Co.; Raritan Copper Works.	Do.
New York: Laurel Hill	Phelps Dodge Refining Corporation	Do.
Texas: El Paso	do	Do.
Washington: Tacoma	American Smelting & Refining Co	Do.

[1] Product shipped as cathodes to other refineries for casting into merchant shapes.
[2] Idle since 1933.

The 12 plants tabulated constitute what commonly are termed "regular refineries." Of these plants, 9 employ the electrolytic process and 3 the furnace process. The electrolytic plants have a rated capacity of 1,549,000 tons [3] of refined copper a year. As they produced 1,388,000 short tons in 1940, this part of the industry was operating at 90 percent capacity.

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

Primary and secondary copper produced by regular refining plants in the United States and imported, 1936–40, in pounds

	1936	1937	1938	1939	1940
Primary:					
Domestic: [1]					
Electrolytic	1, 198, 132, 177	[2] 1,548,857,307	[2] 1,032,976,656	[2] 1,324,817,430	[2] 1,767,219,614
Lake	91, 105, 431	[2] 84, 007, 120	[2] 72, 021, 341	[2] 84, 928, 386	[2] 87, 259, 382
Casting	1, 686, 587	11, 640, 702	150, 326		
	1, 290, 924, 195	1, 644, 505, 129	1, 105, 148, 323	1, 409, 745, 816	1, 854, 478, 996
Foreign: [1]					
Electrolytic	353, 817, 802	486, 285, 376	479, 635, 732	609, 284, 939	772, 633, 048
Casting and best select	235, 413	2, 837, 298	47, 674		
Refinery production, new copper	1, 644, 977, 410	2, 133, 627, 803	1, 584, 831, 729	2, 019, 030, 755	2, 627, 112, 044
Imports, refined copper [3]	9, 563, 232	14, 974, 815	3, 603, 025	32, 527, 473	136, 674, 143
Total new refined copper made available	1, 654, 540, 642	2, 148, 602, 618	1, 588, 434, 754	2, 051, 558, 228	2, 763, 786, 187
Secondary:					
Electrolytic	265, 437, 556	[4] 312, 831, 103	[4] 185, 084, 601	[4] 233, 225, 695	[4] 235, 337, 792
Casting	392, 167	380, 000			
	265, 829, 723	313, 211, 103	185, 084, 601	233, 225, 695	235, 337, 792
Grand total	1, 920, 370, 365	2, 461, 813, 721	1, 773, 519, 355	2, 284, 783, 923	2, 999, 123, 979

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

[3] This figure for rated capacity, quoted from the American Bureau of Metal Statistics, is less than that given in the preceding edition of Minerals Yearbook; the change is a result of recalculation rather than any decrease in physical plant capacity.

Copper cast in forms in the United States, 1939–40

Form	1939		1940	
	Pounds	Percent	Pounds	Percent
Wire bars	1,077,000,000	47.83	1,245,000,000	43.50
Cathodes	532,000,000	23.62	906,000,000	31.66
Cakes	330,000,000	14.65	293,000,000	10.24
Ingots	137,000,000	6.08	175,000,000	6.11
Other forms	176,000,000	7.82	243,000,000	8.49
	2,252,000,000	100.00	2,862,000,000	100.00

In addition to the regular refineries, numerous plants throughout the country operate on scrap exclusively, producing metallic copper and a great variety of alloys. The output of these plants is not included in the statements of refined-copper production in the preceding tables but is included in the following statement of secondary-copper production.

Copper sulfate.—The production of hydrous copper sulfate or bluestone by copper refineries in the United States was 44,308,107 pounds having a copper content of 11,286,000 pounds in 1940 compared with 38,219,447 pounds having a copper content of 9,735,000 pounds in 1939.

The output of copper sulfate by plants other than the regular primary refineries was 89,723,720 pounds with a reported copper content of 22,808,000 pounds in 1940 compared with 48,312,400 pounds containing 12,290,000 pounds of copper in 1939.

SECONDARY COPPER

Secondary copper includes material recovered from remelting old copper and copper scrap and from the treatment of copper alloys or alloys treated without separation of the copper. The following table summarizes the production of secondary copper during 1936–40. Further details appear in the chapter on Secondary Metals—Nonferrous.

Secondary copper produced in the United States, 1936–40, in short tons

	1936	1937	1938	1939	1940
Copper as metal	260,000	285,600	192,400	151,370	170,839
Copper in alloys	224,600	246,500	167,400	[1] 348,330	[1] 361,207
Total secondary copper	484,600	532,100	359,800	499,700	532,046
From new scrap	101,900	123,200	92,500	212,800	198,156
From old scrap	382,700	408,900	267,300	286,900	333,890
Percent of domestic mine output	79	63	65	69	61

Includes 3,200 tons in chemicals in 1939 and 9,431 in 1940.

CONSUMPTION AND USES

New supply.—The total available supply of new copper consists of the total output of primary copper by refineries plus the imports of refined copper. In 1940 it was 2,763,786,187 pounds—a 35-percent increase from 1939. If this figure is reduced by the quantity of refined copper exported and adjusted for changes in stocks at refineries the quantity of new copper made available for domestic consumption may be estimated. This computation is made in the table that follows. It should be noted, however, that exports and stocks include some refined secondary copper that cannot be determined separately and that actual consumption of new copper would differ from the figures shown in the table by the changes in consumers' stocks, on which data are not available.

New refined copper withdrawn from total year's supply on domestic account, 1936–40, in pounds

	1936	1937	1938	1939	1940
Total supply of new copper	1, 654, 540, 642	2, 148, 602, 618	1, 588, 434, 754	2, 051, 558, 228	2, 763, 786, 187
Stock at beginning of year	350, 000, 000	220, 000, 000	358, 000, 000	362, 000, 000	191, 000, 000
Total available supply	2, 004, 540, 642	2, 368, 602, 618	1, 946, 434, 754	2, 413, 558, 228	2, 954, 786, 187
Copper exported [1]	472, 182, 922	620, 791, 029	770, 446, 945	792, 812, 995	754, 215, 509
Stock at end of year	220, 000, 000	358, 000, 000	362, 000, 000	191, 000, 000	183, 000, 000
	692, 182, 922	978, 791, 029	1, 132, 446, 945	983, 812, 995	937, 215, 509
Withdrawn on domestic account	1, 312, 357, 720	1, 389, 811, 589	813, 987, 809	1, 429, 745, 233	2, 017, 570, 678

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

As shown in the foregoing table, the quantity of new copper withdrawn on domestic account in 1940 was 41 percent larger than in 1939. Furthermore, it established a new record by being 13 percent larger than in 1929.

Estimated use of copper in the United States, 1936–40, in short tons

Use	1936	1937	1938	1939	1940
Electrical manufactures [1]	164, 000	212, 000	150, 000	185, 000	247, 000
Telephone and telegraphs	26 000	40, 000	30, 000	39, 000	49, 000
Light and power lines [2]	72, 000	83, 000	62, 000	67, 000	74, 000
Wire cloth	6, 500	6, 800	6, 000	8, 000	9, 200
Other rod and wire [3]	90, 000	102, 000	60, 000	95, 000	120, 000
Ammunition	11, 900	14, 100	12, 500	14, 500	26, 000
Automobiles [4]	108, 000	112, 000	55, 000	85, 000	103, 000
Buildings [5]	71, 000	70, 500	67, 500	89, 000	102, 000
Castings, n. e. s.[6]	39, 000	40, 000	31, 000	33, 000	35, 000
Clocks and watches	3, 400	4, 000	3, 000	4, 000	4, 400
Copper-bearing steel	3, 900	4, 600	2, 600	4, 200	4, 700
Radiators, heating	2, 000	2, 100	2, 000	3, 600	2, 900
Radio receiving sets	24, 000	23, 100	21, 000	27, 000	32, 000
Railway equipment [7]	4, 000	7, 100	1, 700	2, 700	5, 700
Refrigerators [8]	15, 000	13, 500	6, 700	10, 000	10, 500
Shipbuilding [8]	5, 000	6, 400	6, 000	8, 500	8, 700
Air conditioning [8 9]	6, 400	7, 200	6, 000	6, 000	6, 000
Other uses [10]	65, 300	66, 600	46, 200	67, 600	81, 500
Manufactures for export	31, 600	45, 000	38, 800	51, 900	148, 400
	749, 000	860, 000	608, 000	801, 000	1, 070, 000

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

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

The table shows that the estimated quantity of copper going into use in 1940 was 34 percent larger than in 1939 but 8 percent less than in 1929. The most important use of copper is for electrical manufactures, which took 34 percent more than in 1939 and 5 percent less than in 1929. Copper consumption in light and power lines increased 10 percent over 1939, and that in telephones and telegraphs increased 26 percent over 1939, but it fell 42 percent and 70 percent, respectively, from 1929. However, other rod and wire, the second largest outlet for copper, took not only 26 percent more than in 1939 but 13 percent more than in 1929. The quantity of copper used in automobiles was 21 percent larger than in 1939 but dropped 25 percent from 1929. Castings gained only 6 percent over 1939 and were 56 percent below 1929, and refrigerators were 5 percent higher and 39 percent lower, respectively. In addition to other rod and wire, the important uses of copper that improved in 1940 over both 1939 and 1929 were buildings, with increases of 15 percent and 73 percent respectively; radios, with 19 percent and 106 percent; ammunition, with 79 percent and 277 percent; and shipbuilding, with 2 percent and 263 percent. The consumption of copper in manufactures for export rose 186 percent over 1939 and 98 percent over 1929. The use of copper in the United States, measured in pounds per person, was 14.0 in 1940, 11.4 in 1939, and 19.1 in 1929.

A new type of copper designed to meet the need of the electrical industry for a copper of greater conductivity, ductility, fatigue resistance, and surface quality was announced by Phelps Dodge Corporation in March 1940. The metal is made, without melting, from cathode copper, which is plastically converted by tremendous pressure in a reducing atmosphere at elevated temperatures into smooth, dense copper bar, rod, strip, or other commercial shape. The metal is said to be particularly applicable where severe vibration is a problem.

STOCKS

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

Stocks of copper in the United States, January 1, 1937–41, in pounds

Year	Refined copper	Blister and materials in process of refining	Year	Refined copper	Blister and materials in process of refining
1937	220,000,000	391,000,000	1940	191,000,000	520,000,000
1938	358,000,000	428,000,000	1941	183,000,000	486,000,000
1939	362,000,000	466,000,000			

At the end of 1940, inventories of refined copper were 4 percent lower than at the close of 1939. Stocks of blister and anode copper at smelters, in transit to refineries, and blister and unfinished materials in process of refining at refineries decreased 7 percent, so that total stocks at smelters and refineries were 6 percent less than at the end of 1939.

Figures compiled by the Copper Institute and published in the press show that domestic stocks of refined, duty-free copper totaled 159,485 tons at the end of 1939. The trend of large deliveries cutting into inventories, characteristic of the latter half of 1939, continued into the first month of 1940, and refined stocks totaled 135,441 tons at the end of January. Subsequent deliveries declined, and supplies on hand rose monthly until the end of July, when they reached the highest level of 1940—215,823 tons. During the remainder of the year, deliveries were increased, and refined stocks diminished progressively to 142,772 tons at the end of 1940. The Copper Institute reported that blister stocks were decreased by 41,417 tons in 1940.

Copper Institute figures for the United States presumably include some metal held by consumers or at some secondary plants, as reports to the Bureau of Mines from primary refineries indicate that stocks of refined copper at refineries (shown in the foregoing table), were 91,500 tons at the end of 1940 and 95,500 tons at the end of 1939 (compared with 142,772 and 159,485 tons, respectively). Data for consumers' stocks are not available.

PRICES

Reports to the Bureau of Mines from copper-selling agencies indicate that 1,014,000 short tons of copper were delivered to domestic and foreign purchasers in 1940 at an average price (f. o. b. refinery) of 11.3 cents a pound compared with 10.4 cents in 1939, 9.8 cents in 1938, and 12.1 cents in 1937.

Fluctuations in copper prices during 1940 were within the relatively narrow range of 10.5 and 12.5 cents a pound. (The prices in this discussion are those quoted by the American Metal Market for producers' electrolytic copper delivered to Connecticut points and are slightly higher than those shown in the accompanying tables, which are calculated prices, f. o. b. New York refinery equivalent.) The high of 12.5 cents for producers' electrolytic copper delivered to Connecticut points was quoted during the first 2 weeks of 1940 and was a continuation of the price gains that followed the outbreak of war in September 1939. Realization of changes in conditions of supply since the previous war and Government restraint on price raising helped to hold down January (1940) domestic sales of copper to 24,987 tons. On January 17 the price of copper began a steady trend downward. It was quoted at 11.25 cents a pound on February 7, and domestic sales skyrocketed to 147,112 tons in that month. By July 23 the pressure of increasing stocks had brought the prices to its 1940 low of 10.5 cents. Domestic sales from March to August ranged from 20,300 tons to 110,500 monthly. Rising prices and decreasing stocks during August and September stimulated record-breaking domestic sales of 254,277 tons in September. On September 24 the price reached 12 cents and stayed there throughout the remainder of the year. Domestic sales in the final quarter of 1940 were 125,531 tons in October, 85,633 tons in November, and 89,517 tons in December.

Producers' Lake copper delivered to Connecticut points was quoted at 12.5 cents a pound at the beginning of 1940 and 12 cents at the end—both the same as for producers' electrolytic copper. During the year, however, prices of the Lake copper changed relatively few times. The price dropped three times in late January and early February to 11.25 cents on February 7. It recovered on February 20 to 11.5 cents, where it remained until August 7, when it hit the 1940 low of 11 cents. Half-cent gains on September 5 and September 24 brought the price of Lake copper to 12 cents, where it stayed during the remainder of the year.

In early February 1940 custom smelters declared wide-open market; that is, they no longer had an established price (usually the same as that quoted by primary producers) but began booking business at individual quotations for each order.

Average monthly quoted prices of electrolytic copper for domestic and export shipments, f. o. b. refineries, United States, and for spot copper at London, 1939–40, in cents per pound

Month	1939				1940			
	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 [3] [4]
January	11.12	11.025	9.912	10.098	12.09	11.954	11.999	(4)
February	11.12	11.025	9.735	9.910	11.28	11.148	11.471	(4)
March	11.12	11.025	9.888	10.065	11.26	11.160	11.407	(4)
April	10.34	10.265	9.820	9.995	11.20	11.087	11.258	(4)
May	9.93	9.833	9.738	9.933	11.20	11.079	11.191	(4)
June	9.87	9.775	9.738	9.935	11.25	11.128	11.216	(4)
July	10.09	9.976	9.944	10.212	10.69	10.564	10.189	(4)
August	10.37	10.261	10.211	10.376	10.83	10.708	9.851	(4)
September	11.80	11.635	11.685	(4)	11.41	11.296	9.849	(4)
October	12.32	12.215	12.491	(4)	11.87	11.826	10.436	(4)
November	12.37	12.275	12.929	(4)	11.87	11.800	10.084	(4)
December	12.37	12.275	12.631	(4)	11.87	11.802	10.293	(4)
Average for year	11.07	10.965	10.727	[5] 10.066	11.40	11.296	10.770	(4)

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

Average yearly quoted prices of electrolytic copper for domestic and export shipment f. o. b. refineries, United States, and for spot copper at London, 1931–40, in cents per pound

	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940
Domestic f. o. b. refinery [1]	8.24	5.67	7.15	8.53	8.76	9.58	13.27	10.10	11.07	11.40
Domestic f. o. b. refinery [2]	8.116	5.555	7.025	8.428	8.649	9.474	13.167	10.000	10.965	11.296
Export f. o. b. refinery [2]	(3)	(3)	6.713	7.271	7.538	9.230	13.018	9.695	10.727	10.770
London spot [2] [4]	8.522	5.629	6.877	7.496	7.753	9.465	13.097	9.912	[5] 10.066	(6)

[1] As reported by the American Metal Market Co.
[2] As reported by Engineering and Mining Journal.
[3] Not available. Export quotation was established after imposition of tariff in 1932.
[4] Conversion of English quotations into American money based on average rates of exchange recorded by the Federal Reserve Board of the Treasury.
[5] Average for 8 months.
[6] No quotations.

Outside prices for electrolytic copper delivered at Connecticut points opened in 1940 at 12.6 cents a pound and closed at 12.375

cents. The highest quotation on this type of copper in 1940 was 13.125 cents, and the lowest was 10.425; the average was 11.676.

Transactions on the London Metal Exchange were suspended at the beginning of the war. The maximum buyers' price on standard copper was fixed by the British Ministry of Supply at 62 pounds throughout 1940.

FOREIGN TRADE [4]

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. Eighty-six percent of the copper imported in 1940 was contained in ore, concentrates, and unrefined furnace products, nearly 14 percent was refined copper, and most of the remainder consisted of ingots to be remelted and recast in the United States. The proportion of refined metal receipts increased from 0.7 percent in 1938 to 5 percent in 1939 and 14 percent in 1940; the loss of normal markets by Chile—the principal contributor of refined copper—was chiefly responsible for this trend. In contrast to the import situation in the United States, 98 percent of the exports comprised refined copper and primary manufactures therefrom.

The United States has long had an exportable surplus of copper and for many years exported more copper than it imported. In 1930–32, imports exceeded exports, and a tariff of 4 cents a pound was placed on copper in 1932. During 1933–39 exports exceeded imports, the principal part of which were for smelting, refining, and export. In 1940, however, imports again exceeded exports; the latter remained about the same as in 1939, but imports rose sharply to meet the demands of national defense.

Separation of total exports to show the quantity of domestic copper shipped from the United States is not possible. Data on hand, however, indicate that exports of domestic copper declined appreciably in the past 2 years. Excess of total exports over imports of unmanufactured copper fell from 340 million pounds in 1938 to 183 million pounds in 1939, and imports surpassed exports by 127 million pounds in 1940. In addition to the copper shown in the accompanying tables, an unrecorded quantity of metal is exported in manufactures, such as electrical machinery, automobiles, and similar equipment.

Imports.—Unmanufactured copper imports were 46 percent greater in 1940 than in 1939 and were the highest on record, though less than 1 percent above the previous record, established in 1929. The increase was shared by all classifications except scrap and was sharpest for regulus—120 million pounds in 1940 compared with 6 million in 1939—and for refined—137 million pounds in 1940 and 33 million in 1939. Other import classifications in 1940 showed increases over 1939 of 83 percent for ore, 15 percent for concentrates, and 13 percent for unrefined blister and converter copper. Scrap imports declined 52 percent in 1940 compared with 1939. Imports of unmanufactured copper of all types in 1938 came principally from Chile, Mexico, Canada, Peru, Cuba, and Yugoslavia. Chile retained its leading position in 1939 and 1940 by a wide margin. Belgian Congo, which

[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.

had not sold copper in the American market since 1930, was the second largest source of imports in 1940. Canada, a rapidly growing exporter of copper in recent years, nearly equaled Mexican shipments to the United States in 1939 and surpassed them in 1940. Imports from Peru and British South Africa were the fourth and fifth largest, respectively, in 1939 and fifth and sixth, but in reverse order, in 1940. Next in line in 1939 were Newfoundland and Cuba in that order, which was reversed in 1940. Imports of copper from Yugoslavia decreased in recent years and were absent in 1940.

Imports of ore were mainly from Chile, the Union of South Africa, Mexico, and Peru. This is the first time since 1921 that South Africa has contributed over a million pounds of copper in ore. Cyprus, the second largest source in 1937–39, sent no untreated copper ore to the United States in 1940, although it did send concentrates. Canada, Cuba, Newfoundland, Mexico, Cyprus, and Bolivia were the sources of the principal portion of concentrates received. Of this group, small decreases from Canada and Newfoundland were much more than balanced by the shipments from Cyprus, a new contributor to the concentrates classification, and by increases from Bolivia, Cuba, and Mexico. Imports of other unrefined copper (regulus, unrefined blister, and converter copper), which gained so heavily in 1940, were primarily from Chile, the Belgian Congo, Mexico, and Peru. Virtually all refined copper entered is from Chile, and this class increased sharply in 1940. The small amount of scrap copper imported in 1939 and 1940 came chiefly from Canada, the Union of South Africa, and Peru.

Copper (unmanufactured) imported into the United States in 1940, 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	4,880,451	644,279	10,336,906	15,581,364		93,950
Other South		1,026,612	15,166,876	38,627,172		
Australia	1,233,728	617,300	226,725			
Belgian Congo			86,714,045	34,915,165		
Bolivia	121,500	8,086,159	62,460	332		7,000
Burma			4,054,377			
Canada	740,377	50,741,663	782,757	45,704,404	3,347,046	2,074,620
Chile	10,051,831	3,935,640	1,489,478	261,857,226	133,327,097	3,800
Cuba	396,150	22,724,038				
Ecuador	79,203	3,002,160	142,519			
Malta, Gozo, and Cyprus Islands		9,304,640				
Mexico	2,695,667	12,878,521	8,320	71,199,389		2,591
Newfoundland and Labrador	7,040	19,675,418				50,718
Norway		1,064,000				
Peru	2,362,600	4,950,537	434,578	76,007,665		320,211
Philippine Islands	(2)	[2] 4,172,913				
Turkey				12,448,322		
Other countries	16,914	324,242	811,214	83,060		1,069,677
	22,585,461	143,148,122	120,230,255	556,424,099	136,674,143	3,622,567

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

[2] Some copper in "ore" and "other" from the Philippine Islands is not separately classified and is included under "concentrates."

Copper (unmanufactured) imported into the United States, 1936–40, in millions of pounds [1]

	1936	1937	1938	1939	1940
Africa:					
Belgian Congo					122
British:					
Union of South	(2)	1	4	34	32
Other South	(2)	4	9	30	55
Australia	2	5	5	6	2
Bolivia	5	6	5	4	8
Canada	28	61	88	95	103
Chile	119	199	135	240	409
Cuba	24	28	36	20	23
Malta, Gozo, and Cyprus Islands	3	9	3	3	9
Mexico	70	108	94	105	87
Newfoundland and Labrador	1	16	13	20	20
Peru	71	82	80	77	84
Philippine Islands	(2)	1	3	3	4
Turkey			5	11	12
United Kingdom	1	2	1	1	(2)
Yugoslavia	38	32	21	19	
Other countries	19	6	2	5	13
Total	381	560	504	673	983

[1] Data include copper imported for immediate consumption plus material entering the country under bond.
[2] Less than one-half million pounds.

Copper (unmanufactured) imported [1] *into the United States, 1936–40*

Year	Pounds	Year	Pounds
1936	380,677,700	1939	672,594,122
1937	559,749,133	1940	982,684,647
1938	504,327,779		

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

Exports.—The recorded quantity of copper of all classes exported in 1940 was a trifle more than in 1939 and the largest since 1929. This quantity, however, does not include the copper exported in machinery, which probably gained appreciably in 1940. This is indicated in that the value of exported industrial and other electrical machinery, automobiles, aircraft engines, and accessories increased 25 percent in 1940. There was a definite trend in 1940 to turn more of the refined copper to be exported into primary products, such as wire, pipes, and sheets, before shipment. The principal class continued to be refined bars and ingots, but it declined 4 percent, and rods and scrap fell 13 percent and 59 percent, respectively. Insulated wire, the second-ranking class in 1940, advanced 263 percent, and all other classes showed tremendous increases—144 percent for uninsulated wire, 144 percent for pipes and tubes, 342 percent for plates and sheets, and 375 percent for ores and unrefined copper.

The principal recipients of copper exported from the United States in 1938 were Japan, Germany, France, Czechoslovakia, United Kingdom, and Italy. The 1939 exports were characterized by increases to France and Italy and decreases to Germany, making the order Japan, France, Italy, Germany, Sweden, and the U. S. S. R. Japan held its leading position in 1940, followed by the United Kingdom and the U. S. S. R., which took 262 percent and 135 percent more, respectively, than in 1939. France was a large purchaser in the first part of the year, but its capitulation relegated it to fourth place in 1940, followed by Italy. Of the copper exports, Japan, Germany, and Italy together took 52 percent in 1938, 44 percent in 1939, and 36 percent in 1940 (though none went directly to Germany in 1940).

Copper exported from the United States in 1940,[1] in pounds

Country	Ore, concentrates, composition metal, and unrefined copper (copper content)	Refined: Bars, ingots, or other forms	Refined: Rods	Old and scrap	Pipes and tubes	Plates and sheets	Wire (except insulated)	Insulated wire and cable	Other copper manufactures
Argentina		8,422,526	27,303		243,532	157,615	365,069	1,877,291	
Belgium		2,364,900	448,003	591,946	109			7,160	
Brazil		10,434,248	403,770	35,401	293,611	750,280	54,782	292,888	
China		9,640,502	53,078	974,699	207,858	234,450	1,765,550	1,494,546	
Denmark		1,120,241	1,791,691		1,408		1,772	10,635	
Finland		661,380	2,933,283					976,073	
France	504,625	60,807,687		146,811		49,169	26,460	11,514,771	
Hong Kong		408,111	2,779		37,980	1,441	267,858	533,631	
Hungary		8,882,003	448,049	732,425					
India, British		2,364,311	6,249,747	642,434	506,604	3,025,890	57,337	687,008	
Indochina, French		510,936			205	619		7,348	
Italy	39,000	67,673,284	462,400						(2)
Japan		233,946,109		6,814,804	59,326	44,800	23,424	58,390	
Kwantung		4,445,159	14,896,822	212,800				84,165	
Mexico	5,449	5,576,538	23,177	38,339	246,889	186,543	69,085	1,113,714	
Netherlands		6,396,654	463,614	57,581	9,157		2,000	489,886	
Norway		130,986	1,054,128	22,028	337	1,076	23,597	51,433	
Sweden		12,070,421		122,800	3,455	22,744	44,000	1,105,070	
Switzerland		13,653,993	560,252	132,289	290,517				
U. S. S. R.		108,955,900		395,853		253	5,533,234	21,558	
United Kingdom		141,016,452	8,430,390	624,180	2,724,543	14,325	664,739	9,654,716	
Other countries	39,472	13,379,787	3,104,895	2,753,187	3,046,267	2,964,867	8,812,415	23,968,850	
	588,546	712,862,128	41,353,381	14,297,577	7,671,798	7,454,072	17,711,322	53,949,133	(2)
Total value	$79,623	$81,840,805	$5,167,363	$1,526,158	$1,631,458	$1,435,438	$2,642,572	$14,210,800	$1,584,441

[1] Changes in table in Minerals Yearbook 1940, p. 95, are as follows: Insulated wire and cable exported to Brazil should read 247,172 pounds; other countries, 12,645,923 pounds.
[2] Figures for quantity not recorded.

Copper exported from the United States, 1936–40, in millions of pounds

	1936	1937	1938	1939	1940
Argentina	4	7	6	4	11
Belgium	33	34	22	14	3
Brazil	10	5	5	8	12
Canada	2	7	4	2	4
China	6	12	4	3	14
Cuba	2	3	2	3	3
Czechoslovakia	(1)	12	70	2	----------
Denmark	4	7	5	7	3
Finland	5	6	9	7	5
France	86	84	70	153	73
Germany	80	100	173	54	----------
Hong Kong	1	6	8	(1)	1
Hungary	(1)	(1)	3	10	10
India, British	4	9	5	11	14
Indochina, French	(1)	(1)	(1)	11	1
Italy	48	42	47	60	68
Japan	86	157	222	259	241
Kwangtung	(1)	2	9	17	20
Mexico	11	8	3	4	7
Netherlands	13	20	21	16	8
Norway	10	8	6	12	1
Philippine Islands	2	3	4	3	3
Poland and Danzig	14	7	25	25	----------
Spain	(1)	(1)	(1)	1	2
Sweden	31	35	39	51	13
Switzerland	(1)	(1)	1	7	15
U. S. S. R.	(1)	4	(1)	49	115
United Kingdom	62	108	62	45	163
Other countries	11	15	19	17	46
Total	525	701	844	855	856

[1] Less than one-half million pounds.

Copper [1] exported from the United States, 1936–40

Year	Pounds: Metallic [2]	Pounds: Total	Total value	Year	Pounds: Metallic [2]	Pounds: Total	Total value
1936	518, 064, 333	524, 833, 536	$50, 077, 631	1939	855, 033, 814	855. 157, 653	$96, 321, 365
1937	692, 458, 087	700, 633, 261	92, 774, 770	1940	855, 299, 411	855, 887, 957	108, 534, 217
1938	842, 023, 197	844, 027, 426	86, 119, 848				

[1] Exclusive of "other copper manufactures" valued at $585,568 in 1936, $851,697 in 1937, $689,008 in 1938 $863,561 in 1939 and $1,584,441 in 1940; 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.

The value of brass and bronze exported from the United States in 1940 was $45,228,774, a five-fold gain over 1939 and the third largest on record. It was exceeded in 1916 and 1917; in the latter of those years the peak value of $239,891,109 was reached, and that figure was for brass alone. Exports of brass and bronze plates and sheets were 52 times greater in 1940 than in 1939, and exports of bars, rods, and wire were 6 times greater. All classes of unmanufactured brass (ingots, bars, rods, plates, and sheets) exported in 1940 totaled 181,814,478 pounds—14 times that of 1939 and standing third only to the record of 328,346,666 pounds in 1917 and to exports of 244,531,706 pounds in 1916. Shipments of copper sulfate to foreign countries were much larger in 1940 than ever before—90 percent higher than in 1939, 78 percent above the former record in 1938, and 91 percent over 1917 exports.

Brass and bronze exported from the United States, 1939–40

	1939		1940	
	Pounds	Value	Pounds	Value
Ingots	1,626,469	$229,753	1,347,729	$188,039
Scrap and old	10,676,747	743,428	11,774,885	1,056,414
Bars and rods	9,091.621	1,182,535	63,179,616	8,894,520
Plates and sheets	2,233,802	534,290	117,287,133	21,719,237
Pipes and tubes	2,237,718	500,492	4,267,606	1,149,321
Pipe fittings and valves	2,540,930	1,572,466	2,944,804	1,786,549
Plumbers' brass goods	1,444,486	801,631	1,424,883	796,402
Wire of brass or bronze	1,355,583	335,820	9,312,705	2,686,117
Brass wood screws	(1)	43,584	(1)	72,929
Hinges and butts of brass or bronze	(1)	74,903	(1)	98,721
Other hardware of brass or bronze	(1)	276,729	(1)	371,646
Other brass and bronze manufactures	(1)	2,622,271	(1)	6,408,879
		8,917,902		45,228,774

1 Weight not recorded.

Unmanufactured brass exported from the United States, 1936–40

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

Year	Pounds	Value	Year	Pounds	Value
1936	2,712,758	$462,535	1939	12,951,892	$1,946,578
1937	17,373,035	2,573,245	1940	181,814,478	30,801,796
1938	3,645,637	677,809			

Copper sulfate (blue vitriol) exported from the United States, 1936–40

Year	Pounds	Value	Year	Pounds	Value
1936	10,734,408	$342,847	1939	29,239,575	$1,157,498
1937	23,528,240	1,212,430	1940	55,480,646	2,293,983
1938	31,249,735	1,229,317			

WORLD ASPECTS OF COPPER INDUSTRY

A perspective of the world copper situation in 1940 and of the outlook for 1941 is given in the introductory pages of this chapter. Some of the details are discussed, by countries, in the following pages.

Albania.—Two new mines in the Rubico district are expected to have an annual output of ore equivalent to 6,000 metric tons of metallic copper.[5]

Australia.—The copper production in Australia in 1940 is estimated at 17,700 metric tons.[6] The British Government has a contract to purchase any exportable surplus up to 7,000 tons a year, but wide expansion of the local munitions industry is absorbing the entire output of the Commonwealth. The maximum price of copper was raised on February 16, 1940, from £63 17s. 6d. to £76 a ton but was still below that fixed by the British Ministry of Supply, the Australian equivalent of which was £77 10s. The increased price was to stimulate copper production in Australia, and it was established with the understanding that the two principal operators would

5 Metal Bulletin (London), No. 2485, April 30, 1940, p. 4.
6 Engineer, vol. 171, No. 4447, April 4, 1941, p. 233.

World mine and smelter production of copper, 1938–40, in metric tons

[Compiled by L. P. Lounsbery]

Country	Mine 1938	Mine 1939	Mine 1940	Smelter 1938	Smelter 1939	Smelter 1940
North America:						
Canada	259,113	275,829	(1)	[2] 215,732	[2] 229,370	(1)
Cuba	14,431	9,964	10,500	------	------	------
Mexico	41,851	44,390	37,602	37,100	44,300	34,400
Newfoundland	8,056	10,341	9,426	------	------	------
United States	505,991	660,717	796,582	[3] 570,773	[3] 698,323	[3] 922,369
	829,442	1,001,241	(1)	823,605	971,993	(1)
South America:						
Bolivia	[4] 2,885	[4] 4,056	[4] 6,660	------	------	------
Brazil	15	14	(1)	------	------	------
Chile	351,443	339,170	352,439	337,508	324,591	337,021
Peru	37,529	38,170	37,686	35,741	34,115	33,584
	391,872	381,410	397,000	373,249	358,706	370,605
Europe:						
Belgium	------	------	------	[5] 81,460	(1)	(1)
Bulgaria	64	320	(1)	------	------	------
Finland	12,232	11,797	(1)	11,824	13,246	(1)
France	[6] 600	(1)	(1)	(1)	(1)	(1)
Germany } Austria }	30,000	30,000	(1)	[7] 70,000	[7] 66,000	(1)
Hungary	336	(1)	(1)	------	------	------
Italy	[6] 1,000	(1)	(1)	2,963	(1)	(1)
Norway	21,619	19,436	(1)	10,547	10,515	(1)
Portugal	4,884	(1)	(1)	------	------	------
Rumania	[8] 580	(1)	(1)	580	(1)	(1)
Spain	[6] 30,000	(1)	(1)	[6] 11,000	[6] 7,300	(1)
Sweden	9,289	9,610	(1)	10,668	11,076	(1)
U. S. S. R.[9]	[10] 114,552	[10] 144,000	(1)	114,552	144,000	(1)
United Kingdom	37	(1)	(1)	7,200	(1)	(1)
Yugoslavia	49,500	64,200	(1)	41,993	41,658	42,951
	275,000	(1)	(1)	363,000	(1)	(1)
Asia:						
Burma	[6] 3,600	(1)	(1)	------	------	------
China [11]	240	1	(12)	240	1	(12)
Cyprus	29,780	24,384	(1)	------	------	------
India, British	[6] 5,600	(1)	(1)	5,416	6,800	(1)
Japan:						
Japan Proper	[10] 102,000	[10] 104,000	(1)	102,000	104,000	(1)
Taiwan	[6] 4,000	[6] 4,000	[6] 4,000	------	------	------
Netherlands Indies	93	94	(1)	------	------	------
Philippine Islands	3,528	7,496	9,259	------	------	------
Turkey	[10] 2,488	[10] 5,917	(1)	2,488	5,917	(1)
U. S. S. R.	(9)	(9)	(9)	(9)	(9)	(9)
	[9] 151,000	(1)	(1)	[9] 110,144	[9] 116,718	(1)
Africa:						
Algeria	22	(1)	(1)	------	------	------
Belgian Congo	[10] 123,943	[10] 122,649	(1)	123,943	122,649	(1)
Rhodesia:						
Northern	254,904	(1)	(1)	216,450	215,065	(1)
Southern	5	(1)	(1)	------	------	------
South-West Africa	4,828	3,530	1,485	------	------	------
Union of South Africa	11,305	10,998	(1)	13,468	14,089	(1)
	395,007	(1)	(1)	353,861	351,803	(1)
Oceania: Australia	19,758	19,800	(1)	17,372	20,219	(1)
	2,062,000	(1)	(1)	2,041,000	[13] 2,216,000	(1)

[1] Data not available.
[2] Copper content of blister produced.
[3] Smelter output from domestic and foreign ores, exclusive of scrap. The production from domestic ores only, exclusive of scrap, was as follows: 1938, 510,133 tons; 1939, 646,524 tons; 1940, 824,703 tons.
[4] Copper content of exports.
[5] 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.
[6] Approximate production.
[7] Exclusive of material from scrap.
[8] Smelter output from ores.
[9] Output from U. S. S. R. in Asia included under U. S. S. R. in Europe.
[10] Smelter product.
[11] Exports of ingots and slabs.
[12] Less than 1 ton.
[13] Approximate production based upon output of countries shown, which in 1938 contributed about 95 percent of total world output.

set aside £4 a ton produced for development and expansion. Improvements at Mount Morgan, Ltd., Queensland, involving extension of the smelter and conversion of the former oxide ore-treatment plant to a sulfide mill, will double its copper output, raising it to 6,000 tons yearly.[7] Copper imported into Australia in the form of blocks, ingots, wirebars, pigs, or scrap was exempted on August 29, 1940, from the payment of certain duties. This exemption was in response to expanded defense demands and facilitates the entry of copper imports, most of which are reported to be coming from Africa.

Belgian Congo.—Copper production in the Belgian Congo during 1940 was about 156,000 metric tons. Early in 1940, as a result of the war, the center of the Belgian copper trade was transferred from Brussels, and sales of Belgian Congo copper were placed on a cash-and-carry basis, f. a. s. Matadi (the Congo river port) or f. a. s. New York. The tendency for the Belgian Congo to smelt and refine a larger proportion of its copper output was accentuated in 1940. Domestic industries in Belgium continued to be supplied until the German invasion in May 1940, after which time shipments to the mother country ceased. From June 1 to December 31, 1940, the Belgian Congo exported 32,270 metric tons of matte—all to the United States—and 59,709 tons of cathode copper and ingots, of which 59 percent went to the United States, 30 percent to England, 8 percent to France, and 3 percent to other countries. Union Minière du Haut Katanga, the principal producer, operated at approximately 75 percent of capacity in 1940, apparently working in loose cooperation with the other leading copper producers of the world.[8] Early in 1941 the United Kingdom contracted for 126,000 metric tons of Congo copper, 12,000 tons to be delivered each month beginning with March. Development of the Ruwe deposits, believed to contain 2,000,000 tons of copper, in the western section of the company properties, was reported in 1940.[9] Copper mining in the Katanga district was described by Birchard.[10]

Bulgaria.—The visible and probable copper reserves of Bulgaria are estimated at 250,000 tons of ore and the possible reserves at twice that amount.[11]

Canada.—Canada has broken copper-production records annually in recent years, and 1940 marked another forward step. According to an estimate by the Northern Miner, mine output was 317,000 metric tons—a gain of 14 percent over 1939. The same journal states that Canada's facilities for the manufacture of semifinished and finished copper and brass products have grown so rapidly that as much as one-third of its copper output is expected to be fabricated locally before the end of 1941. On October 9, 1940, Canada placed a ban on copper exports to all countries except those of the British Empire and, under certain conditions, the United States. This embargo principally affects shipments of copper concentrates by the Granby Consolidated Mining, Smelting & Power Co., Ltd., British Columbia, to Japan. Nearly all of the copper mines of Canada are under contract to sell everything over domestic requirements to

[7] Engineering and Mining Journal, vol. 142, No. 3, March 1941, p. 93.
[8] Metal Bulletin (London), No. 2471, March 8, 1940, p. 4.
[9] Metal Bulletin (London), No. 2473, March 15, 1940, p. 6.
[10] Birchard, Ralph E., Copper in the Katanga Region of the Belgian Congo: Econ. Geography, vol. 16, No. 4, October 1940, pp. 429–436.
[11] Mining World and Engineering Record, vol. 139, No. 3634, November 23, 1940, p. 323.

the British Government. Early in 1940, such contracts were reported to total 190,500 metric tons of electrolytic copper.[12]

More than half of the copper produced in the Dominion comes from the nickel-copper mines of the Sudbury district, Ontario. The principal producer is the International Nickel Co. of Canada, Ltd., which refines the major part of the copper it mines in the company refinery at Copper Cliff and exports the remainder as matte. Falconbridge Nickel Mines, Ltd., also exports matte from the same district. Quebec is the second largest copper-producing Province, and about 62 percent of its output comes from Noranda Mines, Ltd., 21 percent from Waite Amulet, 7 percent from Aldermac Mines, Ltd., and 6 percent from Normetal Mining Corporation, Ltd. During most of 1940 the Waite Amulet mill was treating 900 metric tons of ore a day, and the quantity was expected to be increased in October of that year to 1,100 tons daily.[13] Concentrates from this mill in 1940 were anticipated to contain 13,600 metric tons of copper.[14] The entire Quebec output is refined at Montreal East by Canadian Copper Refiners, Ltd., a subsidiary of Noranda Mines, Ltd. In 1940 this refinery raised its capacity to 101,600 metric tons of copper annually, according to the Northern Miner. The principal copper producers in British Columbia are Britannia Mining & Smelting Co., subsidiary of Howe Sound Co., at Howe Sound, and Granby Consolidated Mining, Smelting & Power Co., which operates the Copper Mountain mine at Allenby. Brittannia concentrates contain about 16,500 metric tons of copper annually and formerly were sent to Europe and some indirectly to Japan.[15] Granby concentrates average 16,300 metric tons of copper yearly, and reserves at the beginning of 1940 were estimated at 13,100,000 metric tons of ore averaging 1.38 percent copper. Operations at the Copper Mountain mine were described in 1940.[16] The Granby company has been exporting its entire production to Japan and in March 1940 extended its agreement with Japanese interests for another 3 years. Following the copper embargo, however, both Britannia and Granby concentrates were shipped to the Tacoma (Wash.), refinery of the American Smelting & Refining Co. under an agreement whereby the British and Canadian Governments reserve the right to buy the copper refined and whereby the American company guarantees not to reexport the copper to any countries unfriendly to the British Empire. Copper is produced along the Manitoba-Saskatchewan border in the Flin Flon district by Hudson Bay Mining & Smelting Co., Ltd., and by Sherritt Gordon Mines Co., Ltd. Ore from both properties is treated at the Hudson Bay smelter and refinery in Flin Flon.

Chile.—Smelter production of copper in Chile in 1940 was 4 percent greater than in 1939 but 15 percent less than in the record year 1937. Mine production was also 4 percent ahead of that in 1939. Exports of copper of all classes totaled 362,914 metric tons in 1940. Of this amount, 316,963 tons went to the United States, 19,257 to Japan, 18,473 to Italy, 2,926 to Argentina, 2,794 to France, 2,058 to Sweden, 432 to United Kingdom, 9 to Peru, and 2 to other countries. The exports included 181,496 tons of electrolytic copper (a 16-percent

12 Mining Journal (London), vol. 208, No. 5450, February 3, 1940, p. 69.
13 Metal Bulletin (London), No. 2521, September 3, 1940, p. 4.
14 Metal Bulletin (London), No. 2478, April 5, 1940, p. 4.
15 Mining World, vol. 2, No. 11, November 1940, p. 36.
16 Mining Digest, Mining at Copper Mountain: Vol. 63, No. 6, December 1940, pp. 317-320

gain over 1939), 172,063 tons of standard copper, 6,713 tons of ore and concentrates, 2,543 tons of blister, 81 tons of precipitate, and 18 tons of cement copper. It was reported that Chilean contracts for shipments to Japan contain a clause permitting the producer to cancel the order if the metal is needed either for Chilean or United States defense requirements.

The bulk of Chile's copper production is by American companies—Chile Copper Co. and Andes Copper Co., subsidiaries of Anaconda Copper Mining Co., and Braden Copper Co., a subsidiary of Kennecott Copper Corporation. The Chile Copper Co., which owns the Chuquicamata mine—the world's largest copper deposit—produced 150,864 tons in 1940 compared with 139,543 in 1939. The Andes Copper Co. had outputs of 72,917 and 55,120 tons in 1940 and 1939, respectively, and the Braden Copper Co. of 109,164 and 118,336 tons, respectively. A report by Charles Will Wright of the Bureau of Mines, cited in the preceding edition of Minerals Yearbook, describes the principal copper mining and reduction operations in Chile and contains general information regarding labor organizations, marketing of ores and concentrates, and other matters.[17]

China.—Copper deposits in Szechwan, Sikang, and the southwestern Provinces are being worked, and the Chinese Government is building an electrolytic copper refinery.[18]

Cuba.—Copper production in Cuba increased 5 percent in 1940 compared with 1939. The output comes principally from the Matahambre mine, Pinar del Rio Province, and after flotation is shipped to Carteret, N. J., for smelting. Operations at this mine were described in 1940.[19]

Finland.—Outokumpu Copper Co., the Government-controlled principal copper producer in Finland, has instituted an expansion program and is erecting a concentration plant at Makola in the Nevala district in order to commence mining operations there in the summer of 1941. The annual output of the new mine is expected to be 45,000 metric tons of ore yielding 9,100 tons of copper and copper-nickel concentrates. The Outokumpu company has been sending its blister copper (and some concentrates) to Germany for reduction to electrolytic copper, which was returned to the Finnish company for rolling in its new mill completed in October 1940. The mill is situated near Pori and produces sheet copper, brass pipe, bars, telephone and telegraph wire, and other products. The firm is erecting an electrolytic copper refinery at Imatra which was to begin operation in April 1941. This smelter will enable Finland to carry on within its own borders every step in the manufacture of copper products.

France.—During the German invasion in June 1940, France was able to reship 75,000 metric tons of copper from Bordeaux to Great Britain, the United States, and French Morocco. The Germans are estimated to have found 25,000 to 50,000 tons of copper at various ports in addition to industrial stocks. In October 1940, about 30,000 tons of copper not yet confiscated remained in the hands of importers, dealers, and manufacturers. In addition, there were supposed to be 50,000 tons of unseized copper scrap in French arsenals, but some

[17] Wright, Charles Will, The Mining Industries of Chile, Their Production and Future Possibilities: Bureau of Mines Foreign Minerals Quart., vol. 3, No. 2, April 1940, 80 pp.
[18] Daily Metal Reporter, vol. 41, No. 45, March 6, 1941, p. 3.
[19] Murdock, T. G., Mining Copper in Cuba: Compressed Air Mag., vol. 45, No. 9, September 1940, pp. 6233–6236.

believe this figure to be exaggerated. In October 1940 Germany ordered French industrialists to use copper in a quantity not exceeding 25 percent of their 1938 rate of consumption and not to utilize the metal in certain specified products, including electric cables, which could be made from aluminum and other substitutes. In April 1941 French manufacturers were reported by the press [20] to have been told that they could no longer use any copper or most other nonferrous metals; they were allowed 3 months to find substitutes and forbidden to accept orders for goods containing the prohibited metals.

Germany.—For many years, the output of copper from domestic ores has averaged less than 30,000 metric tons. During these years Germany has alternated with the United Kingdom as the second-largest consuming nation in the world, with an average annual apparent consumption of 162,000 tons for 1913–38 and 237,000 tons for 1934–38. In 1938 and 1939, the apparent consumption is believed to have been considerably above actual consumption because large stocks had been accumulated in preparation for war. The wide divergence between mine output and consumption of copper in Germany must necessarily be filled by imports. In 1938, more than 85 percent of the German imports were from the Western Hemisphere and Africa, sources closed to it in 1940. If every ton of copper mined on the Continent of Europe (exclusive of the U. S. S. R.) were sent to Germany, the total, judging from the most recent data available, would be about 175,000 tons a year. This includes 30,000 tons from Spain, whose production is below normal and apparently is being consumed entirely at home, and 4,900 tons from Portugal, which probably is not shipping to Germany. The most important improvement in Germany's copper situation during 1940 was its acquisition of French metal stocks and supplies from the Bor mine in Yugoslavia, formerly French-operated, which produced 64,200 tons of copper in 1939. It is doubtful if Germany obtained any significant amounts of copper in 1940 from the U. S. S. R., the largest European producer, because the Soviets have been importing metal to meet their own requirements. During 1940, Germany completed installation of haulage systems and other improvements at the Mansfeld mine (the principal producer in Germany proper), developed the adjacent Kur-Hesse mines, and claimed to have shown by diamond drilling the existence of a million metric tons of copper in the Permian limestone regions of Bunzlau, Goldberg, and Löwenberg in Lower Silesia, but the deposits are of even lower grade than those at Mansfeld.[21] In general, in spite of the use of confiscated metal, scrap, and substitutes, it appears that Germany must have drawn on its stocks of copper in 1940 to meet the wartime demand. The established price of electric copper was 605 marks a metric ton at the beginning of 1939 and 615 marks by the middle of October; it rose to 740 marks on October 17, where it remained during the balance of 1939 and the first quarter of 1940. The price was 750 marks during the second and third quarters of 1940.

India, British.—The Indian Copper Corporation (the only copper producer in the country) in 1939 milled 338,879 metric tons of ore and refined 6,430 tons of copper. Increased Government demand for refined copper prompted the company to build a second refinery

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[20] Chemical Age, vol. 44, No. 1138, April 19, 1941, p. 225.
[21] Mining Journal (London), vol. 211, No. 5493, November 30, 1940, p. 706.

soon after the war began. As the capacity of the two refineries exceeds India's production ot copper ore, Rhodesian blister copper is being imported and treated for the Government. Production of copper in the first 5 months of 1940 was 2,732 tons. Reserves at the beginning of 1940 are estimated at 866,000 tons of ore averaging 2.86 percent copper.[22] Operations by the Indian Copper Corporation were described in 1940.[23]

Italy.—During the first 7 months of 1939, Italy produced 1,602 metric tons of copper and imported 57,462 tons. In the first half of 1939 imports were 53,863 tons, 97 percent of which was shipped by sea. Of the sea-borne shipments, 257 tons originated in the Mediterranean basin, 14,117 tons came through the Suez Canal from East and South Africa, and the remainder came through the Straits of Gibraltar—17,526 tons from North America, 14,412 tons from South America, 5,497 tons from North and West Europe, and 355 tons from West and South Africa. Italian copper mines produced 1,000 tons in 1938 and 335 tons in 1935 compared with a consumption of 80,000 and 90,000 tons, respectively. The substitution of aluminum for copper, especially in the electrical industry, is expected to save 20,000 tons yearly.[24] The use of copper oxychloride as a fungicide in Italian vineyards in place of copper sulfate (of which Italy is the world's chief producer and consumer) will constitute a saving of 35 percent—12,300 tons—in the quantity of copper required. The official price of cathode copper at the beginning of 1940 was 6.40 lire a kilogram.

Japan.—Smelter production in Japan in 1939 was 104,000 metric tons; data for 1940 are not available. Japanese imports of copper, which have advanced materially in recent years, were approximately 146,000 tons in 1940. Of these, 109,000 came from the United States, 19,000 from Chile, about 12,000 from Canada, and about 6,000 from the Philippine Islands. According to the American Bureau of Metal Statistics, Japanese imports were 1,181 tons in 1930, 13,327 in 1933, and 65,261 in 1935, and are estimated at 95,000 tons in 1937 and 100,000 in 1938. The same source estimated Japan's new supply of copper as 183,000 tons in 1937 and 201,000 in 1938.

Mexico.—Mine production of copper in Mexico decreased 15 percent and smelter output 22 percent in 1940 compared with 1939. It was reported that the Mexican Government expropriated the French copper mines of Compagnie de Boleo, Santa Rosalia, Baja California, in June 1940.[25]

Newfoundland.—Copper-ore reserves of Newfoundland are estimated at 6,700,000 metric tons, of which 4,100,000 tons averaging 1.5 percent Cu are at the Buchans mine and 2,000,000 tons averaging 2.62 percent Cu at the unworked Gull Pond deposit. An exhaustive study of Newfoundland's copper deposits was published in 1940.[26]

Northern Rhodesia.—Copper output from the three principal mines—Roan Antelope, Mufulira, and Rhokana—is estimated in 1940 at a new record of 370,000 metric tons, all of which was contracted for by the British Government.[27] Assuming that this estimate represents

[22] Metal Bulletin (London), No. 2500, June 21, 1940, p. 4.
[23] Wraight, E. A., Indian Copper Corporation—the Only Copper Producer in India: Mining Journal (London), vol. 210, No. 5478, August 17, 1940, pp. 511–512.
[24] American Metal Market, vol. 57, No. 51, March 15, 1940, p. 5.
[25] Daily Metal Reporter, vol. 40, No. 119, June 21, 1940, p. 1.
[26] Douglas, G. Vibert, Williams, David, Rove, Olaf N., and others, Copper Deposits of Newfoundland Newfoundland Geol. Survey Bull. 20, 1940, 176 pp.
[27] Engineering and Mining Journal, vol. 141, No. 10, October 1940, p. 84.

the total for the country, the 1940 output was apparently 45 percent more than that of 1938. Prices of £43 10s. for blister and £48 10s. a long ton for electrolytic, the quotations that obtained immediately before the war, prevailed in 1940 for most of the Rhodesian copper, but a much higher price was believed to have been paid later in the year.[28] Miners at the Mulfulira mine and another mine in the Nkana area were on a strike for about 10 days in March 1940.[29] Mining methods in Northern Rhodesia were described in 1940.[30]

Norway.—None of the Norwegian copper mines was destroyed during the German invasion in April 1940. The Röros mine, one of the principal producers, was shut for about 2 months but resumed normal operations in June. The entire output, which used to go chiefly to France and Belgium, is being shipped to the Reich. Plans are being made for expansion of the Röros copper works, and ore reserves are reported to justify the proposed work.

Peru.—Mine and smelter production decreased 1 and 2 percent, respectively, in 1940 compared with 1939. The Peruvian export tax on electrolytic copper had been $1.25 a short ton when the New York quotation was 11 cents a pound. In September 1940 the same tax was made effective on a 9-cent base, and higher taxes were designated when higher prices prevail.[31] The exportation of copper scrap from Peru was prohibited on January 2, 1941.

Philippine Islands.—The mine output in 1940 was 9,259 metric tons—a gain of 24 percent over 1939 and 162 percent over 1938. Japan takes most of the production, which is exported in the form of ores and concentrates. Nielson & Co., Inc., which owns the Lepanto and Hixbar mines, is the principal operator.

Spain.—Production of copper in Spain in 1940 is estimated at 4,400 metric tons, of which approximately 3,000 tons were blister copper and 1,400 tons were black copper. This 40-percent decline in output was attributed to loss of markets by extension of the war, inability to secure ocean transportation, shortages of dynamite and coal, and general disorganization within the country. Figures for mine shipments by the British-owned Rio Tinto Co., Ltd. (the principal operator in Spain), are not available for 1940, but were 820,000 tons of copper ore in 1939 compared with 1,283,000 tons in 1938. The company's entire 1939 output was consumed in Spain; it was stated in May 1940 that no shipments had been made to Germany—normally its largest customer—or to any German-occupied countries since May 1939.

Sweden.—In December 1940 the Swedish Riksdag appropriated 2,000,000 crowns ($476,190) for a plant and equipment required to increase the domestic production of copper. It also transferred (until the end of 1945) exclusive mining rights to the Boliden Mining Co. at the state-owned Adak, Bjurfors, and Rävliden fields in the Province of Västerbotten. Field work by the Swedish Geological Survey in 1940 indicated that the Adak mine will yield 750,000 metric tons of copper ore.

Union of South Africa.—Copper production in 1940 totaled 17,963 metric tons, of which 9,000 tons were ingots, 4,624 blister, and 4,338 in gold concentrates; 1 ton was in ore. Exports in 1940 included

[28] Engineering and Mining Journal, Work cited in footnote 27.
[29] Mining Journal (London), vol. 208, No. 5457, March 23, 1940, p. 181; No. 5458, March 30, 1941, p. 195.
[30] Morgan, J. D., Copper Mining in Northern Rhodesia: Proc. South Wales Inst. Eng., vol. 56, No. 3, September 24, 1940, pp. 111–156.
[31] Metal Bulletin (London), No. 2527, September 24, 1940, p. 4.

3,701 tons of blister, all of which went to the United Kingdom, and 7,978 tons of ingots, of which 6,598 went to the United Kingdom, 1,345 to India, and 35 tons to the Netherlands East Indies and Malaya. Domestic sales of ingots in 1940 were 1,002 tons.

The principal producer in recent years has been the Messina mine, but in addition the Rustenburg platinum mines ship a platinum-nickel-copper matte to Great Britain. Operations in the Namaqualand field, which ceased in 1919 and were on a greatly reduced scale from 1922 to 1932, were resumed in the middle of 1940 by the O'okiep Copper Co., Ltd., which is owned by the Newmont Mining Corporation and other American and British interests. Production in the third quarter of 1940 was 1,232 tons, but full utilization of the new smelter and of other machinery and equipment is expected to permit a production of 11,800 tons of copper annually, all of which is to be sold to the British Ministry of Supply. Reserves in the district are estimated as follows: 6,260,000 tons of ore averaging 2.52 percent Cu at the Nababeep mine, 2,427,000 tons averaging 2.33 percent at the O'okiep mine, and 567,000 tons averaging 2.18 percent at the Narrap mine. The company owns a 90-mile narrow-gage railroad from the mines to the Atlantic coast at Port Nolloth. The above information, with flow-sheet diagrams and other details, appeared in the South African Mining and Engineering Journal.[32]

U. S. S. R.—The output of copper during the first 5 months of 1940 was 35 percent ahead of the same period in 1939, although operations are still relatively inefficient, according to an editorial in the Moscow Industriya of June 20, 1940.[33] Efforts of the U. S. S. R. not only to become self-sufficient in regard to copper but to produce a large exportable surplus have thus far fallen short of plans. The Central Urals copper smelter at Revda (25 miles west of Sverdlovsk) began operations in 1940 but is not expected to be working at full capacity until 1942, when it alone is supposed to produce one and one-half times as much crude metal as all the smelters in Russia as of 1913. Ore supplies will be drawn from the Degtyarsk pyrites deposits, which are estimated to contain about half the total Urals copper reserve.[34] In Central Kazakhstan during 1940 a flotation mill to produce tens of thousands of tons of copper concentrates a year was constructed, and the Karsakpai mill was rebuilt. Both these mills treat ore from the Jezkazgan mines, which have a capacity ranging from 400,000 to 1,200,000 metric tons of ore yearly. Operations were expanded at the Balkhash and Irtysh flotation mills, which treat ore from the Kounrad mines.[35]

United Kingdom.—Supplies of copper in the United Kingdom during 1940 equaled the requirements of the national war effort, and a certain amount of copper appears to have been available for the manufacture of exportable products, such as copper sheets.[36] For example, about 338,000 pounds of copper, brass, and bronze manufactures were exported to Burma in 1940. It is estimated that about 800,000 metric

[32] South African Mining and Engineering Journal, O'okiep Starts Production: Vol. 51, part 1, No. 2483, August 31, 1940, pp. 2-5.

[33] Bureau of Foreign and Domestic Commerce, Russian Economic Notes: Vol. 2, No. 16, August 30, 1940, pp. 8-9.

[34] Bureau of Foreign and Domestic Commerce, Russian Economic Notes: Vol. 2, No. 17, September 15, 1940, pp. 5-7.
Metal Bulletin (London), No. 2521, September 3, 1940, p. 4.

[35] Metal Bulletin (London), No. 2502, June 28, 1940, p. 6.

[36] Engineer, vol. 171, No. 4447, April 4, 1941, p. 233.

tons of copper were shipped to the United Kingdom during 1940—370,000 tons from Northern Rhodesia, 250,000 from Canada, 74,000 from the United States, 50,000 reshipped from France, 24,000 from Cyprus, 20,000 from the Belgian Congo, 10,000 from the Union of South Africa, 1,500 from South-West Africa, and 500 tons from Chile.[37] What proportion of this tonnage of copper reached Great Britain safely is not known. The outlook for 1941 is that the United Kingdom will count on increases of 100,000 metric tons from the Belgian Congo and of at least 10,000 tons from the Union of South Africa, where the reopened O'okiep mine will have swung into full production.

The Ministry of Supply in August 1940 began buying all the domestic secondary copper it could get. The prices paid were £53 for 97.25 percent Cu and £54 for 99 percent Cu.[38] In accordance with a 1939 control order, owners of stocks of virgin copper were asked to submit a report of such supplies to the Controller of Nonferrous Metals by July 22, 1940.[39] From the standpoint of consumption, the following commentary is interesting:[40]

> With reference to the expenditure of brass by aircraft in the form of spent cartridge cases, investigation shows that on the basis of the standard .303 small arms cartridge, which is used quite extensively in aircraft machine guns, one minute's full firing by a fighter aircraft with eight guns (9,600 rounds) results in some 240 pounds of cartridge cases being spread over the countryside or over the sea, and so irrecoverable. In bomber aircraft, however, the bulk of the cartridge cases are recovered, since they fall within the machine.

Yugoslavia.—Smelter production of copper in Yugoslavia increased 3 percent in 1940. The principal output is from the Bor mine, which was French-operated and sold its output to Allied countries until the capitulation of France in June 1940. From that time, German interests were given free access to the mine, but they had to arrange for shipments with the Yugoslav Metal and Ore Control Board until after the German invasion in April 1941.[41]

[37] These amounts were deduced as follows: Northern Rhodesia, total production from trade-journal estimate; Canada, 80 percent of trade-journal estimate of total output; United States, official figures of Bureau of Foreign and Domestic Commerce; France, estimate based on United States consular report of total reshipped to the United Kingdom, United States, and Morocco; Cyprus, official 1939 total production; Belgian Congo, United States consular report of exports for last half of 1940 (note—figure does not include any that might have been shipped in first half of 1940); Union of South Africa, official export figures; South-West Africa, official total production; Chile, official export figures.
[38] Daily Metal Reporter, vol. 40, No. 147, August 1, 1940, p. 3.
[39] Metal Bulletin (London), No. 2506, July 12, 1940, p. 6.
[40] Metal Bulletin (London), No. 2510, July 26, 1940, p. 4.
[41] Engineering and Mining Journal, vol. 141, No. 8, August 1940, p. 116.

LEAD [1]

By E. W. Pehrson and A. L. Ransome

SUMMARY OUTLINE

Reflecting in part the pressure of the national defense program, the domestic lead industry in 1940 scored moderate statistical gains over 1939. The output of refined primary lead from domestic and foreign ores was 10 percent above that in 1939 and the largest recorded since 1929. Production from domestic ores increased only 3 percent, but that from foreign ores and base bullion advanced 59 percent. The estimated industrial use of primary and secondary pig lead rose 17 percent, but the quantity used in 1940 was still 17 percent below the record established in 1929. As production failed to pace demand, year-end stocks of domestic refineries declined for the sixth consecutive year. Prices for lead were remarkably stable in view of world events. The average price at New York increased from 5.05 cents a pound in 1939 to 5.18 cents in 1940. The quotation at the beginning and end of 1940 was the same, despite the fact that domestic shipments in December were 42 percent greater than in January.

An unusual feature of the industry in 1940 was the record quantity of lead received from abroad. Imports of pig lead were more than four times those in the previous peak year 1920. The enormous receipts of metal resulted largely from disruption of normal trade caused by the war. For example, little Mexican lead was sent to European countries in 1940, whereas in previous recent years somewhat more than half of the total was shipped there. The United States received 128,680 short tons of refined metal from Mexico in 1940 compared with only 298 tons in 1939 and none in 1938, but receipts of Mexican bullion declined from 47,915 tons in 1939 to 19,009 in 1940. The drop in the latter category was more than offset by increased imports of ore and matte from other countries; the lead content of ore and matte, including that imported from Mexico, jumped to 111,300 tons in 1940 from 30,842 tons in 1939. Peru and Argentina shipped more lead ore to the United States in 1940, and ore was received in sizable tonnages from Newfoundland, Australia, and South Africa.

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

Salient statistics of the lead industry in the United States, 1925–29 (average) and 1936–40, in short tons

	1925–29 (average)	1936	1937	1938	1939	1940
Production of refined primary lead:						
From domestic ores	660, 525	387, 698	443, 142	331, 964	420, 967	433, 065
From foreign ores and base bullion	123, 104	11, 458	24, 175	51, 705	63, 068	100, 114
	783, 629	399, 156	467, 317	383, 669	484, 035	533, 179
Recovery of secondary lead	280, 000	262, 900	275, 100	224, 900	241, 500	260, 300
Imports: [1]						
Lead in pigs, bars, and old	4, 592	2, 590	4, 903	3, 235	7, 139	151, 568
Lead in base bullion	95, 747	312	1, 800	15, 296	48, 902	19, 624
Lead in ore	40, 096	20, 713	34, 103	45, 370	30, 842	111, 300
Exports of refined pig lead	98, 048	18, 313	20, 091	45, 866	74, 392	[2] 49, 079
Lead remaining in bonded warehouses at end of period	136, 969	35, 331	60, 131	87, 811	79, 215	211, 826
Refined primary lead available for consumption	690, 916	383, 433	449, 464	339, 708	415, 031	633, 989
Estimated consumption of primary and secondary lead	900, 250	633, 550	678, 700	546, 000	667, 000	782, 000
Prices:						
New York:						
Average for year cents per pound	7. 47	4. 71	6. 01	4. 74	5. 05	5. 18
Quotation at end of year do	6. 25	6. 03	4. 75	4. 85	5. 50	5. 50
London average do	5. 87	3. 91	5. 15	3. 33	[3] 3. 09	[4]
Mine production of recoverable lead	664, 230	372, 919	464, 892	369, 726	413, 979	457, 392
World smelter production of lead	1, 850, 000	1, 629, 000	1, 851, 000	1, 878, 000	1, 919, 000	[5]

[1] Data include lead imported for immediate consumption plus material entering the country under bond.
[2] Includes 25,324 tons of foreign refined lead reexported, according to the American Bureau of Metal Statistics; official figures not available.
[3] Average for 8 months; London Metal Exchange dealings suspended for duration of war.
[4] Official maximum price fixed by British Ministry of Supply at £25 per long ton.
[5] Data not yet available.

Because exports were much lower in 1940 than in 1939, a large quantity of foreign lead accumulated in bonded warehouses during the year. Although this growing inventory had a restraining effect pricewise, the tonnage on hand at the end of 1940 provided a reservoir from which the increased requirements anticipated for 1941 could be obtained with assurance.

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

Events outside the United States were obscured by censorship. According to trade estimates, world production declined about 1 percent; substantial decreases in Mexico, Belgium, France, and Italy largely were almost offset by advances in the United States, Canada, Germany, Spain, India, and Australia. The British Empire increased its output 11 percent, whereas Reich-dominated continental Europe suffered a 12-percent decline. World consumption also is estimated to have declined about 1 percent, with decreases assigned to many countries, including the United Kingdom and Germany. The increase in lead consumption in the United States was outstanding.

National defense activities.—Except for ammunition, very little lead is used directly in the manufacture of armament. There are, of course, several important secondary or indirect uses, such as lead for storage batteries and bearing metals employed in motorized equipment, lead paints for military structures, chemical lead for the construction of explosive plants, and tetraethyl lead employed in making high-octane gasoline, but the defense program affected none of these as it did copper and zinc, with the sharply increased demand for brass, aluminum, and magnesium vital to the expanding airplane schedule. Consequently there was little concern as to lead supplies during 1940, whereas acute shortages of copper, zinc, aluminum, and magnesium were in sight before the year closed.

Because of this situation, only nominal surveillance over the lead industry was necessary by the Industrial Materials Division of the Advisory Commission to the Council of National Defense in 1940, and early in 1941 by the Production Division of the Office of Production Management. The Price Stabilization Division of the Advisory Commission was more active. On September 27, 1940, a series of advances in nonferrous metal prices prompted Leon Henderson, the commissioner directing the price group, to warn the copper, lead, and zinc industries that Government action to control prices would be invoked

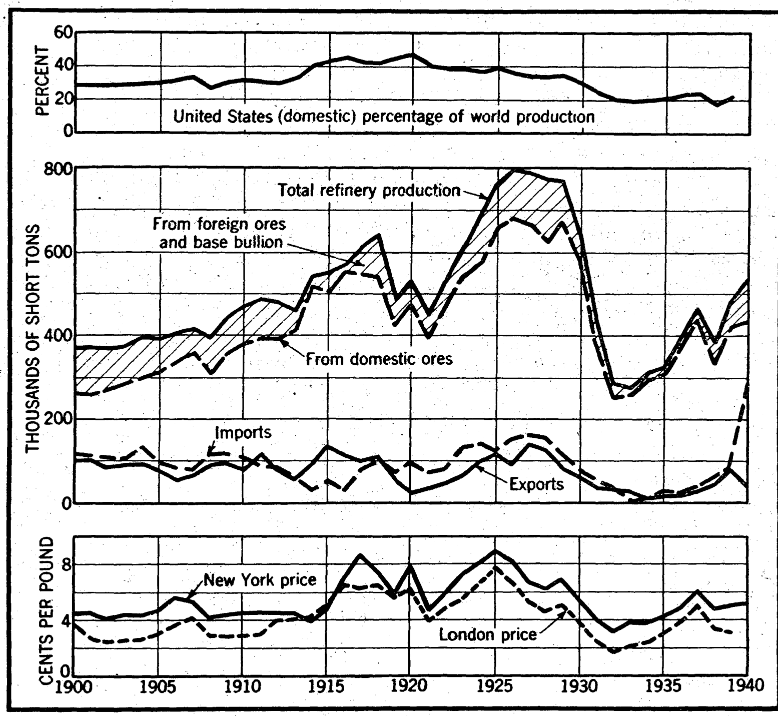

FIGURE 1.—Trends in the lead industry in the United States, 1900–1940. Imports include lead in ore, base bullion, pig lead, and scrap; exports include pigs, bars, and scrap lead exported in manufactures with benefit of drawback.

"if the apparently artificial price-supply-demand pressure continues." This announcement halted the upward trend in copper and zinc quotations, but lead prices rose much higher in the succeeding months. Again, on April 5, 1941, the commissioner threatened ceiling prices on lead if the advances (two in March) were not checked. Up to the time this was written (June 20) no further increases had occurred.

In the early months of 1941, consumption of lead was expanding rapidly as the defense industries began requiring more lead products and as nondefense industries turned to lead and its alloys as substitutes for the scarcer metals. To conserve supplies and to prevent lead from getting into unfriendly hands, the metal was placed under export control as of March 24, 1941. Thereafter shipments of lead—

including ore, matte, pigs, bars, and lead manufactures—to foreign countries could be made only under Government license. Export control was extended to the lead pigments on May 6.

On May 1, 1941, the Director of Priorities of the Office of Production Management issued General Metals Order No. 1 establishing inventory control of 16 metals and alloys, including lead. This order was designed to prevent the accumulation of excess stocks and required manufacturers to keep inventories down to the minimum necessary to assure efficient operations.

DOMESTIC PRODUCTION

Pig lead is produced at primary plants that treat mainly ore and at secondary plants that treat scrap exclusively. Both types of plants may produce refined lead or antimonial lead. Because of the large quantity of battery scrap treated at secondary smelters, their output comprises antimonial-lead alloys chiefly. Figures for production of refined lead at secondary plants previously given under this heading were in error because they included substantial quantities of antimonial lead. The canvass of secondary producers was revised in 1939, and a more accurate classification of product has been developed. These data are shown in a succeeding table.

The following table shows the production of refined lead and antimonial lead at primary refineries from 1936 to 1940.

Refined and antimonial lead produced at primary refineries in the United States, 1936–40, in short tons

Year	Refined lead				Antimonial lead
	From domestic ores and base bullion	From foreign ores and base bullion	From scrap	Total	
1936	387,698	11,458	34,556	433,712	23,230
1937	443,142	24,175	29,986	497,303	27,524
1938	331,964	51,705	24,800	408,469	24,123
1939	420,967	63,068	29,011	513,046	21,995
1940	433,065	100,114	16,588	549,767	29,762

PRIMARY LEAD

Refinery production.—Production of refined primary lead increased 10 percent in 1940 but was only 68 percent of the 1925–29 average (783,629 short tons). Output from domestic ores and base bullion increased 3 percent and that from foreign ores and base bullion increased 59 percent in 1940. The production from foreign materials was the largest since 1929 and represented 81 percent of the 1925–29 average (123,104 short tons); it comprised 19 percent of the total output of refined primary lead.

Refined primary lead produced in the United States, 1936–40

Year	Production by— Classes (short tons): Desilverized lead [1] [2]	Soft lead [3]: Desilverized	Soft lead [3]: Undesilverized	Total production [1]	Sources (short tons): From domestic ores and base bullion	From foreign ores	From foreign base bullion	Value: Average per pound	Value: Total
1936	239,944	47,462	111,750	399,156	387,698	11,401	57	$0.046	$36,722,000
1937	272,051	55,317	139,949	467,317	443,142	23,393	782	.059	55,143,000
1938	243,891	31,986	107,792	383,669	331,964	32,862	18,843	.046	35,298,000
1939	280,356	65,349	138,330	484,035	420,967	24,652	38,416	.047	45,499,000
1940	336,456	43,400	153,323	533,179	433,065	83,563	16,551	.050	53,318,000

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

Sources of primary lead.—Of the total refined primary lead produced in 1940, 81 percent was derived from domestic ores and 19 percent from foreign material. Production from foreign ores increased 239 percent to reach an all-time high. Refining of foreign bullion declined 57 percent in 1940. Details of the sources of lead from domestic ores are given in the section on Mine Production.

Refined primary lead produced in the United States, 1936–40, by sources, in short tons

Source	1936	1937	1938	1939	1940
Domestic ore	387,698	443,142	331,964	420,967	433,065
Foreign ore:					
Australia	172	3,088	7,320	7,580	14,856
Canada	2,277	5,343	3,562	4,763	9,009
Europe	1,133	388	14	188	3,650
Mexico	1,486	3,836	9,745	227	1,303
South America	3,883	8,497	9,887	8,869	34.744
Other foreign	2,450	2,241	2,334	3,025	20,001
	11,401	23,393	32,862	24,652	83,563
Foreign base bullion:					
Mexico	57	782	18,268	37,463	16,161
South America				9	
Other foreign			575	944	390
	57	782	18,843	38,416	16,551
Total foreign	11,458	24.175	51,705	63,068	100,114
Grand total	329.156	467,317	383,669	484,035	533,179

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

Several lead-smelting plants handle scrap materials exclusively. Production data from such plants are summarized in the following section and discussed in detail in the chapter on Secondary Metals—Nonferrous. A large quantity of hard-lead scrap also is treated at primary smelters and refineries; the production of antimonial lead at these plants is shown in the following table.

Antimonial lead produced at primary lead refineries, 1936–40

Year	Production (short tons)	Antimony content		Lead content by difference (short tons)			
		Short tons	Percent	From domestic ore	From foreign ore	From scrap	Total
1936	23,230	2,162	9.3	7,442	696	12,930	21,068
1937	27,524	2,579	9.4	7,833	1,721	15,391	24,945
1938	24,123	2,809	11.6	6,759	3,385	11,170	21,314
1939	21,995	2,031	9.2	4,117	3,189	12,658	19,964
1940	29,762	2,944	9.9	7,364	3,023	16,431	26,818

SECONDARY LEAD

As previously stated, some scrap lead is treated at primary plants but the greater part is refined at a large number of plants that operate exclusively on secondary materials. Secondary lead is recovered in the form of refined lead, antimonial lead, other alloys, and chemicals. Recovery at primary and other plants in 1939 and 1940 is shown in the following table. Total secondary lead recovered in 1940 was 8 percent greater than in 1939 and was equivalent to 60 percent of the domestic refined primary lead output. Further details appear in the chapter on Secondary Metals—Nonferrous.

Secondary lead recovered in the United States, 1939 and 1940, in short tons

Lead content recovered	1939	1940
As refined metal:		
At primary plants	29,011	16,588
At other plants	57.889	42,992
	86,900	59,580
In antimonial lead:		
At primary plants	12,658	16,431
At other plants	100,392	110,256
	113,050	126,687
In other alloys [1]	41,550	74,079
Grand total	241,500	260,346
Value	$22,701,000	$26,034,600

[1] Includes some lead in chemical compounds.

LEAD PIGMENTS

Lead pigments manufactured in 1940 contained 213,104 tons of lead—a 1-percent decrease from 1939. Of this total, 196,235 tons were derived from refined pig lead; litharge comprised 43 percent, white lead 35 percent, red lead 20 percent, sublimed lead and orange mineral 1 percent, and leaded zinc oxide 1 percent. Leaded zinc oxide and sublimed lead are the principal pigments in which the lead content is derived from ores. Details of the production and consumption of lead pigments are given in the chapter on Lead and Zinc Pigments and Zinc Salts.

Lead in pigments, 1936–40, by sources, in short tons [1]

Year	Lead in pigments from— Domestic ore [2]	Metal	Scrap	Total	Year	Lead in pigments from— Domestic ore [2]	Metal	Scrap	Total
1936	15,062	204,997	37	220,096	1939	15,171	200,390	--------	215,561
1937	17,363	204,961	127	222,451	1940	16,869	196,235	--------	213,104
1938	12,025	163,815	--------	175,840					

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

MINE PRODUCTION

The output of recoverable lead from domestic mines in 1940 increased 10 percent over that in 1939. Lead from the Western States and Alaska increased 35,760 tons in 1940 and from the Central States 9,106 tons; but lead from the Eastern States continued to decline, the decrease amounting to 1,453 tons. Lead production from Southeastern Missouri rose 16,386 tons (11 percent) in 1940, whereas the output from Oklahoma and Kansas declined 23 and 13 percent, respectively, from the 1939 figures. Idaho continued to be the leading producer in the Western States group, followed by Utah and Montana. All of the principal producing States in the western group showed increases; the total for all States (including Alaska) advanced 17 percent. Idaho, the second largest lead-producing State in the United States, increased 15 percent in output over 1939; nearly 92 percent of the State total was recovered from zinc-lead ores. Utah increased its output 12 percent; three districts—Bingham, Park City, and Tintic—together produced 85 percent of the recoverable lead output of the State. The first two districts increased and the Tintic district decreased.

Lead from Montana increased 39 percent in 1940 to a total of 23,036 tons of recoverable metal—the largest output of lead in the history of the State. Most of the gain was in increased production from the lead-zinc properties of the Anaconda Copper Mining Co. at Butte, but gains were also reported from the Jack Waite mine in Sanders County, the Flathead mine in the Hog Heaven district, the Comet-Gray group in Jefferson County, the slag-fuming plant at East Helena, and the Hecla tailing dump in Beaverhead County. Production of lead in Arizona increased 23 percent; the largest lead-producing mine is the Trench near Patagonia. In Colorado, lead was produced in nearly all the lode-mining counties, and the total output increased 40 percent over 1939. Production in Nevada, chiefly from zinc-lead ore from the Pioche district and from dry and siliceous ores mined throughout the State, increased 77 percent. Lead from New Mexico declined 29 percent owing to closing of the Pecos mine in May 1939. Gains in output from Grant County were insufficient to offset the loss. The largest lead producer in New Mexico during 1940 was the Ground Hog mine of the American Smelting & Refining Co. near Hanover, Grant County. A decrease of 31 percent in lead production in Washington was noted for 1940; three properties at Metaline Falls produced nearly all the recoverable lead output of the State. Additional details of production by mines, districts, and States can be found in the State chapters.

Mine production of recoverable lead in the United States, 1925–29 (average) and 1936–40, in short tons

State	1925–29 (average)	1936	1937	1938	1939	1940
Western States and Alaska:						
Alaska	982	941	823	994	937	779
Arizona	9,743	10,688	12,354	10,571	10,771	13,266
California	2,070	482	1,186	495	526	1,772
Colorado	30,112	7,267	9,786	9,455	8,222	11,476
Idaho	141,610	91,339	103,711	92,177	90,981	104,834
Montana	18,871	19,059	17,957	9,327	16,555	23,036
Nevada	9,807	10,712	9,347	4,679	4,236	7,499
New Mexico	6,730	6,626	6,512	4,949	5,392	3,822
Oregon	6	79	109	23	15	35
South Dakota	21	----------	----------	----------	----------	7
Texas	213	468	395	342	227	205
Utah	149,509	69,886	89,458	65,657	67,634	75,688
Washington	1,323	840	2,830	4,284	3,718	2,555
	370,997	218,387	254,468	202,953	209,214	244,974
Central States:						
Arkansas	38	24	40	7	----------	55
Illinois	552	294	186	175	308	1,508
Kansas	26,121	11,409	16,008	15,239	13,697	11,927
Kentucky	135	50	89	101	87	360
Missouri	202,240	110,428	157,631	122,027	156,281	172,052
Oklahoma	58,306	25,427	29,840	21,004	27,720	21,240
Wisconsin	1,745	904	1,091	320	388	445
	289,137	148,536	204,885	158,873	198,481	207,587
Eastern States:						
New York	----------					1,973
Tennessee	4,096	5,996	5,539	7,896	6,284	573
Virginia						2,285
North Carolina	----------		----------	4	----------	----------
	4,096	5,996	5,539	7,900	6,284	4,831
	664,230	372,919	464,892	369,726	413,979	457,392

Mine production of recoverable lead in the principal lead-producing districts of the United States, 1936–40, in short tons

District	State	1936	1937	1938	1939	1940
Southeastern Missouri region.	Missouri	108,422	153,205	118,870	153,522	169,908
Coeur d'Alene region	Idaho	86,634	96,505	82,274	81,699	95,609
Bingham	Utah	32,451	45,233	41,334	36,842	37,857
Joplin region	Kansas, Missouri, Oklahoma.	38,842	50,274	39,400	44,176	35,311
Park City region	Utah	17,421	22,417	7,258	11,631	19,749
Butte	Montana	10,527	5,780	204	4,708	8,859
San Juan Mountains	Colorado	3,279	4,998	5,885	4,402	7,323
Tintic	Utah	7,063	10,198	9,605	8,618	6,536
Pioche	Nevada	4,706	4,759	3,214	2,964	5,520
Ophir	Utah	3,862	3,307	2,013	6,050	5,354
Warm Springs	Idaho	2,757	4,004	7,370	5,565	5,050
Rush Valley	Utah	8,191	6,410	4,619	3,422	4,760
Harshaw	Arizona	1,049	984	149	2,287	4,581
Eagle	Montana	3,113	4,812	4,301	3,252	4,108
Hog Heaven	do	----------	808	1,214	2,767	3,588
Central	New Mexico	2,689	2,281	340	2,941	3,245
Metaline	Washington	770	2,644	4,009	3,509	2,495
Wallapai	Arizona	841	2,489	4,004	703	2,304
Austinville	Virginia	[1]	[1]	[1]	[1]	[2] 2,285
St. Lawrence County	New York	[1]	[1]	[1]	[1]	1,973
Old Hat	Arizona	463	794	1,919	1,861	1,908
Cataract	Montana	1,704	1,946	1,326	1,672	1,904
Port Hill	Idaho	72	519	291	1,111	1,837
Red Cliff	Colorado	491	580	933	1,137	1,412
Smelter	Montana	945	1,178	710	1,256	1,363
Leadville	Colorado	1,550	2,100	1,222	1,088	794
Bisbee (Warren)	Arizona	1,154	1,018	14	120	692
Upper Mississippi Valley	Iowa, northern Illinois, and Wisconsin.	904	1,091	320	388	453
Tombstone	Arizona	417	315	315	290	276
Flint Creek	Montana	1,496	1,511	113	218	119
Tybo	Nevada	3,818	2,439	----------	14	27
Banner	Arizona	1,541	1,205	302	3	3
Oro Blanco	do	4,426	3,864	4,150	3,568	----------
Willow Creek	New Mexico	3,746	3,852	4,277	1,800	----------

[1] Bureau of Mines not at liberty to publish figures.
[2] Total for Virginia but almost entirely from Austinville district.

STOCKS

Lead stocks, as reported by the American Bureau of Metal Statistics, are shown in the following table. Stocks of refined and antimonial lead include metal held by all primary refiners and by most refiners of secondary material who produce common lead. Foreign lead refined in the United States and entered for domestic consumption is included.

Lead stocks at end of year at smelters and refineries in the United States, 1936–40, in short tons

	1936	1937	1938	1939	1940
Refined pig lead	165,159	119,837	102,489	52,783	32,458
Antimonial lead	6,697	9,294	13,413	5,994	8,468
	171,856	129,131	115,902	58,777	40,926
Lead in base bullion:					
At smelters and refineries	9,187	10,959	18,693	10,337	9,166
In transit to refineries	1,070	2,219	2,339	3,521	3,457
In process at refineries	14,100	14,413	16,690	15,958	18,141
	24,357	27,591	37,722	29,816	30,764
Lead in ore and matte and in process at smelters	50,098	52,081	56,332	59,486	71,722
	246,311	208,803	209,956	148,079	143,412

During the first quarter of 1940, the excess of output over shipments resulted in increasing inventories. Stocks of refined and antimonial lead at refineries, which totaled 58,800 tons at the end of 1939, rose to 74,700 tons by the end of March—the peak for the year. Accelerated demand thereafter (largely as a result of intensification of the national defense program) resulted in a steady monthly decline in stocks until at the end of October they reached the lowest point of the year—35,400 tons. In November, a virtual balance was reached between production and shipments, and at the end of the month stocks were slightly higher than at the beginning. During December production increased over shipments, but refinery inventories (which rose to 40,900 tons at the end of the year) were only 70 percent of those on hand at the end of 1939. Stocks of lead in ore and matte and in process at smelters, and base bullion at smelters and refineries, in transit to refineries, and in process at refineries, were 15 percent higher at the end than at the beginning of the year.

DOMESTIC CONSUMPTION

New supply.—The following table shows the refined primary lead available for consumption from 1936 to 1940. The figures do not consider variation in producers' stocks, and as these have changed considerably during the past 5 years the quantities stated do not indicate the true trend in actual consumption of new lead. The supply available for consumption in 1940 was 53 percent higher than in 1939 and was equivalent to 92 percent of the 1925–29 average (690,916 tons). Although domestic production of refined pig lead from both foreign and domestic ores increased 10 percent and exports (including reexports of foreign refined lead amounting to 25,324 short tons) declined 34 percent, the greatest factor contributing to the larger available supply was the great increase in imports, which is directly attributable to diversion to the United States of metal formerly shipped to foreign markets now closed by blockade.

Refined primary pig lead for consumption in the United States, 1936–40, in short tons

	1936	1937	1938	1939	1940
Supply:					
Imports	[1] 2,590	2,238	1,905	5,388	149,889
Production	399,156	467,317	383,669	484,035	533,179
	401,746	469,555	385,574	489,423	683,068
Withdrawn: Exports	18,313	20,091	[2] 45,866	74,392	[3] 49,079
Supply available for consumption	383,433	449,464	339,708	415,031	633,989

[1] Includes small quantities of old, reclaimed, and scrap lead.
[2] Includes a small quantity, not separable, of "sheets."
[3] Includes 25,324 tons of foreign refined lead reexported, according to the American Bureau of Metal Statistics; official figures not available.

Consumption by uses.—Owing to the return of large quantities of secondary lead in discarded and obsolete articles and from the lead-consuming industries, the total consumption of pig lead greatly exceeds the supply of new lead available. The following table gives the American Bureau of Metal Statistics estimate of the total consumption of lead by industries, 1936–40.

Lead consumed in the United States, 1936–40, in short tons [1]

Purpose	1936	1937	1938	1939	1940
White lead	85,500	86,000	71,000	75,000	65,500
Red lead and litharge	54,000	57,000	43,000	57,200	59,400
Storage batteries	191,000	192,000	167,000	198,000	220,200
Cable covering	61,400	90,000	60,000	74,400	107,400
Building	40,000	45,000	36,000	50,000	65,000
Automobiles	11,100	12,000	6,000	8,900	11,000
Ammunition	32,500	39,500	31,200	42,300	56,000
Terneplate	6,200	6,400	4,300	6,000	6,000
Foil	28,500	21,700	22,000	21,800	23,500
Bearing metal	16,500	15,000	9,000	12,800	14,000
Solder	22,000	22,000	15,000	20,000	24,000
Type metal	17,000	17,000	12,000	14,000	16,800
Calking	13,500	15,000	12,000	16,000	19,200
Castings	5,750	6,000	6,000	7,500	9,000
Other uses	48,600	54,100	51,500	63,100	85,000
	633,550	678,700	546,000	667,000	782,000

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

Consumption of lead in the United States during 1940 was 17 percent above 1939 and 17 percent below the record established in 1929. The principal use of lead is in the manufacture of storage batteries, and in recent years requirements of lead for that purpose have averaged approximately 30 percent of the total. Consumption of lead in storage batteries during 1940 reached an all-time high, having exceeded (by a slight margin) the record total of 220,000 tons in 1928. The 1940 figure indicates that the registration of motor vehicles was the largest on record. Lead withdrawn from use in storage batteries noticeably curtails the need for newly mined metal, as it rapidly returns to the trade in the form of scrap and there competes with the primary market. Second place in uses for lead has been divided about equally between white lead and cable covering during the past 20 years. For 3 of the last 5 years, white lead took second place over cable covering; in 1939, by a very slight margin; in 1940, the amount of lead consumed for this purpose declined 12.7 percent, whereas that for cable covering increased 44 percent to the highest total since 1931. Of the total amount of lead used during 1940, that required for white lead was 8 percent and for cable covering 14 percent compared with 11 percent for each in 1939. This increase in cable covering, which reflects especially an increased use for telephones, is encouraging, as the failure of the utility industry to purchase its proportionate share of the total lead requirements of the country for several years has been a depressing influence on the lead industry. The building industry has also lagged behind most others with respect to consumption of lead but has been on the upgrade in recent years and used 30 percent more lead in 1940 than in 1939; nevertheless, the quantity was 32 percent below the total for 1929.

Red lead and litharge—exclusive of quantities used in storage batteries—consumed nearly 8 percent of the total lead used in 1940 and 98 percent more than the quantity used for this purpose in 1929. Ammunition (usually among the smaller uses for lead) took 32 percent more lead in 1940 than in 1939 and amounted to a little more than 7 percent of the total. The increase in this use is due principally to the expanded ammunition-manufacturing program, largely for export. It was one of the four uses indicated by the foregoing table to have been higher in 1940 than in 1929, having been 36 percent larger than in that year. The large increase of "other uses" can be ascribed chiefly to the consumption of lead in the manufacture of tetraethyl lead for tempering gasoline; greater amounts of this fuel were produced in 1940.

PRICES

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

Again, as in 1939, the average prices for lead fluctuated less during 1940 than those for the other common nonferrous metals in spite of the abnormal conditions of world trade plus a large and growing domestic demand for the metal. The price for pig lead at New York, outside market, at the beginning of the year was 5.50 cents a pound. The pressure of unusually large supplies of foreign metal had a depressing effect on the domestic market, and the price declined to the low point of 4.75 cents in August. Thereafter the trend was reversed, and early in November, quotations reached 5.80 cents but declined again to 5.50 cents, where they remained throughout December.

In the early months of 1940, production of refined lead exceeded shipments, and stocks rose until the end of March. Excess of shipments thereafter caused a steady decline in stocks until November, when a virtual balance was reached between production and shipments. During December, production exceeded shipments, and stocks rose slightly. The average price for 1940 was 5.18 cents compared with 5.05 cents in 1939 and 4.74 cents in 1938.

Quotations on the London Metal Exchange were discontinued at the outbreak of the war in September 1939. In September 1939 it was announced that the British Ministry of Supply had established the maximum price of Empire lead at £17 per long ton ex ship, and of foreign lead at £16 12s. 6d. ex ship. In December (1939) control prices for Empire and foreign lead were raised to £25 per long ton, duty paid, delivered. There was no reported change from this figure during 1940.

Average monthly and yearly quoted prices of lead at St. Louis, New York, and London, 1938–40, in cents per pound [1]

Month	1938			1939			1940		
	St. Louis	New York	London	St. Louis	New York	London	St. Louis	New York	London
January	4.72	4.89	3.60	4.68	4.83	3.03	5.32	5.47	(2)
February	4.48	4.63	3.45	4.65	4.80	3.20	4.93	5.08	
March	4.35	4.50	3.56	4.67	4.82	3.07	5.04	5.19	
April	4.35	4.50	3.46	4.63	4.78	3.00	4.92	5.07	
May	4.25	4.40	3.15	4.60	4.75	3.03	4.87	5.02	
June	4.00	4.15	3.09	4.65	4.80	3.04	4.85	5.00	
July	4.73	4.88	3.28	4.70	4.85	3.08	4.85	5.00	
August	4.75	4.90	3.13	4.89	5.04	3.30	4.70	4.85	
September	4.85	5.01	3.27	5.30	5.45	(2)	4.78	4.93	
October	4.95	5.10	3.44	5.35	5.50	(2)	5.16	5.31	
November	4.94	5.09	3.38	5.35	5.50	(2)	5.58	5.73	
December	4.69	4.84	3.15	5.35	5.50	(2)	5.35	5.50	
Average	4.59	4.74	[3] 3.33	4.90	5.05	[3, 4] 3.09	5.03	5.18	

[1] St. Louis: Metal Statistics, 1941, p. 465. 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, 1941, p. 469. Average price of foreign lead. Price per long ton, as published in Metal Statistics, converted to cents per pound at average exchange rate reported by the Federal Reserve Board.
[2] London Metal Exchange dealings suspended for duration of war. Official maximum price fixed by British Ministry of Supply at £25.
[3] London quotations in pounds sterling per long ton, as follows: 1938, £15.2667; 1939 (8 months), £14.7083.
[4] Average for 8 months; comparable average for New York was 4.83 cents.

FOREIGN TRADE [2]

Most significant during 1940 was the sharp increase in imports of lead in ore, matte, and pigs and bars, amounting to 592 percent. In consequence of the inability of foreign producers of lead ore and metal to find markets outside of this country, the United States has virtually become the metallurgical center of the world with respect to custom smelting. To many foreign producers, the United States was the only market available for their products. Exports of pig lead from the United States, although 68 percent less than in 1939, still supplied the total consumption of some countries.

Imports.—Several notable features characterize the large increase in total imports of lead in 1940. Mexico, for years the principal source of unrefined lead imports, contributed 53 percent of the total tonnage imported in 1940, principally in the form of pigs, bars, and old scrap amounting to 85 percent of the total of that category, which total showed a tremendous increase over 1939. Lead imported in base bullion, of which Mexico also supplies almost the entire amount, declined 60 percent in 1940. The greater part of the total Mexican imports remained in warehouses under bond at the close of 1940. The total tonnage of lead imported in the form of ore and matte rose 261 percent in 1940, all countries showing an increase except Mexico. This increase was credited chiefly to Newfoundland and Labrador, Peru, Australia, and Argentina, nations (with the exception of Peru) which, before 1940, had shipped their entire output to European plants now cut off because of the war.

[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.

Total lead imported into the United States, 1936–40, by classes, in short tons [1]

Year	Lead in ore and matte	Lead in base bullion	Pigs, bars, and old	Total lead content
1936	20,713	312	2,590	23,615
1937	34,103	1,800	4,903	40,806
1938	45,370	15,296	3,235	63,901
1939	30,842	48,902	7,139	86,883
1940	111,300	19,624	151,568	282,492

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

Total lead imported into the United States, in ore, base bullion, and refined, 1936–40, by countries, in short tons [1]

Year	Canada	Mexico	New-found-land	South America	Europe	Other countries	Total
1936	1,692	10,501	3,955	[2] 6,861	341	265	23,615
1937	5,749	17,068		[2] 13,229	535	4,225	40,806
1938	3,174	38,467		[2] 13,426	680	8,154	63,901
1939	5,641	52,059	1	[2] 16,527	1,971	10,684	86,883
1940	8,721	149,493	27,563	[2] 63,120	3,891	29,704	282,492

[1] Data include lead imported for immediate consumption plus material entering the country under bond.
[2] Includes 15 tons imported from Argentina in 1936; 17 tons in 1937; 4 tons in 1938; 3,362 tons in 1939; and 16,469 tons in 1940.

Total lead imported into the United States in ore, matte, base bullion, pigs, bars, and old, 1936–40, by countries, in short tons [1]

Country	1936	1937	1938	1939	1940
In ore and matte:					
Africa				7	7,586
Argentina	15	17	4	3,362	16,469
Australia	222	2,241	6,434	7,612	17,472
Canada	1,419	5,211	3,173	5,624	8,666
Chile	574	474	2,107	1,844	6,271
Mexico	10,462	15,970	24,023	3,846	1,804
Newfoundland	3,955				27,563
Peru	4,007	10,132	9,317	7,174	18,383
United Kingdom	17	11	2	1,058	3,498
Other countries	42	47	310	315	3,588
	20,713	34,103	45,370	30,842	111,300
In base bullion:					
Mexico	39	1,067	14,444	47,915	19,009
Peru	52	239	198	84	179
Other countries	221	494	654	903	436
	312	1,800	15,296	48,902	19,624
In pigs, bars, and old:					
Australia		1,769	1,475	2,727	4,266
Mexico		31		298	128,680
Peru	2,162	2,344	1,736	4,051	18,452
Other countries	428	759	24	63	170
	2,590	4,903	3,235	7,139	151,568

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

Lead remaining in warehouses in the United States, Dec. 31, 1936–40, in short tons

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

Year	Lead in ore and matte	Lead in base bullion [1]	Year	Lead in ore and matte	Lead in base bullion [1]
1936	33,401	1,930	1939	72,737	6,478
1937	57,509	2,622	1940	110,580	101,296
1938	76,287	11,524			

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

Lead [1] imported for consumption in the United States, 1936–40, by classes

Year	Lead in ores, flue dust, and mattes, n. s. p. f.		Lead in base bullion		Pigs and bars		Sheets, pipe, and shot		Not otherwise specified	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value		
1936	5,836	$225,568	763	$45,340	1,979	$97,614	304	$38,546	12,729	$443,331
1937	5,613	507,945	188	12,788	2,355	74,077	376	54,649	13,527	793,796
1938	6,722	543,164	304	31,147	2,001	84,109	166	30,906	23,381	733,081
1939	12,317	1,063,512	1,764	166,298	4,772	176,437	170	28,296	11,611	1,449,541
1940	70,027	4,659,445	9,992	929,946	36,882	2,269,075	201	36,444	12,046	7,910,873

[1] In addition 342 tons valued at $23,534 of "reclaimed, scrap, etc." were imported in 1936; 349 tons ($30,810) in 1937; 189 tons ($20,374) in 1938; 36 tons ($3,387) in 1939; and 24 tons ($3,917) in 1940; value included in total values.

Miscellaneous products containing lead imported for consumption in the United States, 1936–40

Year	Babbit 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
1936	334	67	$112,205	456	400	$34,694
1937	618	178	213,734	132	115	13,572
1938	390	77	126,660	433	374	38,708
1939	136	45	96,492	380	321	38,491
1940	1,368	429	1,026,432	1,482	1,291	108,286

Exports.—Significant during 1940 were the decreases in exports of pig lead to Europe and to Asia, principally Japan. These factors are largely responsible for the 68-percent decline from 1939, although exports to South American countries, particularly to Brazil, increased. Exports to the United Kingdom declined from 9,411 tons in 1939 to almost nothing, largely because an adequate supply was available from British sources. Exports to Mexico continued to decline, being almost nil in 1940 due in large part to increased refining of bullion in that country.

Lead exported from the United States, 1936–40

Year	Pigs, bars, and old		Foreign lead exported in manufactures with benefit of draw-back (short tons)	Year	Pigs, bars, and old		Foreign lead exported in manufactures with benefit of draw-back (short tons)
	Short tons	Value			Short tons	Value	
1936	18,313	$1,390,454	8,312	1939	74,392	$4,547,219	10,379
1937	20,091	1,838,262	8,679	1940	23,755	1,794,590	15,604
1938	[1] 45,866	[1] 3,354,616	9,061				

[1] Contains sheets and pipes; figures not separable.

Pig lead exported from the United States, 1936–40, by destinations, in short tons

Destination	1936	1937	1938 [1]	1939	1940 [2]
Countries:					
Belgium		43	28	588	644
Brazil	795	652	111	647	1,559
Canada	45	7	101	5	34
Denmark				1,569	
Finland			560	616	112
France			(3)	540	1,120
Germany	2	568	1,092	8,333	
Hungary				560	437
Japan	8,629	7,320	30,203	34,790	11,958
Kwangtung		56	314	99	336
Mexico	8,049	8,122	11,403	2,922	15
Netherlands				2,101	2,352
Norway		112		1,091	
Philippine Islands	223	569	1,037	974	450
Sweden	5		23	7,340	301
United Kingdom	123	2,226	78	9,411	2
Other countries	442	416	916	2,806	4,435
	18,313	20,091	45,866	74,392	23,755
Continents:					
North America	8,282	8,337	12,002	3,345	865
South America	1,021	784	303	1,317	3,078
Europe	133	2,949	1,950	33,152	6,400
Asia	8,865	7,989	31,606	36,122	13,384
Africa and Oceania	12	32	5	456	28

[1] Includes sheets and pipes; figures not separable.
[2] In addition, 25,324 tons of foreign lead were reexported, according to American Bureau of Metal Statistics; official figures not available.
[3] Less than 1 ton.

WORLD ASPECTS OF LEAD INDUSTRY

World production.—Lack of production data from the British Empire and other important producers of lead precludes an official statement of world output in 1940. The Metal Bulletin, London, estimates world smelter production at 1,700,000 metric tons—a slight decline from the 1,723,000 tons reported for 1939 by the American Bureau of Metal Statistics. The Bureau of Mines estimate for 1939 is 1,741,000 tons. The Metal Bulletin records substantial increases in the United States, Canada, Germany, Spain, India, and Australia, whereas declines are noted for Mexico, Belgium, France, and Italy. The British Empire contributed 34 percent of the estimated 1940 total and increased its production 11 percent over that of 1939. Continental Europe, now under German domination, exclusive of the U. S. S. R. and Spain, produced 20 percent of the world total and suffered a 12-percent decline in output.

World production of lead, 1936–40, in metric tons [1]

[Compiled by L. P. Lounsbery]

Country	1936	1937	1938	1939	1940
Argentina	10,700	9,900	10,200	14,000	(2)
Australia	196,051	232,198	226,155	269,590	(2)
Belgium	67,000	93,310	94,170	82,000	(2)
Burma	74,329	77,728	80,166	77,220	(2)
Canada	164,857	181,162	181,783	172,880	(2)
China	(3) 1,600	(3) 1,500	(4)	(4)	(2)
Chosen	2,738	5,850	(4)	(4)	(2)
Czechoslovakia	4,126	4,300	(4)	(4)	(2)
France	15,127	37,168	41,753	42,000	(2)
Germany [5]	139,000	162,400	171,700	181,440	(2)
Austria	8,732	10,836	9,280		
Greece	4,172	5,890	6,050	4,925	(2)
Hungary	26	147	(4)	(4)	(2)
Indochina	12	8	10	5	(2)
Italy	36,307	38,938	34,287	38,102	(2)
Japan	8,883	10,200	(4)	(4)	(2)
Mexico	214,376	214,653	273,529	219,300	195,071
Northern Rhodesia	305	568	277	163	(2)
Norway	227	236	323	321	(2)
Peru	8,899	19,053	28,478	24,310	37,072
Poland	15,021	17,587	19,973	(4)	(2)
Rumania	4,783	6,725	5,655	5,100	(2)
South-West Africa		1,355	3,214	4,283	690
Spain	46,600	30,000	36,000	27,000	(2)
Tunisia	21,497	24,758	23,916	23,421	(2)
Union of South Africa			19	11	(2)
U. S. S. R.	50,800	(3) 55,000	(4)	(4)	(2)
United Kingdom	13,800	10,313	10,000	(4)	(2)
United States (refined) [6]	362,055	423,232	330,963	404,257	468,675
Yugoslavia	5,804	4,038	8,646	10,652	(2)
	1,478,000	1,679,000	1,704,000	1,741,000	(2)

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

The last reported world figure for lead in ore production was 1,772,334 metric tons in 1938, as given by the American Bureau of Metal Statistics. The only available total for 1940 is for South America, which produced 89,715 metric tons, according to the American Bureau of Metal Statistics. This output was just under the 1939 total of 90,902 tons and compares with 95,891 tons for 1938, as reported from the same source. Peru and Argentina were the principal producing countries, with outputs of 46,253 and 30,300 metric tons, respectively. The total for North America is unavailable, due to absence of Canadian statistics, but a slight increase over 1939 is indicated; mine production increased in the United States but declined in Mexico. Incomplete data for the Western Hemisphere indicate little change in 1940 from 1939.

World consumption.—For the same reasons as outlined under world production, the total consumption of lead in 1940, by countries, cannot be given. In 1938, the American Bureau of Metal Statistics reported the world consumption of lead as 1,638,100 metric tons. Estimates of world consumption for 1939 and 1940, given by the Metal Bulletin (London), amounted to 1,780,500 and 1,760,000 metric tons, respectively. Many countries consumed a smaller amount of lead in 1940 than in 1939, with the notable exception of the United States, which is the largest consumer of lead, followed by the United Kingdom and Germany. According to this authority, both of the latter countries showed a decline in consumption.

REVIEW BY COUNTRIES

As a preface to the world review, it is pertinent to call attention to the meagerness of published statistical data, particularly from countries outside of the Western Hemisphere. The war has affected communication of news concerning foreign operations, and censorship bans on production, import, and export figures add further restrictions.

Argentina.—Lead production in Argentina, though not large, has considerable commercial importance as it supplies domestic needs and there is a large surplus of lead concentrates for export. Because of the smelting facilities in Argentina, several thousand tons of high-grade lump galena ore are imported from Bolivia each year by local smelters. At the National Lead Co. smelter this lump ore is advantageously mixed with the flotation concentrates from the Aguilar district, Province of Jujuy. The Aguilar mining district 75 miles north of Jujuy comprises the Aguilar mine and six other groups of mining claims in the heart of the Aguilar Mountains covering a length of about 10 miles from north to south and a width of 3 to 4 miles. The known ore reserves containing 11 to 12 percent lead will last 12 years or more at the present rate of production. Among other known lead deposits in Argentina, the Largo Fontana deposit is the most important potentially. It is situated in the Territory of Chubut close to the Chilean border. A new 400-ton mill is being considered for construction at this property to treat ore averaging 6.25 percent lead, 7 percent zinc, and 20 grams of silver a ton.

During 1940, Argentina produced 40,275 metric tons of lead concentrates containing 30,300 tons of lead compared with 36,728 tons in 1939 containing 29,700 tons of lead. From January to September 1940, 2,888 metric tons of lead ore were imported, chiefly from Bolivia, compared with 3,211 tons for the same period in 1939. The National Lead Co. subsidiary smelter at Puerto Vilelas made about 90 percent of Argentina's primary lead, and although the total is not known it is estimated that in 1940 the production was above the 1939 figure of 14,150 metric tons. The concentrator recovers 80 percent of the lead as a 74-percent concentrate. The National Lead Co. has a lead-manufacturing plant in Argentina where most of the lead products consumed in the country are made.

Australia.—The mines at Broken Hill, Rosebery, and Mt. Isa all produced a greater amount of lead ore during 1940. Although figures relating to production are not available for 1940, the smelter output of lead has been estimated by the Metal Bulletin (London) to be 275,000 metric tons compared with 252,383 in 1939. The Broken Hill Associated Smelters Pty., Ltd., whose annual capacity for refined lead totals 203,000 long tons, agreed early in the war to sell 75 percent of its production to the British Ministry of Supply at £15 1s. 3d. a ton f. o. b. Port Pirie.

Belgium.—During the first part of 1940, the lead industry in Belgium was working at various degrees of capacity. Overpelt-Lommel was reported to have worked at only one-third capacity, while Campine was fairly well employed. A decline in the importation of ores owing to lack of ships and high freight rates caused the curtailment of production. Following the German invasion in May, the British blockade shut off all importation of sea-borne supplies, and production was reduced still more. Although no direct information has since been available, it has been estimated that the 1940 production totaled only 55,000 metric tons compared with 82,000 in 1939. The Germans issued a decree on July 9, calling for a census of the non-ferrous metal industry.

Bolivia.—Mine production of lead, derived principally from small mines in the La Quiaca region, amounted to 11,662 metric tons in 1940 (14,119 tons in 1939). A total of 23,636 tons of ore containing 11,663 tons of lead was exported during 1940. All concentrates are generally exported to smelters in Argentina, but during the past year ore containing 2,468 short tons of lead was shipped to the United States.

Brazil.—Numerous deposits of argentiferous galena are reported in the southern part of the State of São Paulo. A treatment plant at Palmital, planned for completion in 1940, was to have a capacity of 35 tons daily, with a production of 10 metric tons of refined lead and 50 kilograms of silver. During 1940, 296 metric tons of lead ore were exported.

Bulgaria.—Production from an ore deposit in the Rhodope Mountains containing 15 to 23 percent lead, 6 to 9 percent zinc, 0.4 to 0.7 percent copper, and 100 to 300 grams of silver a ton, by the Pirin Co.—a German-Bulgarian firm—was scheduled to begin at the end of 1940; no definite word has since been received. If development continues as planned, the annual capacity is expected to be 10,000 to 15,000 tons, chiefly lead, and the mine will be the leading producer in the country. There are no smelting facilities in Bulgaria, and all potential production will have to be reduced abroad. As of July 1940, ore reserves were estimated at 350,000 metric tons, visible and probable, with an additional 1,000,000 tons of possible ore.

Burma.—Following the outbreak of war the Burma Corporation contracted with the British Ministry of Supply for a large tonnage of lead, increased its sales in an expanding Indian market, and continued to supply considerable quantities to Japan. However, during the fiscal year 1940, exports of 72,824 long tons of lead represented a decline from the 82,366 tons exported during same period in 1938–39. For the fiscal year ended June 30, 1940, the Bawdwin mines produced 473,568 long tons of ore assaying 14.4 ounces of silver, 19.0 percent lead, 10.8 percent zinc, and 0.6 percent copper per ton. Improvements in operating costs and metallurgical efficiency enabled the corporation to mine ore of lower grade than when the original estimate of ore reserves was made. On June 30 the reserves were estimated at 3,411,200 tons assaying 15.7 ounces of silver, 20.4 percent lead, 12.6 percent zinc, and 0.9 percent copper per ton.

Canada.—Although data on the production of lead in Canada during 1940 are not available, all branches of the Canadian metal industry were operating at a rate never attained before. Lead production in Canada is derived mainly from the Sullivan silver-lead-zinc mine at Kimberley, British Columbia. Other sources include the Monarch silver-lead-zinc mines near Field, British Columbia, and the Mayo district, Yukon Territory. In Nova Scotia the Stirling lead-zinc mine was back in full production after a shut-down of several years. According to estimates of the Metal Bulletin (London), the smelter production of lead was 210,000 metric tons in 1940 compared with 177,865 tons in 1939.

China.—The Ching chen tzu lead mine in the Antung Province, South Manchuria, is reported to produce a concentrate averaging 40 to 50 percent lead, 400 grams of silver, 2 grams of gold, and 1 percent zinc per ton. The mine production of lead in China (including Hong Kong) is estimated to be 5,000 metric tons for 1940—a decline from 6,000 tons in 1939.

France.—After the fall of France in July 1940, no further data on lead have been available from that country. It is reported that the Germans seized 19,000 metric tons of lead stocks in September. Production for 1940 has been estimated at 20,000 tons, approximately half of the 1939 output.

Germany.—The German position with regard to lead is less satisfactory than with zinc. Immediately before the present war, it still relied on foreign ore (chiefly from Yugoslavia, Australia, and South-West Africa) for more than half its supply. The same conditions apply to imports of pig lead, which came from the United States, Mexico, Peru, Belgium, and Australia. Of these countries, Yugoslavia with ore supplies and Belgium with smelting capacity are now under German control, but for the most part German reliance for lead must now be placed on the territories of the old Reich, including Upper Silesia and the deposits in the Harz Mountains. Because production from domestic mines is inadequate for home needs, the drive for expansion of domestic production and restriction of use continued in 1940. Efforts are being made to develop an electric storage battery that will dispense with or reduce the need for lead and other metals. It is reported that some progress is being made which, if successful, would be significant because the large amount of lead needed for this use, particularly as an adjunct to war, would be released for other purposes.

Germany ranks as the third largest lead-consuming nation, following the United States and the United Kingdom; consumption for 1940 has been estimated at 250,000 metric tons. Production from Germany (and Austria) was reported to be 181,440 metric tons in 1939 and has been estimated at 200,000 tons for 1940.

Hong Kong.—Operations at the Lin Ma Hang mine, managed by the Hong Kong Mines, Ltd., were continuous during the first 6 months of 1940, and additional ore bodies were discovered; production increased. In June the smelter was almost completed and was expected to be in operation within a short time. Stocks of lead concentrate at the beginning of July 1940 amounted to 7,000 metric tons, of which 5,000 were sold to Great Britain.

Italy.—Information regarding lead in Italy is very meager for 1940. Although Italy is more nearly self-sufficient with regard to lead than most other metals, there are indications that this situation has not improved during 1940. Production during the past year has been estimated at 35,000 metric tons and consumption at 50,000 tons; for comparison, production for 1939 was reported to be 38,102 tons, whereas consumption for that year was estimated to be 52,000 tons.

Mexico.—Mine production of lead in Mexico during 1940 amounted to 196,250 metric tons, representing a considerable decrease from the 219,506 tons produced in 1939. Exports of lead in all forms in 1940 totaled 172,744 metric tons compared with 207,199 tons in 1939. Of this total, 135,724 tons (nearly 79 percent) were exported to the United States compared with approximately 50 percent in 1939.

A large percentage of the remainder accumulated as producers' stocks; there was no way to dispose of it in the European market.

Difficulties arising from labor problems at home and the war abroad beset Mexico during 1940. The American Smelting & Refining Co. closed its Matahuala refinery in the State of San Luis Potosi, the company asserting that such a move was imperative because of unprofitable operation.

Taxation underwent some changes in 1940; on October 21 the existing 12-percent export tax on lead was removed. On the other hand, the income tax on excess profits created at the end of 1939 and retroactive with respect to that year remained in effect during 1940.

The lead cartel formed in 1939 by the local smelter and major mining companies in the Chihuahua district was active in 1940. As the result of efforts to sustain production through the metal-price slump, the cartel was worked to the limit, but fewer contracts were made to purchase the lead production of small mines, and those in operation were run on a minimum price cancellation basis. Mineral production in the district was lower for 1940 than for any year since 1934.

Newfoundland.—In Newfoundland about 445,900 metric tons of ore were milled during 1940, providing 41,900 tons of lead concentrates containing approximately 23,900 tons of lead. In 1939 the comparable figures were 425,167, 37,332, and 21,223 tons, respectively. The Buchans Mining Co. installed two 33-foot air-lift flotation machines at this plant in 1940 to treat copper-lead flotation tailings.

Peru.—Mine production in Peru in 1940 totaled 46,253 metric tons—within a few tons of the 1939 total. Exports from Peru during 1940 included 5,430 tons of lead ore, 19,086 tons of concentrate, and 23,241 tons of pig lead compared with 8,998, 26,099, and 20,966 tons, respectively, in 1939. Peru's largest lead production is from the mines of the Cerro de Pasco Copper Corporation, and the Casapalca is the principal mine. Large reserves of ore have been developed in the Cerro de Pasco district that average 17 percent zinc and 6 percent lead a ton. The corporation is building a new 800-ton lead-zinc concentrator, to be ready in 1941. If production is maintained at the planned capacity the reserves would last 40 years. Next to the Casapalca mine, the largest producer of lead is the Huaron mine, 30 miles northwest of Cerro de Pasco in the district of Shelby. No estimates of the known ore reserves are available, but they are said to be adequate for several years at the present rate of production. Several important lead-zinc deposits are known in the southern part of Peru; when transport facilities are extended, these deposits may also become important producers. The Oroya lead smelter, operated by the corporation, is the only one in Peru; about half of the total ore produced is refined here. An increase in lead-smelting capacity is being contemplated.

Spain.—Little information is available regarding reconstruction of the Spanish lead industry following the conclusion of the Spanish Civil War in 1939. The sale of lead is under control of the Spanish Government, and stocks are reported to be negligible. In June 1940 production was reported to be 2,450 metric tons a month, and Italy and Germany were the principal purchasers. Few or no old mines are being reopened owing to the low price set by the Government for its own purchases. The production of lead in 1939 was estimated at 27,000 tons, and estimates from as low as 31,700 to as high as 56,500 tons have been given for 1940.

Sweden.—Early in 1940, Sweden, anticipating difficulties if Germany occupied Belgium and Holland, announced plans for developing domestic resources looking toward an annual production of 15,000 long tons of metallic lead. .

United Kingdom.—During 1940 the Ministry of Supply Nonferrous Metals Control drew all supplies of lead from Empire countries; these supplies have been adequate to meet reduced demands. Under normal conditions, the building industry is the main consumer of lead; but during 1940 only small amounts were used, owing to the cessation of private building. On the other hand, requirements of battery and cable makers are reported to have expanded. According to the Metal Bulletin, the production of lead in the United Kingdom declined from 11,000 metric tons in 1939 to an estimated 10,000 tons in 1940. The same authority has estimated the consumption of lead during 1940 to have been 350,000 metric tons—a decrease from 385,000 tons in 1939. Stocks of lead were increasing. This fact, coupled with the reduced level of consumption, is highly desirable from the strategic reserve point of view.

U. S. S. R.—Official statistical information concerning the lead industry, as of all metallic industries, in the U. S. S. R. is meager. It is reported, however, that the output of nonferrous metals is being pushed and that during 1940 new lead and zinc works, mines, and power stations were being built and developed in the Altai region. A new raw material base for the Chimkent lead works was reported under construction in South Kazakhstan. In Aral-Tan a new lead deposit is being exploited. The production of lead for 1940 has been variously estimated at 75,000 to 77,000 metric tons, which indicates that the output may be far short of the total necessary to fulfill the planned annual production of 134,000 tons to be reached by 1942.

Uruguay.—Minor deposits of lead occur in Uruguay in the Department of Lavalleja; the principal mine is that of Valencia, 6 miles from the railway station at Minas and 487 feet above sea level.

Yugoslavia.—Mine production in Yugoslavia in 1940 was reported to be 68,800 metric tons of lead in ore compared with 69,000 tons in 1939. Smelter production in 1940 is estimated as 14,000 tons compared with 10,624 in 1939. Trepca Mines, Ltd., continued operation successfully during the year and reported a large increase in profit over 1939. The lead smelter built by a subsidiary of Trepca has been in operation since December 21, 1939. Early in 1941, Yugoslavia fell under control of the German Government following armed occupation, and the effect on the lead industry has not yet been reported.

ZINC[1]

By E. W. Pehrson and A. L. Ransome

SUMMARY OUTLINE

The national defense program dominated the domestic zinc industry in 1940. In an endeavor to meet the unprecedented demand for metal for domestic defense and British orders, the smelting industry increased its output 33 percent over that in 1939 to a new high record and reduced its stocks 77 percent to the lowest year-end level experienced since 1925. The augmented supply, however, was inadequate to meet consumer requirements, and in consequence manufacturers' inventories of slab zinc declined substantially. The exceptionally heavy call for high-grade metal resulted in an 81-percent increase in output compared with a 9-percent gain for the lower grades. The demand for the special high-grade variety was particularly emphasized. At the close of 1940 smelters were operating near capacity, and additional capacity was being constructed and planned with vigor.

Domestic mines could not pace the advance in consumption. Mine output increased only 14 percent and was 14 percent below the record production of 1926. To maintain capacity operations, smelters turned to foreign ores, which were available in substantial tonnages at favorable prices because the British blockade prevented their shipment to the continental European smelters. Imports exceeded all previous records, and were sufficient to provide the second largest domestic output of zinc from foreign sources to date as well as a substantial increase in ore inventories at the smelters.

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

Salient statistics of the zinc industry in the United States, 1925–29 (average) and 1936–40

	1925–29 (average)	1936	1937	1938	1939	1940
Production of primary slab zinc:						
By sources:						
From domestic ores......short tons..	589,648	491,803	551,165	436,007	491,058	589,988
From foreign ores..............do....	12,734	329	5,739	10,334	16,178	85,287
	602,382	492,132	556,904	446,341	507,236	675,275
By methods:						
Electrolytic.....percent of total....	21	26	21	21	25	28
Distilled.......................do....	79	74	79	79	75	72
Production of redistilled secondary slab zinc..........................short tons..	43,756	42,209	51,554	31,613	50,428	48,917
Stocks on hand at primary smelters Dec. 31..........................short tons..	45,575	55,500	79,144	157,511	83,728	19,212
Primary zinc available for consumption short tons..	548,472	538,794	570,219	375,004	607,464	677,168
Price—Prime Western at St. Louis:						
Average for year......cents per pound..	6.76	4.90	6.52	4.61	5.12	6.34
Highest quotation................do....	8.90	5.45	7.50	5.05	6.50	7.25
Lowest quotation.................do....	5.40	4.75	5.00	4.00	4.50	5.50
Price—yearly average at London.......do....	6.46	3.31	4.91	3.05	[1] 2.89	(2)
Mine production of recoverable zinc short tons..	724,720	575,574	626,362	516,699	583,807	665,068
Tri-State district (Joplin) percent of total..	49	39	38	38	38	35
Western States..................do....	30	31	31	28	29	36
Other...........................do....	21	30	31	34	33	29
World smelter production of zinc short tons..	1,435,000	1,614,000	1,792,000	1,728,000	1,802,000	(2)

[1] Average for 8 months; London Metal Exchange dealings suspended in September.
[2] Data not available.

Prices responded to the rapid increase in demand. The quotation for Prime Western zinc at St. Louis was 5.75 cents a pound at the beginning of the year and 7.25 cents at the close and averaged 6.34 cents for the year compared with 5.12 cents in 1939 and 4.61 in 1938. During the closing months of 1940, the statistical position of zinc was such that under normal conditions official quotations probably would have moved to higher levels. Largely in deference to the Government's desire to avoid run-away markets that might precipitate a general increase in prices, official quotations were stabilized at 7.25 cents beginning September 24. On December 4, following complaints from Washington that the Commodity Exchange was facilitating trading in zinc at prices considerably above official market quotations, the exchange appointed a committee to examine the open market position; in consequence, the opening of new future positions for zinc was banned on and after March 4, 1941. Contracts for liquidation of open accounts as of that date were permitted.

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

National defense activity.—The German invasion of Belgium, Netherlands, and France gave considerable impetus to defense preparations in the United States. The various agencies created to administer the program are described in the chapter entitled Review of the Mineral Industries in 1940. In early summer, activities in minerals were confined largely to the strategic items, but as defense orders began to be translated into requirements for raw materials it became evident that bottlenecks were to be encountered elsewhere. By late summer zinc shortages were in sight, and during the last quarter of the year expansion of smelting capacity was being pushed vigorously. On October 28, 1940, John A. Church, consulting mining engineer of New York, was appointed consultant on zinc and copper to direct those activities of the Industrial Materials Department of the Advisory Commission to the Council of National Defense; later he occupied the same position with the Production Division of the Office of Production Management.

As the year progressed, shortages became more acute, and by the latter part of December individual producers were allocating supplies to customers. Imposition of Government priorities in deliveries was

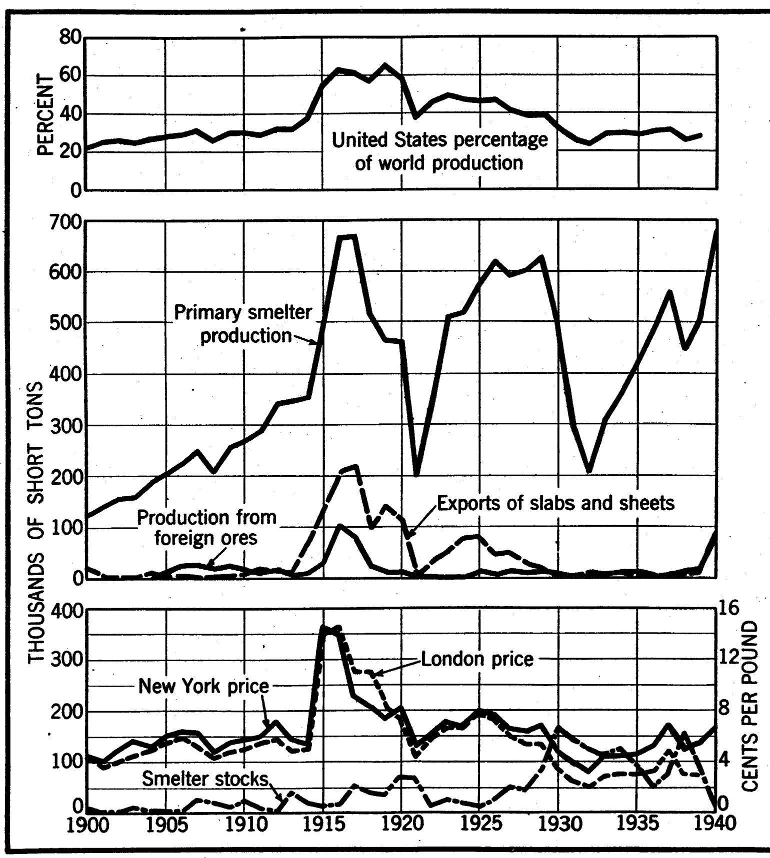

FIGURE 1.—Trends in the zinc industry in the United States, 1900–1940. Imports of slab and sheet zinc are not shown. Before 1936 they seldom exceeded 500 tons annually, but in recent years they have increased, amounting to 37,439 tons in 1937, 7,456 tons in 1938, 31,138 tons in 1939, and 10,164 tons in 1940.

suggested as early as November, but no positive action was taken until March 1941. On January 30, 1941, a Priorities Committee for Nonferrous Metals was established in the Priorities Division of the Office of Production Management. Exports of zinc ores, slab zinc, and manufactures of zinc were added to the list of commodities subject to export control on February 3. On February 20 the American Zinc Institute appointed a committee to coordinate supplies to consumers. These steps proved to be inadequate, as demand continued to exceed supplies and nondefense consumption of zinc was being curtailed. On March

7 the Office of Production Management requisitioned 5 percent of each producer's January output to create a pool from which shortages in defense industries in March could be relieved. Subsequently the pool requirements for May were increased to 17 percent of the March production and for June to 22 percent of April production. As of June 1, establishment of full priority control was imminent.

Smelting capacity.—In October 1940 the Bureau of Mines, at the request of the Advisory Commission to the Council of National Defense, surveyed zinc-smelting capacity and estimated production. The inquiry revealed that the maximum possible output at primary smelters in October would be at the annual rate of 754,000 short tons. By May 1941 the capacity would be increased to 789,000 tons and by August to 810,000 tons. Estimated production for 1941 at primary plants was 792,000 tons and at secondary smelters 33,000 tons, indicating a presumable total output of 825,000 tons. Subsequent extensions to plants have resulted in further increases in capacity. In April 1941, Young[2] estimated the domestic production of zinc from primary and secondary sources in 1941 as 880,000 to 890,000 tons, and in 1942 at 956,000 tons. Although it is impossible to forecast the requirements for 1941 and 1942 because of uncertainty regarding the magnitude of the defense program, this substantial expansion of smelting facilities apparently assures adequate zinc for all defense needs and an appreciable proportion of civilian requirements.

Supply of zinc concentrates.—As a result of a canvass conducted in January 1941, the Bureau of Mines forecast mine output for 1941 at 714,000 tons of recoverable zinc at current prices. It was estimated that smelters would require 830,000 tons and other industries using zinc ore 100,000 tons—a total of 930,000 tons of recoverable metal in ore. A deficit of 216,000 tons was thus revealed that would have to be obtained from sources other than current domestic production. A canvass of smelter ore inventories and available concentrates abroad indicated that ample supplies of zinc were available for 1941.

Smelter stocks of concentrates, as of February 28, 1941, totaled 377,000 tons containing 185,000 tons of recoverable zinc. The latter included 125,000 tons in domestic ores and 60,000 tons in foreign ores. In addition, the smelting industry had on order 288,000 tons of foreign ores, delivery of which was reasonably certain.

A survey of foreign sources indicated that these advance purchases of foreign ores constituted a large proportion of the more accessible supplies but only a relatively small part of the total obtainable from all sources. Information received by the Bureau of Mines indicated that over 270,000 tons of concentrates were potentially available from stocks in South America and Mexico and that an additional 300,000 tons annually over present commitments to other consumers could be sent from these areas to the United States. Very large tonnages likewise might be imported from the British Empire, so that if necessary a considerable further increase in domestic smelting capacity probably could be supported by foreign ores. This would require continued control of the seas by the British and American fleets and a more favorable shipping situation than now prevails. Doubtless higher prices would be required to move some of these ores at present ocean freight rates.

[2] Young, Howard I., Slab Zinc Review: Am. Zinc Inst., Ann. Convention, April 29, 1941; published in mimeographed form by that agency.

The foregoing résumé indicates that ample supplies of foreign concentrates are available if ships can be found to bring them to the United States. As of June 1, 1941, the outlook for adequate shipping facilities for this purpose was poor, and consideration was being given to methods for stimulating domestic mine production should such action become necessary.

The senior author [3] of this chapter discussed the zinc concentrate situation in detail at the annual convention of the American Zinc Institute.

DOMESTIC PRODUCTION

Production of primary and redistilled secondary slab zinc.—Production of primary slab zinc from both domestic and foreign ores in 1940 was the highest ever recorded, exceeding the previous peak of 1917 by 0.9 percent. It was 33 percent higher than in 1939 and 12 percent more than the average annual output in the 5 years 1925–29. Both domestic and foreign ores contributed to the increase, as production from the former advanced by 20 percent and that from the latter by 427 percent. The domestic output was the largest since 1929, and the quantity produced from foreign ores was exceeded only in 1916.

The production of redistilled secondary slab zinc dropped 3 percent. Figures for the output of remelted secondary slab zinc previously reported under this heading frequently have been in error on account of inadvertent duplication by reporting companies. In 1940, only 2,704 tons were recovered by remelting purchased scrap. Zinc rolling mills and other consumers recover much more than this from home scrap, but such metal normally does not enter the market. It is not measured statistically.

Primary and redistilled secondary slab zinc produced in the United States, 1936–40, in short tons

Year	Primary			Redistilled secondary	Total (excludes remelted)
	Domestic	Foreign [1]	Total		
1936	491,803	329	492,132	42,209	534,341
1937	551,165	5,739	556,904	51,554	608,458
1938	436,007	10,334	446,341	31,613	477,954
1939	491,058	16,178	507,236	50,428	557,664
1940	589,988	85,287	675,275	48,917	724,192

[1] All foreign zinc smelted in the United States in 1936 was derived from Mexican ores; in 1937–38, most of it originated in Peru; in 1939, in Mexico, Peru, and Argentina; and in 1940, principally in Mexico, Canada, Newfoundland, and Peru.

Distilled and electrolytic zinc.—Of the primary zinc produced in 1940, 72 percent was distilled and 28 percent electrolytic compared with 75 and 25 percent, respectively, in 1939.

Because of the importance of special high-grade zinc in the manufacture of munitions, producers were requested to report their output of it in 1940. The figures reveal the exceptional demand for metal of this grade. Statistics for 1939 are not available, but it is apparent that the major part of the tonnage increase for all grades was supplied

[3] Pehrson, E. W., Zinc Concentrates—the Available Supply at Home and Abroad: Am. Zinc Inst., Ann. Convention, April 29, 1941; published in mimeographed form by that agency.

by special high-grade zinc. Production of special and ordinary high-grade metal increased 81 percent compared with an increase of only 9 percent for all other grades.

Distilled and electrolytic zinc, primary and secondary, produced in the United States, 1936–40, in short tons

APPORTIONED ACCORDING TO METHOD OF REDUCTION

Year	Electrolytic primary	Distilled primary	Redistilled secondary [1]		Total
			At primary smelters	At secondary smelters	
1936	127,175	364,957	22,142	20,067	534,341
1937	117,511	439,393	24,131	27,423	608,458
1938	93,272	353,069	14,003	17,610	477,954
1939	127,056	380,180	23,471	26,957	557,664
1940	187,040	488,235	20,003	28,914	724,192

APPORTIONED ACCORDING TO GRADE

Year	Grade A		Grade B (Intermediate)	Grades C and D (Brass Special and Selected)	Grade E (Prime Western)	Total
	Special high grade (99.99%Zn)	Ordinary				
1936	183,841		59,879	65,728	224,893	534,341
1937	196,052		67,132	72,993	272,281	608,458
1938	140,256		58,128	73,724	205,846	477,954
1939	162,345		66,591	86,274	242,454	557,664
1940	195,119	98,940	65,321	80,681	284,131	724,192

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

Production of primary slab zinc by States.—Pennsylvania continued to be the leading producer of primary slab zinc in the United States—a distinction it has held without interruption since 1934. Next in order of importance ranked Montana and Illinois, closely followed by Oklahoma; the last two States reversed their respective positions compared with 1939. All producing States made impressive gains, particularly Idaho, the West Virginia-Texas group, and Arkansas; these increased 103, 94, and 78 percent, respectively. Again, as in 1939, Montana and Idaho produced electrolytic zinc only, and the other States named produced distilled zinc only.

Primary slab zinc produced in the United States, by States, 1936–40, in short tons

Year	Arkansas	Idaho	Illinois	Montana	Oklahoma	Pennsylvania	Other States [1]	Total	
								Short tons	Value
1936	18,005	21,223	81,174	105,952	62,963	150,425	52,390	492,132	$49,213,000
1937	25,799	22,831	73,151	94,680	96,153	175,275	69,015	556,904	72,398,000
1938	20,476	15,634	68,167	77,638	68,224	139,897	56,305	446,341	42,849,000
1939	19,892	18,427	79,480	108,629	84,551	155,598	40,659	507,236	52,753,000
1940	35,497	37,477	101,819	149,563	96,689	175,352	78,878	675,275	85,084,650

[1] Texas and West Virginia.

Secondary zinc.—In addition to the redistilled secondary slab zinc (unalloyed) already reported herein, some remelted slab is produced and a large quantity of secondary zinc is recovered each year in the form of alloys, zinc dust, zinc pigments, and zinc salts. Additional information on secondary zinc is given in the chapter on Secondary Metals—Nonferrous.

Byproduct sulfuric acid.—Sulfuric acid made from the sulfur dioxide gases produced in the roasting of zinc blende (sphalerite) is an important byproduct of zinc smelting. To utilize a larger proportion of their acid-producing capacity, some plants also consume large quantities of sulfur as well. The production of sulfuric acid at zinc blende roasting plants from 1935 to 1939, inclusive, is shown in the following table. Data for 1940 are not yet available.

Sulfuric acid (60° B. basis) made at zinc blende roasting plants in the United States, 1935–39 [1]

Year	Made from zinc blende		Made from sulfur		Total		
	Short tons	Value [2]	Short tons	Value [2]	Short tons	Value [2]: Total	Value [2]: Average per ton
1935	[3] 443,476	$3,756,242	90,884	$769,787	534,360	$4,526,029	$8.47
1936	505,882	4,497,291	161,169	1,432,792	667,051	5,930,083	8.89
1937	[3] 542,356	5,060,181	151,090	1,409,670	693,446	6,469,851	9.33
1938	[3] 466,879	4,253,268	30,996	282,373	497,875	4,535,641	9.11
1939	[3] 528,872	4,765,137	102,663	924,993	631,535	5,690,130	9.01

[1] Figures for 1940 not yet available.
[2] At average of sales of 60° acid.
[3] Includes acid from small quantity of foreign blende.

Rolled zinc.—Contrary to general industrial trends, the production of rolled zinc declined 7 percent in 1940, but owing to advances in prices the average value increased 17 percent (from $0.086 a pound in 1939 to $0.101 in 1940). Some mills that manufacture their rolled zinc into various products, other than those shown in the accompanying table, remelt and reroll the resulting scrap. The scrap thus treated in 1940 was 10,183 tons—a 21-percent decrease from the 1939 figure. The zinc lost in such waste products as skimmings, dross, and pot losses totaled 1,500 tons in 1940—equivalent to about 2.6 percent of the net production of rolled zinc. Zinc purchased for rolling in 1940 comprised 41 percent Brass Special, 24 percent Electrolytic and Intermediate grades, 16 percent Prime Western, 14 percent High Grade, and 5 percent Selected. These figures compare with the 1939 figures of 39, 4, 24, 14, and 19 percent, respectively. This pronounced shift toward the use of higher grades of zinc in 1940 probably reflects the congested market conditions during the latter part of the year rather than technologic changes within the industry. Stocks of slab zinc on hand at zinc rolling mills were about 8,200 tons (revised figure) at the beginning and 5,700 tons at the end of the year.

Rolled zinc produced and quantity available for consumption in the United States, 1939–40

	1939			1940		
	Short tons	Value		Short tons	Value	
		Total	Average per pound		Total	Average per pound
Production:						
Sheet zinc not over 0.1 inch thick	15,599	$3,282,000	$0.105	21,415	$5,016,000	$0.117
Boiler plate and sheets over 0.1 inch thick	1,098	184,000	.084	1,904	363,000	.095
Strip and ribbon zinc [1]	45,185	7,148,000	.079	34,080	6,256,000	.092
Total zinc rolled [1]	61,882	10,614,000	.086	57,399	11,635,000	.101
Imports	178	21,000		18	2,800	
Exports	6,449	1,052,000	.082	7,055	1,421,100	.101
Available for consumption	55,611			50,362		
Value of slab zinc (all grades)			.052			.063
Value added by rolling			.034			.038

[1] Figures represent net production. In addition, 12,916 tons of strip and ribbon zinc in 1939 and 10,183 tons of strip and ribbon zinc in 1940 were rerolled from scrap originating in fabricating plants operated in connection with zinc rolling mills.

Zinc dust.—Production of zinc dust in 1940 increased 23 percent over 1939 and was the largest on record. As in 1939, the zinc content of dust produced ranged from 94.0 to 98.5 percent and averaged 97.0 percent. Zinc dust is finding increasing markets in the chemical-manufacturing industry, chiefly as a reducing agent in the printing and dyeing of textiles. Another expanding use for zinc dust in this country is in the Schori process of metal spraying, by which a protective coating of zinc is applied to any surface. The increasing metallurgical use of zinc dust in the cyanide process by the gold mines of the Transvaal is shown by the higher export figure for this material from the United States, the chief source of supply during the past year.

Zinc dust [1] produced in the United States, 1936–40

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average per pound			Total	Average per pound
1936	14,425	$1,957,300	$0.068	1939	16,835	$2,367,861	$0.070
1937	15,242	2,587,577	.085	1940	20,731	3,404,970	.082
1938	11,609	1,542,511	.066				

[1] All produced by distillation.

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

Mine production.—Mine production increased 14 percent in 1940, owing to gains of 41 percent in the Western States and 6 percent in the Central States. Production from the Eastern States declined 1 percent. Tonnages advanced 70,141 tons in the Western States and 13,260 tons in the Central States, but decreased 2,140 tons in the Eastern States. New Jersey continued to be the leading producer among the Eastern States and maintained its rank as second in importance in the country. In the Eastern States gains in New Jersey and Tennessee did not offset decreases in New York and Virginia. The output of the Eastern States comprised 27 percent of the country's total in 1940.

All the Western States gained in production during 1940 and together produced 36 percent of the total domestic output. This gain can be attributed entirely to the favorable price of zinc. As in 1939, Idaho continued to be the largest producer in this region, with an output exceeding all previous records. Montana ranked second and Utah third. Notwithstanding the permanent closing of the Pecos mine in 1939, the New Mexico total still showed a slight increase in 1940. Arizona's production was the largest in the history of the State. The output from Washington increased 14 percent; it came from three properties at Metaline Falls. About 90 percent of the Nevada zinc production was recovered from ores in the Pioche district.

The Central States supplied 37 percent of the total domestic zinc produced in 1940. Production increased 6 percent over 1939 owing to increased demand and continued higher prices. Oklahoma (the principal zinc-producing State) showed an increased output, but production from the other two States of the Tri-State region—Kansas and Missouri—declined slightly. The Tri-State (or Joplin) region supplied 35 percent and the remaining Central States only 2 percent of the total domestic production.

Mine production of recoverable zinc in the United States, 1925–29 (average) and 1936–40, in short tons

State	1925–29 (average)	1936	1937	1938	1939	1940
Western States:						
Arizona	2,628	3,589	5,026	5,814	6,711	15,456
California	3,999	8	20	-------	6	79
Colorado	32,868	1,172	4,247	4,553	1,830	5,060
Idaho	29,128	49,100	54,199	44,030	47,549	70,601
Montana	72,519	49,717	39,168	8,844	34,799	52,587
Nevada	5,570	13,477	14,236	8,944	6,228	11,833
New Mexico	23,351	20,668	23,927	28,236	29,356	30,313
Oregon	-------	61	24	-------	-------	-------
Utah	44,385	36,192	48,001	33,658	34,526	43,788
Washington	575	4,403	4,116	11,402	10,131	11,560
	215,023	178,387	192,964	145,481	171,136	241,277
Central States:						
Arkansas	71	182	241	152	123	440
Illinois	1,174	-------	-------	-------	334	4,818
Kansas	114,323	79,017	80,300	73,024	68,971	57,032
Kentucky	644	238	270	322	909	1,278
Missouri	16,708	18,709	20,600	10,226	15,096	12,703
Oklahoma	226,969	129,175	135,696	112,924	140,379	162,935
Wisconsin	23,055	8,126	6,938	2,073	5,904	5,770
	382,944	235,447	244,045	198,721	231,716	244,976
Eastern States:						
New Jersey	93,839	89,883	101,408	85,839	88,716	91,406
New York	7,091	26,941	32,690	29,896	36,014	35,686
Tennessee } Virginia	25,823	44,916	55,255	56,766	56,225	
Tennessee						34,796
Virginia						16,927
	126,753	161,740	189,353	172,501	180,955	178,815
	724,720	575,574	626,362	516,703	583,807	665,068

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

Mine production of recoverable zinc in the principal zinc-producing districts of the United States, 1936–40, in short tons

District	State	1936	1937	1938	1939	1940
Joplin region	Kansas, Missouri, Oklahoma	226,857	236,585	196,174	224,446	232,437
New Jersey	New Jersey	89,883	101,408	85,839	88,716	91,406
Coeur d'Alene region	Idaho	44,310	47,070	31,937	40,065	62,948
Summit Valley (Butte)	Montana	34,940	22,033	942	20,016	35,899
St. Lawrence County	New York	26,941	32,690	29,896	36,014	35,686
Eastern Tennessee	Tennessee	[1] 44,916	[1] 55,255	[1] 56,766	[1] 56,225	34,796
Central	New Mexico	10,706	11,887	16,695	23,677	29,573
Bingham	Utah	17,422	20,570	23,096	20,861	21,812
Park City region	do	13,579	19,342	5,678	9,054	17,598
Austinville	Virginia	(1)	(1)	(1)	(1)	[2] 16,927
Smelter	Montana	7,986	10,330	6,063	12,639	14,462
Metaline	Washington	4,389	4,095	11,402	10,130	11,560
Pioche	Nevada	12,047	12,472	8,414	5,737	10,773
Warm Springs	Idaho	4,771	6,959	12,070	7,463	7,104
Kentucky-Southern Illinois	Kentucky-southern Illinois	238	270	322	1,243	6,090
Upper Mississippi Valley	Iowa, northern Illinois, Wisconsin.	8,126	6,938	2,073	5,904	5,776
Wallapai	Arizona	524	1,714	1,660	770	4,29
San Juan Mountains	Colorado	140	2,092	4,308	1,465	4,151
Pioneer	Arizona	—	—	825	2,000	3,175
Rush Valley	Utah	1,366	2,205	1,955	2,370	2,971
Harshaw	Arizona	—	—	—	1,075	2,714
Warren	do	—	—	—	7	1,812
Big Bug	do	—	—	—	110	1,740
Cataract	Montana	1,354	1,043	605	1,070	773
Ophir	Utah	3,563	4,023	1,893	1,268	603
Oro Blanco	Arizona	3,065	2,700	3,265	2,377	484
Tintic	Utah	177	1,259	921	851	225
Leadville	Colorado	871	1,676	97	172	172
Flint Creek	Montana	4,307	4,641	426	663	99
Willow Creek	New Mexico	9,667	10,882	11,291	4,925	—
Tybo	Nevada	(3)	1,417	—	—	—

[1] Virginia included with Tennessee for 1936–39. Bureau of Mines not a tliberty to publish separately.
[2] Includes a very small quantity produced elsewhere in the State.
[3] Bureau of Mines not at liberty to publish.

STOCKS

Producers' stocks.—Stocks of zinc at primary reduction plants fell 77 percent during 1940 and were the lowest on record since the end of 1925. Stocks at secondary distilling plants decreased 70 percent, and total stocks dwindled a little less than 77 percent. Of the total stocks on hand at the end of the year, 9,710 tons were of the higher grades of zinc (A and B) and 10,263 tons of the lower grades (C, D, and E) compared with 34,334 and 51,949 tons, respectively, at the end of 1939.

Stocks of zinc on hand at zinc-reduction plants in the United States at end of year, 1936–40, in short tons

	1936	1937	1938	1939	1940
At primary reduction plants	55,500	79,144	157,511	83,728	19,212
At secondary distilling plants	626	1,969	1,915	2,555	761
	56,126	81,113	159,426	86,283	19,973

According to the American Zinc Institute, stocks of slab zinc increased moderately during the first quarter of 1940 and reached the peak for the year at the end of April. There was a gradual decline for the remainder of the second quarter, but throughout the balance of the year, as shipments to consumers increased, the decline continued at a more rapid pace so that the year-end figure was less than one-quarter of that at the beginning of 1940.

Stocks of zinc ore (60 percent concentrates) in the Tri-State district at the end of 1939 totaled 12,000 tons. During the first part of 1940, shipments greatly exceeded production, and stocks were reduced to 2,900 tons on March 2. This was followed by a fairly steady advance to a midyear high of 7,700 tons on June 22. A reduction to 5,100 tons on August 17 was followed by an increase to 8,200 tons on September 7. This cycle was repeated, with a low point on October 12 of 5,400 tons followed by a rise to 9,800 tons on November 16—the peak for the year. A subsequent sharp increase in shipments, accompanied by a fairly steady decline in production throughout the balance of November and December, caused a rapid depletion of stocks to 2,800 tons on December 28, with a continued drop to 1,200 tons on January 4, 1941. Thus, at the year-end period, stocks were at their lowest point for the year.

Data on stocks of metallic zinc outside the United States are not available for 1940 owing to the disruption of international trade in zinc ore caused by the war. A discussion of zinc concentrate stocks abroad is included in the introductory pages of this chapter.

Consumers' stocks.—In September 1940 the Bureau of Mines, at the request of the Advisory Commission to the Council of National Defense, made a telegraphic survey of consumers' stocks. The 132 companies cooperating in that canvass reported inventories of 94,400 tons on April 30 and 82,300 on September 21. This group also accounted for 90 percent of the inventories held by the 178 companies that reported on September 30. Applying this proportion to the April 30 inventory, stocks held at that time by the group of 178 companies may be estimated at nearly 105,000 tons. Data for July through October were obtained by a monthly mail canvass of the group of 178, but the canvass for November was expanded to include 304 companies, and figures for September and October have been revised upward to include the additional consumers. The April inventories were not strictly comparable with those of September, but a steady decline in each month except September was indicated. After September 30, inventories showed a rapid and continual decline throughout the remainder of the year and into 1941. By April 30, 1941, stocks declined 42 percent. Comparable stock totals for this period are summarized in the following table.

Consumers' stocks of slab zinc at month's end, September to December 1940 and January to April 1941, by industries, in short tons [1]

	Galvanizers	Die casters	Brass mills	Zinc rolling mills and oxide plants	Others	Total
1940:						
September	52,500	17,700	21,600	10,800	500	103,100
October	47,301	18,039	21,446	9,590	752	97,128
November	40,147	16,149	17,101	8,457	706	82,560
December	35,889	13,604	19,550	8,348	803	78,194
1941:						
January	34,947	13,046	14,834	7,051	762	70,640
February	32,432	11,371	15,844	6,806	836	67,289
March	31,941	8,740	14,592	8,295	862	64,430
April	29,665	6,830	15,719	6,344	856	59,414

[1] Based upon a canvass of approximately 300 companies.

DOMESTIC CONSUMPTION

New supply.—Establishing a new high record in 1940, the supply of new slab zinc available for consumption increased to 677,168 tons —a rise of 11 percent over the previous record of 1939 (607,464 tons) and of 23 percent over the 1925–29 average (548,472 tons). By comparison, supplies of copper, lead, and pig iron in 1940 increased 41, 59, and approximately 15 percent over 1939, respectively. As was the case in 1939, larger production from both domestic and foreign ores and a substantial reduction in producers' stocks during the year explained the record supply of zinc available in 1940.

In addition to primary zinc, redistilled secondary metal was available for consumption in 1940. Allowing for depletion of stocks at secondary smelters, the total supply to consumers aggregated 50,711 tons, which, added to the 677,168 tons of primary, gives a total of 727,879 tons of slab zinc available for consumption. Although over 6,000 tons of metal imported in 1940 did not enter domestic consumption in that year, actual consumption probably exceeded the foregoing calculation because of the decline in consumers' stocks. Incomplete data on stocks, as of January 1, 1940, indicate a possible depletion of 20,000 tons in consumers' inventories for the year.

Primary slab zinc available for consumption in the United States, 1936–40, in short tons

	1936	1937	1938	1939	1940
Supply:					
Stock at smelters Jan. 1	90, 539	55, 500	79, 144	157, 511	83, 728
Production	492, 132	556, 904	446, 341	507, 236	675, 275
Imports for consumption	11, 660	37, 208	7, 230	30, 960	[1] 16, 468
Total available	594, 331	649, 612	532, 715	695, 707	775, 471
Withdrawn:					
Exports	37	249	[2] 200	4, 515	79, 091
Stock at smelters Dec. 31	55, 500	79, 144	157, 511	83, 728	19, 212
Total withdrawn	55, 537	79, 393	157, 711	88, 243	98, 303
Available for consumption	538, 794	570, 219	375, 004	607, 464	677, 168

[1] General imports.
[2] Not separately recorded; estimated.

Industrial use of slab zinc.—The estimated industrial use of primary and secondary zinc, as calculated by the American Bureau of Metal Statistics, is shown in the following table:

Estimated industrial use of zinc in the United States, 1936–40, in short tons [1]

Purpose	1936	1937	1938	1939	1940
Galvanizing:					
Sheets	132,000	139,000	108,500	147,500	147,700
Tubes	36,000	37,000	29,300	43,300	51,200
Wire	30,000	33,000	23,600	33,000	33,900
Wire cloth	6,000	7,000	5,600	7,700	8,400
Shapes [2]	38,000	40,000	31,000	43,500	45,800
	242,000	256,000	198,000	275,000	287,000
Brass making	165,000	169,000	102,000	175,000	232,000
Rolled zinc	55,000	58,000	46,000	62,000	58,000
Die castings	72,000	88,000	48,000	84,000	116,000
Other uses [3]	48,000	39,000	27,000	30,000	26,000
	582,000	610,000	421,000	626,000	719,000

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

The quantity of zinc used by industry in 1940 as estimated by the American Bureau of Metal Statistics was 15 percent higher than in 1939 and 14.5 percent higher than the record amount established in 1929 (628,300 tons). All of the principal uses except rolled zinc increased in 1940—galvanizing 4 percent, brass making 33 percent, and die castings 38 percent; the largest use—galvanizing—took 40 percent of the total tonnage in 1940 compared with 44 percent in 1939. This item includes zinc used in electro-galvanizing and that used in sheradizing. The former increased from 5,740 tons in 1939 to 6,071 in 1940 and the latter from 511 tons to 618. Zinc used in rolled products in 1940 (1939 figures in parentheses) included 20,985 tons (21,670) in battery cans, 17,000 (20,000) in glass-jar tops, 1,000 (1,000) in automobile manufacture, 5,000 (5,000) in photoengraving sheet, 1,904 (1,100) in boiler plate, and 426 (340) in brake lining. The remaining tonnage was absorbed in miscellaneous other uses or was exported. The chief item in "other uses" is the slab zinc employed in making French-process zinc oxide, which totaled about 20,000 tons in 1940 compared with 17,000 in 1939.

PRICES

With the exception of a slight drop in January, the price of zinc remained unchanged during the first half of 1940 but advanced consistently during subsequent months to a high that remained constant for the last quarter of the year. During the early months of the year, the market was fairly stable but after the invasion of Norway and Belgium (both important zinc-producing countries) prices moved upward. At the beginning of the year the St. Louis price of Prime Western zinc was 5.75 cents; on January 19 it dropped to 5.50 cents, but on February 26 it rose again to 5.75 cents, where it remained until May 24, when the quotation reached 6.00 cents. As production failed to meet the rapidly expanding demand, stocks trended downward, and prices responded with a rise to 6.25 cents on June 3, to 6.50 cents on August 14, and to 6.85 cents on September 5. On September 23 the price reached a peak of 7.25 cents—apparently raised to this point by advance buying by consumers—and remained there for the remainder of the year. During the closing months of 1940, substantial premiums over official quotations were being paid in the open market for spot and future metal, but the tonnages available were relatively small. During this period the statistical position of zinc was such that under normal conditions official quotations probably would have moved higher. Largely in deference to the desire of the Advisory Commission to the Council of National Defense to avoid run-away markets that might precipitate a general increase in prices, official quotations were stabilized at 7.25 cents, beginning September 23. The average price of zinc for the year was 6.34 cents compared with 5.12 cents in 1939—an increase of nearly 24 percent.

London Metal Exchange dealings were suspended at the outbreak of the war, and zinc quotations in London have not been available since August 1939.

On December 18, 1939, the Nonferrous Metal Control for the United Kingdom fixed the price of zinc at £25 15s., delivered consumers, duty paid, for foreign zinc, and £26 10s. for domestic metal. These established prices did not change during 1940.

Price of zinc and zinc concentrates, 1936–40

	1936	1937	1938	1939	1940
Average price of common zinc at—					
St. Louis (spot) .... cents per pound	4.90	6.52	4.61	5.12	6.34
New York .... do	5.28	6.87	4.99	5.51	6.73
London .... do	3.31	4.91	3.05	[1] 2.89	(2)
Excess New York over London .... do	1.97	1.96	1.94	[3] 2.03	(4)
Joplin 60-percent zinc concentrates:					
Price per short ton .... dollars	31.95	39.87	27.83	34.15	41.87
Price of zinc content .... cents per pound	2.66	3.32	2.32	2.85	3.49
Smelter margin .... do	2.34	3.20	2.29	2.27	2.85
Price indexes (1925–29 average=100):					
Zinc (New York)	74	97	70	77	95
Lead (New York)	63	80	63	68	69
Copper (New York)	65	90	70	75	77
Nonferrous metals [5]	72	91	74	79	82
All commodities [5]	82	88	80	79	80

[1] Average for 8 months; London Metal Exchange dealings suspended in September.
[2] Official maximum price fixed by British Ministry of Supply at £25 15s., equivalent to 4.64 cents a pound at the official 1940 rate of exchange.
[3] Difference based upon 8-month averages.
[4] Not available.
[5] Based upon price indexes of U. S. Department of Labor.

Average monthly quoted prices of common zinc (prompt delivery or spot) at St. Louis and London, and of 60-percent zinc concentrates at Joplin, 1939–40 [1]

Month	1939			1940		
	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	29.00	4.50	2.85	38.15	5.64	(2)
February	29.00	4.50	2.83	35.43	5.54	
March	29.00	4.50	2.87	37.05	5.75	
April	30.00	4.50	2.81	37.50	5.75	
May	30.00	4.50	2.87	37.70	5.81	
June	30.00	4.50	2.93	40.54	6.24	
July	30.00	4.52	2.97	41.37	6.25	
August	31.27	4.72	3.01	41.98	6.40	
September	37.96	6.15	(3)	44.75	6.94	
October	44.00	6.50	(3)	48.24	7.25	
November	44.00	6.50	(3)	48.23	7.25	
December	41.42	6.01	(3)	48.19	7.25	
Average for year	34.15	5.12	[4] 2.89	41.87	6.34	(2)

[1] All quotations from Metal Statistics, 1941. Conversion of English quotation into American money based upon average rates of exchange recorded by the Federal Reserve Board of the Treasury.
[2] Official maximum price fixed by British ministry of Supply at £25 15s., equivalent to 4.64 cents a pound at the official 1940 rate of exchange.
[3] London Metal Exchange dealings suspended for duration of war.
[4] Average for 8 months; comparable average for St. Louis was 4.53 cents.

Average price of zinc received by producers, 1936–40, by grades, in cents per pound

	1936	1937	1938	1939	1940
Grade A (High Grade) [1] Grade B (Intermediate)	5.15	6.65	5.03	5.34	6.59
Grades C and D (Select and Brass Special) [1]	4.91	6.47	4.73	5.00	6.04
Grade E (Prime Western)	4.89	6.44	4.71	5.08	6.14
All grades	5.0	6.5	4.8	5.2	6.3
Prime Western; spot quotation at St. Louis	4.9	6.5	4.6	5.1	6.3

[1] American Metal Market quotes average prices of High Grade and Brass Special as follows: High Grade (f.o.b. New York)—1936, 5.90 cents; 1937, 7.76 cents; 1938, 5.74 cents; 1939, 6.16 cents; 1940, 7.38 cents; Brass Special (f.o.b. East St. Louis)—1936, 4.98 cents; 1937, 6.62 cents; 1938, 4.71 cents; 1939, 5.22 cents; 1940, 6.44 cents.

ZINC-REDUCTION PLANTS

Zinc smelters.—During 1940 there were 17 active zinc smelters; 1 idle plant at Peru, Ill., was partly dismantled. Of the active plants, 13 operated exclusively with horizontal retorts, 1 with both horizontal and vertical retorts, 2 with large vertical retorts exclusively, and 1 with electrothermic furnaces. The total number of retorts reported at the regular horizontal-retort primary plants was 62,368, considerably below the 69,180 retorts recorded for December 31, 1939, because most companies wrote off their obsolete equipment in 1940. This decrease was larger than the figures indicate but was balanced by the construction of 832 new retorts during the year. An appreciable number of the retorts still reported at plants represent equipment that has been idle for several years and cannot be brought into production without extensive repairs or the addition of roasting or sintering devices. The usable capacity is therefore somewhat less than is indicated by the retorts reported at plants. Of the total retorts reported, 55,328 were in use, a 12.6-percent increase over the 49,151 in operation at the close of 1939. Smelting operations were believed to be nearly at usable capacity levels at the close of 1940. At the end of 1940, 6,480 new retorts were under construction, and more than 800 additional units were planned for 1941. All of the 52 large vertical retorts were in use at the year's end, and 14 new units were being installed.

Many primary smelters treat scrap as well as ore. Horizontal-retort plants at Beckemeyer and Sandoval, Ill., and large graphite-retort plants at Trenton, N. J., Philadelphia and Bristol, Pa., Wheeling, W. Va., Tottenville, N. Y., and Fairfield, Ala., handle scrap exclusively. The Torrance (Calif.) plant of the Pacific Smelting Co., Ltd., uses small clay retorts as well as large graphite retorts for treating secondary materials. At the close of 1940, additional retorts were under construction at Beckemeyer for treatment of secondary zinc.

Electrolytic plants.—Three electrolytic zinc plants were in operation during 1940. The plant of the Sullivan Mining Co. at Kellogg, Idaho, made full use of its newly increased capacity. The Anaconda Copper Mining Co. plant at Anaconda, Mont., operated at capacity and the Great Falls plant at near capacity at the end of the year. The Evans-Wallower plant at East St. Louis, Ill., idle since 1931, was purchased late in 1940 by the American Zinc Co. of Illinois and was being reconditioned for 1,400 ton-a-month production beginning in the spring of 1941. At the three active plants, 2,204 cells out of a total of 2,228 were in use at the end of 1940 compared with 1,904 out of 2,192 at the end of 1939. The American Smelting & Refining Co. recently announced plans to construct an electrolytic zinc plant at Corpus Christi, Tex., which will have capacity for producing 25,000 tons of metal annually.

FOREIGN TRADE [4]

Imports.—The following tables give zinc imports into the United States, 1936–40, inclusive, and a record of bonded-warehouse inventories.

[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.

Zinc ores (zinc content) imported into the United States, 1936–40, in short tons[1]

	1936	1937	1938	1939	1940
Argentina				1,544	6,723
Canada		84		1,613	33,993
Mexico	172	338	7,253	23,221	93,789
Newfoundland and Labrador					23,640
Peru		8,373	11,330	9,722	17,285
Other countries		17			[2] 4,890
Total	172	8,812	18,583	36,100	180,320

[1] Data include ore imported for immediate consumption plus material entering the country under bond.
[2] Includes 2,530 tons imported from Bolivia, 1,749 tons from Australia, and 611 tons from Chile.

Zinc[1] *remaining in warehouse in the United States, December 31, 1936–40*

	Pounds		Pounds
1936	10,690,832	1939	20,295,817
1937	24,904,405	1940	184,442,754
1938	51,058,373		

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

Imports of zinc ore and concentrates in 1940 advanced 400 percent over 1939 owing to sharply increased shipments, chiefly from Canada, Mexico, and Newfoundland, whose ores formerly were treated in Europe. Shipments from Mexico represented approximately 52 percent of the total and were 304 percent greater than in 1939. Imports from Canada comprised 19 percent of the total and those from Newfoundland 13 percent. Most of the remainder came from Peru and Argentina; smaller amounts were imported from Bolivia, Australia, and Chile.

Imports of slab zinc for consumption decreased from 30,960 short tons in 1939 to 10,146 in 1940. The 1940 tonnage (1939 figures in parentheses) included 6,877 tons (6,402) from Canada, 2,647 tons (16,506) from Mexico, and 336 tons (4,790) from Belgium. In comparison, the total imports of slab zinc (general imports) decreased from 30,898 tons in 1939 to 16,100 in 1940. In 1939 the total import figure very closely approximated the imports for consumption, whereas in 1940 the total was higher than the imports for consumption by about 600 tons. This increased amount of zinc remaining in warehouse was principally from Mexico. The 1940 tonnage (1939 figures in parentheses) included 8,600 tons (16,600) from Mexico, 6,900 tons (6,900) from Canada, and 330 tons (4,700) from Belgium.

Zinc imported for consumption in the United States, 1936–40

Year	Blocks, pigs, or slabs		Sheets		Old, dross, and skimmings[1]		Zinc dust		Value of manufactures	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value		
1936	11,660	$770,496	242	$23,077	16	$769	57	$3,647	$540	$798,529
1937	37,208	3,852,884	231	30,398	678	70,460	69	6,169	828	3,960,739
1938	7,230	480,169	226	25,989	96	8,944	64	5,074	463	520,639
1939	30,960	1,890,236	178	21,166	203	14,067	41	3,388	1,545	1,930,402
1940	10,146	801,331	18	2,796	520	36,689			32	840,848

[1] Includes dross and skimmings: 15 tons valued at $721 in 1936; 560 tons valued at $59,635 in 1937; 30 tons valued at $1,918 in 1939; and 356 tons valued at $21,815 in 1940. None reported in 1938.

Exports.—The total value of the 1940 exports of zinc ore and manufactured articles containing zinc of foreign and domestic origin (excluding galvanized products, alloys, and pigments) was $11,302,228, more than five times the 1939 figure of $2,075,000. Nearly all the increase was in slabs, plates, and blocks. In addition to the items shown in the accompanying tables, considerable zinc is exported each year in brass, pigments, chemicals, and galvanized iron and steel. The American Bureau of Metal Statistics estimates that 22,900 tons of zinc were exported in galvanized products in 1940. Export data on zinc pigments and chemicals are given in the chapter in this volume on Lead and Zinc Pigments and Zinc Salts. Much of the zinc used in the manufacture of these products is of foreign origin, and when it is exported a draw-back of 99 percent of the import duty is paid. In 1940 draw-back was paid on 19,306 tons of zinc, of which 7,206 tons had been imported as slabs and 12,100 tons as ore. The totals for previous years were: 1939, 16,213 tons; 1938, 11,550 tons; 1937, 9,253 tons; 1936, 8,909 tons; and 1935, 7,297 tons.

Zinc ore and manufactures of zinc exported from the United States, 1936–40

Year	Zinc ore, concentrates, and dross (zinc content)		Slabs, plates, or blocks		Sheets, strips or other forms, n. e. s.		Zinc dust	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1936	245	$5,902	37	$4,962	4,483	$723,142	1,793	$273,813
1937	314	10,145	249	25,706	5,813	1,103,533	2,145	418,376
1938	135	6,404	(1)	(1)	[1] 5,736	[1] 908,381	2,253	355,856
1939	303	11,253	4,515	479,338	[2] 6,708	[2] 1,116,485	2,834	468,516
1940	448	42,207	79,091	9,103,030	[2] 7,490	[2] 1,564,720	3,044	592,271

[1] Pigs and slabs not shown separately; included with sheets, strips, or other forms, n. e. s.
[2] Includes 259 tons valued $64,434 of "Other forms, n. e. s. (including scrap)" not separately classified before 1939; and 435 tons valued at $143,652 in 1940.

Slab and sheet zinc exported from the United States, 1937–40, by destinations, in short tons

Destination	Slabs, plates, and blocks				Sheets, strips, or other forms, n. e. s.			
	1937	1938	1939	1940	1937	1938	1939	1940
Country:								
Argentina		(1)	56	890	344	471	404	579
Australia		(1)			977	841	1,052	246
Brazil	2	(1)	526	1,391	(2)	9	50	96
Canada	1	(1)	5	(2)	2,251	2,317	2,902	2,813
Chile	65	(1)	298	428	1	9	20	130
China	6	(1)	201	4,115	331	11	148	40
India, British		(1)		9,634	[3] 90	[3] 110	[3] 122	[3] 1,422
Japan		(1)	3,252	13,958	194	232	5	259
United Kingdom	23	(1)		36,718	849	775	841	585
Other countries	152	(1)	177	11,957	776	961	1,164	1,320
Total	249	(1)	4,515	79,091	5,813	5,736	6,708	7,490
Continent:								
North America	10	(1)	31	258	2,413	2,527	3,167	3,127
South America	72	(1)	996	2,760	409	643	555	997
Europe	148	(1)		45,982	922	914	952	783
Asia	19	(1)	3,488	29,431	1,010	673	741	1,657
Africa		(1)		640	82	107	159	653
Oceania		(1)		20	977	872	1,134	273

[1] Slabs, blocks, or pigs not shown separately; included with sheets, strips, or other forms, n. e. s.
[2] Less than 1 ton.
[3] Includes 514 tons to Burma in 1940; not separately classified in 1937; none reported in 1938 and 1939.

WORLD ASPECTS OF ZINC INDUSTRY

Choatic conditions in Europe during 1940 left no room for international cooperation in economic matters, and consequently the world zinc industry was seriously jolted from its normal balance. As a result of the progressive subjugation of Norway, Netherlands, Belgium, and France, the Axis Powers gained control of zinc-reduction capacity which, added to their own, amounted to three-fourths of the world total. However, they did not gain control of the corresponding sources of ore supply; therefore increasing amounts of ore and concentrates originating in countries affected by the British sea blockade were diverted to the United States and the United Kingdom.

World smelter production.—The dislocation of the zinc industry throughout Europe, plus the war's affect upon communication of news concerning foreign operations, have made it impossible to give a figure for world smelter production. The Axis-dominated zinc-producing plants in countries that depend on imported concentrates have undoubtedly been forced to reduce output, but the degree of increase or decrease in total production for all of the Axis-controlled countries is unknown. The total output of this group in 1939 was estimated at approximately 760,000 short tons. Production in U. S. S. R., Japan, and Indochina during 1940 likewise is unknown. Exclusive of the United States, where the yield of slab zinc during the year increased 33 percent to an all-time high, the output of those countries on which reliable data are available (including Mexico and Canada and other countries of the British Empire) increased approximately 7 percent above 1939.

World smelter production of zinc, 1936–40, by countries where smelted, in metric tons [1]

[Compiled by L. P. Lounsbery]

Country	1936	1937	1938	1939	1940
Australia	71,641	70,869	70,941	72,363	(2)
Belgium [3]	201,686	225,580	210,400	185,700	(2)
Canada	137,078	143,826	156,008	159,338	(2)
Czechoslovakia	7,670	7,336	8,876	(4)	(2)
France	51,694	60,427	60,560	60,262	(2)
Germany [5]	133,427	163,814	194,370	[6] 212,285	(2)
Indochina	4,112	4,204	4,470	5,439	(2)
Italy	27,025	37,982	33,637	33,566	(2)
Japan	39,066	45,500	(7)	(7)	(2)
Mexico	31,913	36,587	35,881	38,167	(2)
Netherlands	15,428	24,645	25,300	20,534	(2)
Northern Rhodesia	21,063	14,256	10,379	12,899	(2)
Norway	45,028	41,276	46,523	45,000	(2)
Poland	92,580	107,174	108,071	117,936	(2)
Spain	7,803	5,279	7,652	11,340	(2)
U. S. S. R.	[8] 65,000	[8] 65,000	(7)	(7)	(2)
United Kingdom [5]	61,768	63,138	56,190	50,440	(2)
United States	446,452	505,212	404,912	460,154	630,740
Yugoslavia	3,599	4,259	3,956	4,182	6,025
	1,464,000	1,626,000	1,568,000	1,635,000	(2)

[1] Statistical data derived in part from American Bureau of Metal Statistics, Year Book.
[2] Data not available.
[3] Includes the following tonnages of electrolytic zinc: 1936, 6,366 tons; 1937, 7,830 tons; and 1938, 8,670 tons. Data not available for 1939 and 1940. Production of electrolytic zinc begun in August 1935.
[4] Included with Germany.
[5] Some secondary metal included.
[6] Includes Czechoslovakia.
[7] Estimate included in total.
[8] Approximate production.

World consumption.—World consumption of slab zinc in 1940, as in 1939, cannot be estimated, as all of the belligerent countries continued the ban on publication of essential data that has been in effect since the outbreak of the war. Undoubtedly there has been a substantial increase above the last available figure of 1,489,800 metric tons reported for 1938 by the American Bureau of Metal Statistics. This assumption is indicated in view of the drastic change in the war from a state of inactivity during 1939 to one of total conflict during 1940, accompanied by sharply increased industrial activity, particularly in Great Britain and in the United States, where the zinc industry set new records in meeting national defense requirements. Zinc consumption in the United States, as measured by supplies of primary metal available for use, reached new peaks in 1940, and the tonnage was 11 percent above 1939. Larger consumption was indicated for Canada, but data for other foreign countries are not complete enough for comparison.

REVIEW BY COUNTRIES

By way of preface to this brief world review of the zinc industry, it is pertinent to emphasize the comparative lack of specific information for 1940. Censorship restrictions imposed by belligerent countries and the general effect of the war on communications have made it difficult to obtain published statistical data from Newfoundland, Canada, and countries outside of the Western Hemisphere.

Argentina.—Argentina produced about 50,000 metric tons of 53-percent zinc concentrates in 1940, principally from the Aguilar mine, Province of Jujuy, controlled by the St. Joseph Lead Co. Before 1940 the total output was shipped to Europe. During the year, 6,723 short tons were shipped to the United States, but a large percentage of the balance accumulated as stocks. A new 400-ton mill is being considered for construction at the Largo Fontana mines.

Australia.—Base-metal production statistics for 1940 are not available. The Sulfide Corporation ceased operations at its Broken Hill property, New South Wales, as the ore reserves have become exhausted, but at the North Broken Hill mine reserves were increased to over 5,000,000 tons as of June 30, 1939. The new 10,000-ton-per-week all-flotation mill of the Zinc Corporation, Ltd., is an outstanding metallurgical development in simplicity of operation and lay-out. Recoveries are: Lead, 96.4 percent; silver, 93.9 percent; and zinc, 87.5 percent.

On the New Broken Hill property, adjoining the Zinc Corporation on the south and managed by that company, diamond drilling continued to disclose ore of good grade and considerable width. Sinking of the new circular air shaft was progressing; mining operations will be served by the new Freeman shaft of the Zinc Corporation. The Mt. Isa lead-zinc mines, Queensland, operated throughout 1940.

Belgium.—During the first 4 months of 1940, the Belgian zinc smelters were operating, but at reduced capacity, because high freight rates—two to three times the f. o. b. value of the ore—and a shortage of ships caused a reduction in receipts of concentrates; neutral countries were reluctant to send ships to Europe. The lead and zinc works of Overpelt-Lommel were operating only at one-third capacity, and the Vieille Montagne zinc plants were also affected by the shortage of ore. On May 10, 1940, Germany invaded Belgium and soon assumed control of the zinc smelters. No further information has been obtained, other than an official German decree of July 9 that provided for a census of nonferrous metal industries, including zinc. Presumably at least a portion of the zinc-reducing capacity is being utilized to handle ores from sources under control of the Axis Powers.

Bolivia.—Bolivia produced about 24,400 short tons of zinc concentrates during 1940 (16,200 in 1939) containing approximately 10,500 tons of recoverable zinc; 2,530 tons were exported to the United States. There is no apparent reserve stock of ore in Bolivia, and the outlook for increased production is not favorable. The 1941 output is contracted for delivery to the United States.

Burma.—The Burma Corporation, Ltd., operating the Bawdwin mines, produced 59,500 long tons of concentrates in 1939—the total for the country. This is the last available figure, as the British Government officially requested the corporation to discontinue publication of production figures early in 1940. Since the outbreak of war, stocks have accumulated there as well as in Australia. The British Government has acquired a substantial share of these inventories and exercises rigid control over all shipments. At the end of the fiscal year (June 30, 1940), reserves of the Bawdwin mines were estimated to be 3,411,200 tons of ore assaying 15.7 ounces of silver, 20.4 percent lead, 12.6 percent zinc, and 0.9 percent copper per ton.

Canada.—War restrictions prevent the publication of base-metal production figures. It is known, however, that, among others, Hudson Bay Mining & Smelting (Flin Flon), Consolidated Mining & Smelting (Sullivan Mines), Waite Amulet, and Normetal increased operations during 1940 and that several zinc-producing mines that were inactive at the outbreak of the war are now in full production. Of the total output in 1940, three-fourths was produced from the Sullivan mines at Kimberley, B. C., the remainder coming from Flin Flon (about 20 percent), Sherritt Gordon, and a number of smaller properties in British Columbia and northwest Quebec. Beginning in April 1940, the Waite Amulet mines produced zinc concentrates from the newly installed differential flotation plant. The Hudson Bay Mining & Smelting Co. increased its daily output by 400 short tons and is enlarging the flotation mill and zinc-leaching plant to provide another 700-ton increase. In Nova Scotia the Stirling mine, controlled by the British Metal Corporation, was back in production after a shut-down of several years. Canadian zinc-ore exports went largely to the United States during 1940 (33,993 short tons) rather than to Belgium, as in past years. The United Kingdom was the chief market for slab-zinc exports. The Metals Controller of the Department of Munitions and Supply announced on November 25, 1940, that no further exports of zinc dross, remelted zinc in slabs, or high-grade zinc scrap would be permitted; export licenses are prohibited.

France.—The industrial areas of France fell into German hands in midyear 1940, and no information concerning the French zinc industry is available.

Germany.—Since the capture of the Polish zinc mines and smelters early in the fall of 1939, Germany continued to gain control of the European zinc industry through subjugation during 1940 of the Netherlands, Belgium, and France and in May 1941 of Yugoslavia. Based upon 1938 statistics, at the end of 1940 Germany controlled over 70 percent of Europe's zinc productive capacity. This majority control, plus expanded ore production from zinc mines within Germany and the subjugated countries, should make Germany self-sufficient in zinc without reliance upon imported ore. Zinc is the premier domestic substitute, and although its use is carefully controlled, has been promoted for all purposes where other more abundant material could not suitably be employed. Many new zinc alloys have been placed on the market; the use of zinc in coins has been contemplated. Zinc output has been increased in Germany by extensive use of flotation at existing mines in the Rammelsburg district in the lower Harz Mountains, the Rhein-Lahn district, and the Ramsbeck Basin. In the Meggen district the supply of zinc has been expanded through the processing of pyrite ore containing 7 to 8 percent zinc. There are no available 1940 statistics to show production, imports, or exports.

Italy.—Rolling mills for the production of zinc and its alloys were completed in May 1940 by the Montecatini group at Porto Marghera; it was reported that operations would begin soon. The existing electrolytic plant is to be enlarged. "Zama" alloys (zinc and aluminum) have been produced regularly and in most instances form a substitute for copper and bronze.

Japan.—It is reported that Japanese production increased somewhat during 1940 through the installation of three small plants having a capacity of 20,000 to 25,000 short tons of zinc a year, principally high grade.

Mexico.—Mine production of zinc in Mexico totaled 109,000 metric tons compared with 134,000 in 1939; the decline resulted from the loss of European markets for concentrates. Although the figure for smelter output was not available for 1940, production was indicated as being lower than the 1939 total of 38,000 tons, principally because of the 4-month strike at the Rosita smelter of the American Smelting & Refining Co., which was settled in February 1941; the smelter has a capacity of 3,500 tons of zinc a month. During 1939 and early 1940, because of the blockades resulting from the European War, substantial quantities of zinc ore and concentrates formerly refined in Europe were temporarily stored by the larger companies. For the remainder of 1940, increasing amounts of concentrates were exported to the United States; for the entire year, this aggregated an amount equivalent to approximately 42,500 tons of recoverable zinc.

Netherlands.—The zinc smelters in the Netherlands fell into German hands in May 1940, and no information concerning the zinc industry in this country has since been available.

Newfoundland.—Zinc concentrates produced in Newfoundland by the Buchans Mining Co., Ltd., totaled 116,400 short tons in 1940 (105,600 in 1939). Exports increased from 61,000 tons to 122,800, indicating a decrease in producers' stocks during 1940. Most of the exports went to the United Kingdom. A considerable tonnage has been contracted for in advance for reduction in the United States during 1941 at the East St. Louis (Ill.) electrolytic plant.

Peru.—Production of zinc concentrates in Peru during 1940 totaled 31,588 metric tons, with an extractable zinc content of 17,000 tons (19,000 in 1939), largely produced by the Cerro de Pasco Copper Corporation. When the new lead-zinc concentrator under construction by this corporation is ready for operation in 1941, the output of Peruvian concentrates will be greatly increased; there are reported to be 10,000,000 tons of 17-percent ore that can be treated in the new plant. The Cerro de Pasco Corporation constructed a pilot electrolytic zinc plant in the latter part of 1940. Almost all of the Peruvian concentrates, normally shipped to Europe, were exported to the United States during 1940.

United Kingdom.—The Nonferrous Metal Control continued its fixed prices for zinc for all grades during 1940. In January the Control refused to grant export licenses for hard spelter, and in April an import-licensing system was introduced for zinc and lead alloys containing more than 50 percent by weight of the metal named. Continental complaints were heard during the early part of the year that British maximum official prices for zinc did not replace the former London Metal Exchange quotations as a satisfactory basis for international dealings. After the fall of France in July, the British position was assisted by the fact that the Metal Control no longer had to worry over supplying the former ally. Throughout the year zinc-supply conditions were rather tight, as there was a heavy demand in the brass, galvanizing, and die-casting factories, particularly during the latter half of the year, because of the greatly intensified armament drive. This condition was clearly indicated in November by the fact that use of alternative finishes to take the place of galvanizing was encouraged.

Yugoslavia.—During 1940, Trepca Mines, Ltd., continued its operations successfully and reported a net profit of £178,124 for the first 9 months of the year (£50,691 for 1939). Production was at the rate of about 600,000 tons of ore a year; 44,100 tons of zinc concentrates were produced from the Stantrg mine. Work preparatory to the construction of an electrolytic zinc plant by Topionica Cinka (a Trepca subsidiary) at Sabac has been suspended. From September 1939 until June 30, 1940, difficulties were experienced with the exportation of concentrates from Yugoslavia and the remittance of funds to that country. For the balance of 1940, a satisfactory arrangement was made whereby a portion of Trepca's production was sold by the Yugoslav Government for dinars, whereas the balance was sold by the company and proceeds were retained in London. Ore reserves in the Stantrg mine were resampled above the 435-meter level during 1940 and calculated to be 4,848,000 tons. Preparations were being made at the end of the year to produce ore from the company Kopaonik mine at the rate of 10,000 tons a month. The effect on the zinc industry of the German occupation of Yugoslavia early in 1941 has not yet been reported.

LEAD AND ZINC PIGMENTS AND ZINC SALTS

By H. M. MEYER and A. W. MITCHELL

SUMMARY OUTLINE

Features of the lead and zinc pigments industries in 1940 included the poor showing made by white lead, the continuation of record performance by leaded zinc oxide, and the lower price for lithopone against the trend for other pigments in the group. Little improvement could be noted for the pigments as a whole, despite the gains made by industries that are the principal consumers of these products—automobiles, rubber, storage batteries, and paint. The use of litharge in the manufacture of storage batteries actually declined, while sales of red lead for this purpose made only a small gain. The record-breaking use of black oxide or suboxide of lead, not included in pigment totals, by the storage-battery manufacturers explains the apparent discrepancy. The use of white lead in paints dropped 21 percent in 1940, and an increase for leaded zinc oxide was almost counteracted by a decline in sales of the lead-free class. Basic lead sulfate and lithopone sales for paint, however, rose 8 and 3 percent, respectively, in part offsetting the drop in white lead. Statistics covering sales of litharge and white lead to the ceramic industry indicated sharp gains for that purpose in 1940.

Zinc pigments made a better record than lead pigments in 1940, both in relation to 1939 and to the prosperous period in the late twenties. The total weight of zinc pigments gained 3 percent over 1939 and was only 13 percent below the 1925–29 average; that for lead pigments fell 6 percent below 1939 and was 26 percent below the 1925–29 average. The total value of lead pigments in 1940 was 8 percent lower than in 1939, and the total for zinc pigments was relatively unchanged from that year.

The expectation of record-breaking plant construction for the production of armament requirements, of increased building for housing a growing army, and of plant construction subsidiary to the above indicates possibilities for considerable expansion in the use of pigments both for paints and for other purposes.

A larger share of the market for white pigments in 1940 was again met by titanium pigments, a group which again reported record-breaking activity in that year.

Average price quotations and average values received by the producers showed little change on the whole, but for the most part were somewhat higher. Quotations for lithopone throughout the year were lower than in 1939, following a drop in January 1940. In December 1940, however, it was announced that increased prices for lithopone, zinc sulfide, and titanium pigments would become effective on January 2, 1941.

Early in January 1941 representatives of the National Paint, Varnish and Lacquer Association and the United States Bureau of Standards presented recommendations for types of paint to be used on Army cantonments, and for tinting such paints, to the Construction Division of the Quartermaster Corps, United States Army. These recommendations covered the use of lead-zinc-titanium paint, both white and tinted, with cream and gray the suggested colors. The suggestions were accepted and are now in use.

Paint specifications of the United States Government bureaus are stated in a circular (No. 618) issued by the scientific section of the National Paint, Varnish and Lacquer Association.

Substitution for lead in pigments in Germany is indicated by the development of an aluminum-silicon alloy, said to contain 87 percent aluminum and 13 percent silicon.[1]

Salient statistics of the lead and zinc pigments industry of the United States, 1925–29 (average) and 1936–40

	1925–29 (average)	1936	1937	1938	1939	1940
Production (sales) of principal pigments:						
White lead (dry and in oil) short tons	154,483	118,407	98,213	100,213	98,429	80,562
Litharge do	84,845	86,246	83,902	68,711	89,518	89,841
Red lead do	41,362	34,896	33,931	30,183	39,976	42,200
Zinc oxide do	154,208	126,800	114,652	79,129	114,552	113,213
Leaded zinc oxide do	26,609	40,512	40,343	38,216	42,684	45,362
Lithopone do	177,745	158,319	154,771	125,746	142,759	151,802
Value of products:						
All lead pigments	$60,092,000	$34,206,000	$35,676,000	$28,351,000	$35,485,000	$32,628,000
All zinc pigments	41,314,000	27,862,000	28,038,000	23,301,000	28,794,000	28,747,000
Total	101,406,000	62,068,000	63,714,000	51,652,000	64,279,000	61,375,000
Value per ton received by producers:						
White lead (dry)	178	126	140	123	138	137
Litharge	176	116	143	122	123	126
Red lead	193	133	160	137	140	141
Zinc oxide	133	90	103	117	117	118
Leaded zinc oxide	124	87	104	107	114	114
Lithopone	98	82	78	79	73	67
Foreign trade:						
Lead pigments:						
Value of exports	1,346,000	546,000	586,000	510,000	715,000	594,000
Value of imports	30,000	12,000	17,000	10,000	10,000	13,000
Zinc pigments:						
Value of exports	2,150,000	420,000	610,000	339,000	925,000	1,585,000
Value of imports	931,000	375,000	414,000	285,000	280,000	46,000
Export balance	2,535,000	579,000	765,000	554,000	1,350,000	2,120,000

[1] The Paint Industry Magazine, Lead-pigment Substitute: Vol. 56, No. 5, May 1941, pp. 170–171.

PRODUCTION

In this chapter stress is placed on sales rather than production because they are a better measure of activity in the industry. Data on stocks are not available at the beginning and the end of the year; and the lack of such information makes statistics on output, taken alone, of questionable value. Moreover, there have been instances where materials reported as one commodity for production have been sold later under another classification. Therefore, sales figures are a more accurate guide to the pigments actually going into consumption. Even sales figures have to be handled carefully to avoid duplication, because some pigments that are reported to be sales of finished products at one plant actually are used by other plants as an intermediate product in the manufacture of another pigment covered by the lead and zinc pigments canvass. Basic lead sulfate used in the manufacture of leaded zinc oxide is the principal offender in this connection, but it does not represent the only problem. Production figures are used in this report only in calculating the metal content of pigments and salts in the section of this report on Raw Materials Used in Manufacture of Lead and Zinc Pigments and Zinc Salts. Pigments used by producers in manufacturing products at their own plants are included under sales throughout this report.

The total value of sales of lead and zinc pigments showed a 5-percent drop from $64,279,000 in 1939 to $61,375,000 in 1940. The decrease was due principally to lower sales of white lead (dry and in oil), although the lower average value for sales of lithopone was a contributory factor. Increased total values for several pigments, including red lead, litharge, and leaded zinc oxide, in part counteracted the lower values for white lead and lithopone.

Lead pigments.—The failure of lead pigments to make a good showing in 1940 was due entirely to lower sales of white lead (dry and in oil); in fact, the white lead in oil grade fell 26 percent. Of the other pigments, sales of litharge were virtually the same as in 1939; those of red lead, basic lead sulfate, and orange mineral showed increases ranging up to 12 percent. Average price quotations trended upward slightly, and values received by producers on the whole confirmed the rise, the gain in average values for the most part approximating $1 a ton. Sales of red lead were slightly above the average for 1925–29 and were the largest on record since 1929. Sales of litharge in 1940 were also above the 1925–29 average.

Lead pigments sold by domestic manufacturers in the United States, 1939–40

Pigment	1939			1940		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Basic lead sulfate or sublimed lead:						
White	4,688	$585,616	$125	5,493	$692,769	$126
Blue	850	111,272	131	707	92,076	130
Red lead	39,976	5,615,838	140	42,200	5,970,156	141
Orange mineral	131	28,010	214	137	30,441	222
Litharge	89,518	11,050,843	123	89,841	11,305,954	126
White lead:						
Dry	30,509	4,196,462	138	30,115	4,114,785	137
In oil [1]	67,920	13,896,464	205	50,447	10,421.585	207

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

Lead pigments sold by domestic manufacturers in the United States, 1936–40, in short tons

Year	White lead		Basic lead sulfate or sublimed lead		Red lead	Orange mineral	Litharge
	Dry	In Oil	White	Blue			
1936	34,775	83,632	7,531	891	34,896	248	86,246
1937	32,661	65,552	7,514	1,108	33,931	206	83,902
1938	29,813	70,400	5,030	771	30,183	127	68,711
1939	30,509	67,920	4,688	850	39,976	131	89,518
1940	30,115	50,447	5,493	707	42,200	137	89,841

Zinc pigments and salts.—Sales of leaded zinc oxide in 1940 continued the uptrend of recent years, and a new record was established—the third since 1935. Sales of zinc oxide in 1940 were 1 percent below 1939 and those of lithopone were 6 percent higher, so that total zinc pigments were higher in 1940 than in the previous year, the increase in total tonnage being 3 percent. Despite the higher tonnage the total value for this group was slightly lower than in 1939, owing to the drop in the average price for lithopone. Sales and average values for lithopone have been running in opposite directions in recent years. The former gained 14 and 6 percent, respectively, in 1939 and 1940, while the latter declined 8 percent in each year. Price quotations for the various grades of zinc oxide (lead-free and leaded) were higher than in 1939. Values reported for leaded zinc oxide by producers were unchanged for 1939 and 1940, while those for lead-free zinc oxide rose $1 a ton.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1939–40

Pigment or salt	1939			1940		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Zinc oxide [1]	114,552	$13,446,443	$117	113,213	$13,361,980	$118
Leaded zinc oxide [1]	42,684	4,886,471	114	45,362	5,187,522	114
Lithopone	142,759	10,461,102	73	151,802	10,197,897	67
Zinc chloride, 50° B	(2)	(2)	(2)	(2)	(2)	(2)
Zinc sulfate	10,157	582,831	57	11,937	695,496	58

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

Zinc pigments and salts sold by domestic manufacturers in the United States, 1936–40, in short tons

Year	Zinc oxide	Leaded zinc oxide	Lithopone	Zinc chloride (50° B.)	Zinc sulfate
1936	126,800	40,512	158,319	(1)	9,721
1937	114,652	40,343	154,771	(1)	10,521
1938	79,129	38,216	125,746	(1)	7,757
1939	114,552	42,684	142,759	(1)	10,157
1940	113,213	45,362	151,802	(1)	11,937

[1] Data not available.

Complete data covering the production of zinc chloride in recent years are not available owing to the absence of a reliable report for one producer, believed to be large.

Sales of zinc sulfate in 1940 established a new high record rate—13 percent above the previous record for 1937.

CONSUMPTION BY INDUSTRIES

White lead.—This product failed to keep pace with other pigments in 1940, as its sales declined 18 percent from 1939, while others were relatively unchanged or higher. Normally 95 percent of the white lead consumed is used in the manufacture of paints. Only 91 percent of the 1940 total was reported to be so used, and the use in ceramics rose to nearly 4 percent.

Late in the year it was announced that new Government specifications for dry and paste basic carbonate white lead (TT-W-251A) would become effective November 15.

Distribution of white lead (dry and in oil) sales, 1936–40, by industries, in short tons

Industry	1936	1937	1938	1939	1940
Paint	113,363	93,580	95,018	92,380	73,137
Ceramics	2,653	2,506	1,918	1,767	3,029
Other	2,391	2,127	3,277	4,282	4,396
	118,407	98,213	100,213	98,429	80,562

Basic lead sulfate.—The outstanding use of basic lead sulfate is also in the manufacture of paint. In recent years the quantities of this pigment used in the manufacture of leaded zinc oxide have risen rapidly, reaching a peak of 7,700 tons in 1939; in 1940 it amounted to 6,500 tons. These quantities are included in the totals for leaded zinc oxide and not in those for basic lead sulfate.

In May a new Federal specification (TT-P-20) for ready-mixed linseed oil paint with a blue lead (basic lead sulfate) base was announced, to become effective August 15.

Distribution of basic lead sulfate sales, 1936–40, by industries, in short tons

Industry	1936	1937	1938	1939	1940
Paints	8,124	8,255	5,024	5,170	5,593
Rubber	126	213	91	140	128
Storage batteries	28	6	3	4	4
Other	144	148	683	224	475
	8,422	8,622	5,801	5,538	6,200

Red lead.—This pigment had a good year in 1940; sales totaled 42,200 tons and were the largest since 1929—2 percent above the 1925–29 average. Red lead is one of the most effective protective paints for iron and steel. Consequently plans for plant expansion to meet increased armament needs promise large demands for this product. Actually storage batteries consume the principal part of the sales of red lead, taking 63 percent in 1940 while paints took 28 percent.

Distribution of red lead sales, 1936–40, by industries, in short tons

Industry	1936	1937	1938	1939	1940
Storage batteries	20,323	20,275	19,057	24,709	26,718
Paints	11,786	10,440	8,698	11,421	11,949
Ceramics	807	854	655	1,123	1,117
Other	1,980	2,362	1,773	2,723	2,416
	34,896	33,931	30,183	39,976	42,200

Orange mineral.—There appears to be no definite pattern in the sales of orange mineral; ink manufacture and color pigments usually vie for first place with widely varying quantities.

Distribution of orange mineral sales, 1936–40, by industries, in short tons

Industry	1936	1937	1938	1939	1940
Ink manufacture	71	76	20	64	51
Color pigments	77	51	94	40	18
Other	100	79	13	27	68
	248	206	127	131	137

Litharge.—Sales of litharge in 1940 were virtually unchanged from 1939, continuing the comparatively favorable showing for that year. These quantities were 30 to 31 percent above 1938 and 6 percent higher than the average annual rate in 1925–29. There were, however, some rather marked changes in sales to various industries between 1939 and 1940. In 1940 relatively small declines in sales for storage batteries (the principal use) and in insecticides and greater decreases in chrome pigments and oil refining were almost entirely offset by a sharp gain in use of litharge for ceramics. The larger requirements for ceramics coincide with gains in the use of white lead for that purpose. Sales of litharge for varnish and rubber manufacture also gained in 1940. Black oxide or suboxide of lead used by storage-battery manufacturers continued the uptrend of recent years, except for a set-back in 1938, and established another new record in 1940. In that year 53,000 tons were so used compared with the previous peak of 45,000 tons in 1939. Sales of black oxide are not included in Bureau of Mines totals for litharge.

Distribution of litharge sales, 1936–40, by industries, in short tons

Industry	1936	1937	1938	1939	1940
Storage batteries	38,700	32,228	32,514	39,754	38,303
Insecticides	14,662	18,242	11,736	16,435	16,041
Ceramics	7,762	7,577	5,889	8,679	12,072
Chrome pigments	6,662	7,330	[1] 5,590	[1] 9,415	8,456
Oil refining	7,259	8,311	6,411	7,619	6,876
Varnish	4,247	3,366	2,449	2,428	3,003
Rubber	2,147	1,659	880	1,404	1,590
Linoleum	254	264	231	226	418
Other	4,553	4,925	[1] 3,011	[1] 3,558	3,082
	86,246	83,902	68,711	89,518	89,841

[1] Revised figures.

Zinc oxide.—Sales of zinc oxide in 1940 differed little from those for 1939, as they declined 1 percent. The insignificant decrease in 1940 was not reflected in sales for rubber manufacture, which gained slightly. This use represented 63 percent of all zinc oxide sold by producers in 1940. Less zinc oxide was purchased for use in paints in 1940, and a small drop was also noted in the quantity required by the ceramics industry, although the amount taken for ceramics compared very favorably with the rate for recent years. The use of zinc oxide in the manufacture of floor coverings and textiles has showed a declining tendency in recent years in relation to total sales of zinc oxide. In 1935 it represented 7 percent and in 1937, 8 percent of the total; but in 1938, 1939, and 1940 it was 4, 5, and 4 percent, respectively. Of the zinc oxide produced in 1940, 64 percent was made by the American process and 36 percent by the French process compared with 59 and 41 percent, respectively, in 1939 and 62 and 38 percent in 1938. The higher proportion of American-process zinc oxide produced in 1940 may have been due to the increasingly tight situation that developed in regard to slab zinc supplies as the year progressed. The proportion of French-process oxide made from scrap zinc (which had been increasing for a number of years and amounted to 49 percent in 1939, 32 percent in 1938, and 25 percent in 1937) reacted to 45 percent in 1940. A large quantity of zinc oxide used in the manufacture of leaded zinc oxide is included under leaded zinc oxide and is excluded from zinc oxide totals.

Additional information supplied to the Bureau of Mines recently makes it possible to publish the distribution of sales of zinc oxide (lead-free and leaded) by uses for 1929 and 1930.

Distribution of zinc oxide sales, 1929–30 and 1936–40, by industries, in short tons

Industry	1929	1930	1936	1937	1938	1939	1940
Rubber	80,892	58,073	72,885	67,061	46,266	70,187	70,979
Paints	54,440	40,986	33,149	27,987	20,884	25,334	23,268
Ceramics	5,109	3,691	6,102	5,216	4,908	6,572	6,352
Floor coverings and textiles	4,068	4,469	7,178	9,019	3,030	5,641	4,752
Other	16,102	11,923	7,486	5,369	4,041	6,818	7,862
	160,611	119,142	126,800	114,652	79,129	114,552	113,213

Leaded zinc oxide.—Sales of leaded zinc oxide again established a new high record rate in 1940—6 percent above the previous record for 1939 and 70 percent over the 1925–29 average. Paint manufacturers take the preponderant part of sales of this pigment—usually more than 97 percent. The total for leaded zinc oxide in 1940 includes 6,500 tons of basic lead sulfate used to increase the lead content of this product; this tonnage is excluded from basic lead sulfate totals to avoid duplication in reporting data on metals.

Additional information recently received makes possible the publication of sales of leaded zinc oxide by uses for 1929 and 1930.

Distribution of leaded zinc oxide sales, 1929–30 and 1936–40, by industries, in short tons

Industry	1929	1930	1936	1937	1938	1939	1940
Paints	26,981	16,717	40,156	39,584	37,348	41,519	44,341
Rubber		77	32	97		1	
Other	168	485	324	662	868	1,164	1,021
	27,149	17,279	40,512	40,343	38,216	42,684	45,362

Lithopone.—Lithopone statistics are reported upon the basis of the regular lithopone content of high-strength lithopone plus normal lithopone sold as such. Before 1936 the figures were upon the basis of standard-strength plus high-strength product. Paints, varnish, and lacquers requisition the principal part of the total lithopone sold, and sales to these users increased 3 percent in 1940. For several years this use had taken about 80 percent of the total, but only 77 percent in 1940. Floor coverings and textiles have used 12 to 13 percent of the total in recent years and rubber 2 to 3 percent. Upon the basis of somewhat incomplete information, separation of the quantities shown in the following table for floor coverings and textiles indicates that 14,900 tons were used for linoleum and felt-base floor coverings and the remainder for coated fabrics and textiles (oilcloth, shade cloth, artificial leather, and similar products). Other uses in 1940 included 4,678 tons for paper and 851 tons for printing ink. An additional quantity for printing ink cannot be separated from the total for paints.

The Chemical Age (London) of September 7, 1940, stated that a lithopone plant was to be installed at Port Pirie, South Australia, by the Electrolytic Zinc Co. of Australasia, Ltd. All lithopone used in Australia, reported as about 3,000 tons a year, has previously been imported.

Distribution of lithopone sales, 1936–40, by industries, in short tons

Industry	1936	1937	1938	1939	1940
Paints, etc	122,461	122,915	101,924	113,995	117,075
Floor coverings and textiles	23,085	20,194	15,400	17,429	18,738
Rubber	4,908	4,383	3,148	3,189	3,387
Other	7,865	7,279	5,274	8,146	12,602
	158,319	154,771	125,746	142,759	151,802

The use of ordinary-strength lithopone in the manufacture of titanated lithopone (which usually contains 15 percent TiO_2) has increased rapidly since the output of this product was begun. It declined, however, in 1938, fell sharply in 1939, and in 1940 recovered only part of the ground lost. The lithopone figures in the following table are included in Bureau of Mines totals for ordinary lithopone.

Titanated lithopone produced in the United States and ordinary lithopone used in its manufacture, 1936–40, in short tons

Year	Titanated lithopone produced	Ordinary lithopone used	Year	Titanated lithopone produced	Ordinary lithopone used
1936	21,300	18,400	1939	16,100	13,700
1937	23,000	19,400	1940	18,100	15,200
1938	20,100	17,000			

Zinc sulfide.—Although zinc sulfide is produced by four plants in the United States, one producer dominates the industry; therefore, the Bureau of Mines is not at liberty to release data on this commodity.

Zinc chloride.—The Bureau of Mines cannot report zinc chloride production because one producer, whose output is believed to be large, has refused to supply reliable data. Returns from producers representing more than two-thirds of the total indicate the following distribution of sales by uses in 1940:

	Percent		Percent
Soldering flux	35	Vulcanized fiber	12
Wood preserving	18	Others	20
Dry-cell batteries	15		100

The first commercial output of zinc chloride in Canada was announced by Canadian Industries, Ltd., in 1940. The material was produced at Hamilton, Ontario, and the project did not involve construction of new buildings.

Zinc sulfate.—Sales of zinc sulfate rose from 1933 to 1937, declined in 1938, and continued the uptrend in 1939 that resulted in new high record sales in 1940. Sales of 11,937 tons in 1940 were 13 percent above the previous record of 10,521 tons in 1937. Of the 1940 sales, 3,649 tons were for rayon manufacture, 2,366 tons for agricultural purposes, 2,151 tons for chemical manufacture (including the medicinal trade), 1,509 tons for paints and varnish, 348 tons for electrogalvanizing, 320 tons for glue manufacture, and 161 tons for flotation reagents; 1,433 tons were undistributed.

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

Lead pigments and zinc pigments and salts are manufactured from a variety of materials, including ore, refined metal, and such miscellaneous secondary materials as scrap and waste from various industrial processes. In 1940, 92 percent of the lead pigments was derived from pig lead and 8 percent from ore. The proportions for zinc pigments in 1940 were 66 percent from ore, 13 percent from slab zinc, and 21 percent from secondary materials.

Metal content of lead and zinc pigments produced by domestic manufacturers, 1939–40, by sources, in short tons

Source	1939		1940	
	Lead in pigments [1]	Zinc in pigments	Lead in pigments [1]	Zinc in pigments
Domestic ore	15, 171	83, 829	16, 869	94, 491
Metal	200, 390	17, 169	196, 235	19, 421
Secondary material [2]		30, 138		29, 675
	215, 561	131, 136	213, 104	143, 587

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

The following tables give the source of the metal used in the manufacture of each pigment and salt. Pig lead is employed exclusively, either directly or indirectly, in the manufacture of white lead, litharge, red lead, and orange mineral and is used also in the manufacture of basic lead sulfate. The lead content of leaded zinc oxide made from basic lead sulfate, which in turn was made from pig lead, is credited to

Lead content of lead and zinc pigments produced by domestic manufacturers, 1939–40, by sources, in short tons

Pigment	1939				1940			
	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		78, 593		78, 593		69, 535		69, 535
Red lead		35, 977		35, 977		38, 905		38, 905
Litharge		83, 935		83, 935		85, 005		85, 005
Orange mineral		120		120		180		180
Basic lead sulfate	2, 868	979		3, 847	4, 705	1, 436		6, 141
Leaded zinc oxide	12, 303	786		13, 089	12, 164	1, 174		13, 338
	15, 171	200, 390		215, 561	16, 869	196, 235		213, 104

Zinc content of zinc pigments and salts produced by domestic manufacturers, 1939–40, by sources, in short tons

Pigment or salt	1939				1940			
	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	49, 125	17, 117	16, 429	82, 671	59, 463	18, 696	15, 148	93, 307
Leaded zinc oxide	21, 050	5		21, 055	21, 178	680	662	22, 520
Lithopone	13, 654	47	13, 709	27, 410	13, 850	45	13, 865	27, 760
Zinc sulfide	(1)			(1)	(1)			(1)
Zinc chloride	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Zinc sulfate	1, 157		1, 674	2, 831	1, 426		1, 958	3, 384

[1] Data not available.

pig lead in the table. Zinc oxide is the only pigment in which considerable slab zinc is used. Ore is employed in the manufacture of zinc oxide, leaded zinc oxide, lithopone, zinc sulfate, and basic lead sulfate. A substantial proportion of the zinc in lithopone and zinc chloride made in the United States is derived from secondary material. There has been a decided increase in the quantity of secondary zinc consumed in the manufacture of zinc oxide since 1933.

PRICES

The total values reported by producers for lead and zinc pigments and zinc salts are given in the tables in the first part of this report. The average values for lead pigments showed little variation, being, for the most part, about $1 higher than in 1939. Market quotations for the year exhibited an upward tendency; the lower part of the price range coincided with that for 1939, but the upper part was ¼ to ½ cent a pound higher. During the year prices for litharge, red lead, and orange mineral followed in general the changes in quotations for pig lead; they sagged until the third quarter and snapped back in the final quarter to reach the highest points of the year. Prices of basic carbonate white lead and basic lead sulfate were unchanged from the beginning of the year until November, then rose ½ and ¼ cent, respectively. Producer values for zinc pigments and salts generally were also about $1 higher in 1940 than in 1939, except lithopone, for

Range of quotations on lead pigments and zinc pigments and salts at New York (or delivered in the East), 1937–40, in cents per pound

Product	1937	1938	1939	1940
Basic lead sulfate, or sublimed lead, less than carlots, barrels	6.50–8.75	5.50–6.50	6.25–6.50	6.25–6.75
White lead, or basic lead carbonate, dry, carlots, barrels	6.75–9.00	6.00–7.00	7.00	7.00–7.50
Litharge, commercial, powdered, barrels	6.25–10.00	5.50–7.50	6.25–7.75	6.25–8.25
Red lead, dry, 95 percent or less, less than carlots, barrels	7.75–11.00	7.00–8.50	7.75–9.00	7.75–9.25
Orange mineral, American, small lots, barrels:				
Ex-white lead Ex-red lead	10.25–13.50	9.50–11.00	10.25–11.25	10.25–11.75
Zinc oxide:				
American process, lead-free, bags, carlots	5.25–7.50	6.25–7.50	6.25–7.50	6.25–7.50
American process, 5 to 35 percent lead, barrels, carlots	5.38–6.88	5.90–6.38	6.25–6.38	6.25–6.75
French process, red seal, bags, carlots	5.75–7.50	7.50	7.50	7.50–7.75
French process, green seal, bags, carlots	6.25–8.00	8.00	8.00	8.00–8.25
French process, white seal, barrels, carlots	7.00–8.75	8.75	8.75	8.75–9.00
Lithopone, domestic, 5-ton lots, bags	4.25–4.63	4.38–4.63	4.00–4.38	3.85–4.00
Zinc sulfide, less than carlots, bags, barrels	9.25–9.50	8.63–9.50	7.75–8.88	7.75–8.00
Zinc chloride, works:				
Solution, tanks	2.00–2.25	2.25	2.25	2.25
Fused, drums	4.25–5.75	4.25–5.75	4.25–5.75	4.25–5.75
Zinc sulfate, crystals, barrels	2.80–4.05	2.65–4.05	2.90–3.65	2.90–3.90

which the average fell $6. Prices for zinc pigments are more independent of price movements for the metal than those for lead pigments, because zinc ores represent a high percentage of the zinc used in zinc pigments. Nevertheless, quotations for zinc pigments (except lithopone), as well as for slab zinc, were at their highest levels in the final quarter of 1940. Lithopone quotations were unchanged in 1940 following a drop in January of that year which coincided with a reduction in prices for titanium pigments. December trade journals however, promised increases in prices for lithopone, titanium pigments, and zinc sulfide, to become effective January 2, 1941.

FOREIGN TRADE[2]

The principal item of interest in connection with foreign trade in lead and zinc pigments was the acute rise in exports of lithopone in 1940. Largely because of this advance, the value of lead and zinc pigments and salts exported in 1940 gained 34 percent. Values of exports of other pigments and salts covered by the following table (except lead arsenate) decreased during the year. Imports of the items covered by the table declined sharply, and the total value for the group fell 80 percent. The principal value in the import group continued to be that for zinc oxide.

Value of foreign trade of the United States in lead and zinc pigments and salts, 1939–40

	1939		1940	
	Imports	Exports	Imports	Exports
Lead pigments:				
White lead	$2,108	$275,311	$249	$211,148
Red lead	300	186,396		185,049
Litharge		253,731	9	197,634
Orange mineral	143	(1)	140	(1)
Other lead pigments	7,430	(1)	12,959	(1)
	9,981	715,438	13,357	593,831
Zinc pigments:				
Zinc oxide	145,916	532,670	45,347	472,305
Lithopone	130,893	392,798		1,112,362
Zinc sulfide	2,728	(1)	693	(1)
	279,537	925,468	46,040	1,584,667
Lead and zinc salts:				
Lead arsenate	3,316	159,797		242,399
Other lead compounds	15,071	(1)		(1)
Zinc chloride	25,661	(1)	1,147	(1)
Zinc sulfate	12,521	(1)	7,736	(1)
	56,569	159,797	8,883	242,399
Grand total	346,087	1,800,703	68,280	2,420,897

[1] Data not available.

Lead pigments and salts.—Imports of these commodities are insignificant. The most important item under this classification has been that for lead compounds, which included lead acetate, nitrate, and others, but none was entered under this heading in 1940. Imports of suboxide of lead increased from 20 tons in 1939 to 31 tons in 1940.

Lead pigments and salts imported for consumption in the United States, 1936–40

Year	Short tons					Total value
	Basic carbonate white lead	Red lead	Litharge	Orange mineral	Lead compounds	
1936	32	2	1	5	185	[1] $37,878
1937	34	1	(2)	5	213	[1] 53,984
1938	20	1	1	2	85	[1] 22,644
1939	11	2		1	104	[1] 28,248
1940	2		(2)	1		[1] 13,357

[1] Includes also—1936: Lead pigments, n. s. p. f., $19 (33 pounds), sublimed lead (basic sulfate) $9 (15 pounds), and suboxide of lead, n. s. p. f., $5,264 (39,010 pounds); 1937: Lead pigments, n. s. p. f., $8 (100 pounds), sublimed lead (basic sulfate), $2 (10 pounds), and suboxide of lead, n. s. p. f., $9,396 (55,453 pounds); 1938: Lead pigments, n. s. p. f., $198 (2,330 pounds), and suboxide of lead, n. s. p. f., $5,335 (31,834 pounds); 1939: Lead pigments, n. s. p. f., $690 (5,270 pounds), and suboxide of lead, n. s. p. f., $6,620 (40,445 pounds); 1940: Suboxide of lead, n. s. p. f., $12,959 (62,412 pounds).
[2] Less than 1 ton.

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

The principal exports are usually white lead and litharge. These two pigments lost ground in 1940, while red lead remained stationary at the increased tonnage for 1939 and lead arsenate made important gains.

White lead exports went principally to Panama, the Philippine Islands and Canada; those to North American countries comprised 56 percent and to South American countries 21 percent of the total. Shipments of red lead and litharge to foreign countries were largely to Canada, Argentina, the Philippine Islands, and Netherlands Indies; North America received 37 percent and South America 28 percent.

White lead, red lead, and litharge exported from the United States, 1937–40, by destinations, in short tons

Destination	White lead				Red lead and litharge			
	1937	1938	1939	1940	1937	1938	1939	1940
Countries:								
Argentina	89	97	87	98	204	359	282	559
Brazil	28	72	166	99	44	47	48	55
Canada	126	220	256	127	703	542	688	568
Cuba	41	20	25	36	149	119	134	180
Curacao (N. W. I.)	5	5	5	8	287	400	144	81
Mexico	44	71	117	50	112	103	186	151
Netherlands	83	222	491	--------	--------	--------	103	--------
Netherlands Indies	--------	1	33	26	12	10	88	214
Panama	206	108	113	510	76	78	26	64
Philippine Islands	272	385	428	223	353	406	515	334
Union of South Africa	17	12	12	7	59	128	258	140
Others	325	198	291	176	387	308	929	576
	1,236	1,411	2,024	1,360	2,386	2,500	3,401	2,922
Continents:								
North America	479	448	541	762	1,379	1,275	1,216	1,086
South America	170	221	360	284	374	494	514	826
Europe	232	279	622	18	157	105	460	160
Asia	336	450	478	283	413	494	948	659
Africa	18	13	23	8	63	131	261	189
Oceania	1	(1)	(1)	5	(1)	1	2	2

1 Less than 1 ton.

Lead pigments and salts exported from the United States, 1936–40

Year	Short tons				Total value
	White lead	Red lead	Litharge	Lead arsenate	
1936	1,862	810	1,386	414	$609,890
1937	1,236	934	1,452	521	677,815
1938	1,411	806	1,694	511	605,075
1939	2,024	1,324	2,077	856	875,235
1940	1,360	1,336	1,586	1,450	836,230

Zinc pigments and salts.—Lithopone is normally the principal item in imports of zinc pigments and salts, but none of this pigment entered the country in 1940; in 1939 receipts amounted to 2,641 tons. All of the other products covered declined in 1940; zinc oxide and zinc chloride showed notable losses.

Zinc pigments and salts imported for consumption in the United States, 1936–40

Year	Short tons						Total value
	Zinc oxide		Lithopone	Zinc sulfide	Zinc chloride	Zinc sulfate	
	Dry	In oil					
1936	694	96	4,781	30	520	385	$425,493
1937	680	95	5,601	113	667	593	488,116
1938	579	66	3,932	12	272	392	321,445
1939	1,485	66	2,641	7	399	325	317,719
1940	273	45	----------	(1)	19	245	54,923

1 Less than 1 ton.

Exports of zinc oxide dropped 7 percent from the rate established in 1939 and amounted to 3 percent of the sales of lead-free zinc oxide by domestic producers. Shipments were principally to Canada, Netherlands Indies, Mexico, and Brazil. Lithopone shipments to foreign countries were the feature of foreign trade in pigments in 1940. They totaled 14,298 tons compared with 4,845 tons in 1939, which was, in turn, greatly above shipments of 1,734 tons in 1938. Exports in 1940 were 9 percent of total sales of domestic producers and went mainly to Canada, Australia, Argentina, Chile, and Brazil.

Zinc pigments and salts [1] exported from the United States, 1936–40

Year	Short tons		Total value	Year	Short tons		Total value
	Zinc oxide	Lithopone			Zinc oxide	Lithopone	
1936	1,330	2,538	$419,987	1939	3,485	4,845	$925,468
1937	2,953	2,671	609,954	1940	3,239	14,298	1,584,667
1938	1,163	1,734	339,415				

1 Zinc salts not separately recorded.

Zinc oxide and lithopone exported from the United States, 1937–40, by destinations, in short tons

Destination	Zinc oxide				Lithopone			
	1937	1938	1939	1940	1937	1938	1939	1940
Countries:								
Argentina	48	86	104	56	63	28	89	982
Australia	155	123	168	83	127	51	549	1,096
Brazil	32	6	285	305	(1)	--------	55	752
Canada	1,583	514	898	752	1,740	1,219	2,775	6,868
Chile	12	13	69	100	(1)	(1)	189	922
Cuba	207	48	84	206	258	115	244	209
Mexico	57	9	105	334	185	146	361	583
Netherlands Indies	(1)	(1)	370	380	(1)	--------	(1)	110
Philippine Islands	415	141	281	220	5	11	20	18
Union of South Africa	57	3	175	38	1	1	25	692
Venezuela	8	4	31	114	1	1	--------	6
Others	379	216	915	651	291	162	538	2,060
	2,953	1,163	3,485	3,239	2,671	1,734	4,845	14,298
Continents:								
North America	1,972	659	1,168	1,395	2,184	1,483	3,405	7,681
South America	149	117	514	657	90	41	359	3,083
Europe	148	85	593	61	217	132	153	336
Asia	467	159	844	941	24	13	287	949
Africa	57	3	175	79	1	1	25	826
Oceania	160	140	191	106	155	64	616	1,423

1 Less than 1 ton.

GOLD, SILVER, COPPER, AND LEAD IN ALASKA

(MINE REPORT)

By Chas. W. Henderson and S. A. Gustavson

SUMMARY OUTLINE

Gold recovered from Alaska ores and gravels in 1940 totaled 755,970 fine ounces valued at $26,458,950—an increase of 12 percent over the 676,737 ounces valued at $23,685,795 in 1939—owing to increased output from all types of placer mines. The value of the gold in 1940 was over 99 percent of the total gross value of the gold, silver, copper, and lead produced. The copper produced in 1940 was a byproduct of gold mining, and the output of recovered metal was only 110,000 pounds—less than one-half the 1939 production.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1936–40

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1936	$35.00	$0.7745	$0.092	$0.046	$0.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052
1940	35.00	[6] .711+	.113	.050	.063

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] 1936–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–40: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464.
[5] $0.67878787.
[6] 0.71111111.

The following tables show the mine production of gold, silver, copper, and lead in Alaska in 1936–40 and 1880–1940 in terms of recovered metals; the output of gold and silver in 1940, by types of operation; and the output of gold, silver, copper, and lead from amalgamation and cyanidation mills (with or without concentration equipment) in 1940, by regions.

Mine production of gold, silver, copper, and lead in Alaska, 1936–40, and total, 1880–1940, in terms of recovered metals

Year	Gold (lode and placer)		Silver (lode and placer)	
	Fine ounces	Value	Fine ounces	Value
1936	540,580	$18,920,300	484,306	$375,095
1937	627,940	21,977,900	494,340	382,372
1938	664,973	23,274,055	479,853	310,208
1939	676,737	23,685,795	201,054	136,473
1940	755,970	26,458,950	191,679	136,305
1880–1940	24,456,563	568,994,307	19,371,146	13,779,478

Year	Copper		Lead		Total value
	Pounds	Value	Pounds	Value	
1936	37,700,000	$3,468,400	1,882,000	$86,572	$22,850,367
1937	34,672,000	4,195,312	1,646,000	97,114	26,652,698
1938	29,098,000	2,851,604	1,988,000	91,448	26,527,315
1939	256,000	26,624	1,874,000	88,078	23,936,970
1940	110,000	12,430	1,558,000	77,900	26,685,585
1880–1940	[1] 685,736	226,531,990	[1] 23,479	2,579,553	811,885,328

[1] Short tons.

Mine production of gold and silver in Alaska in 1940, by types of operation, in terms of recovered metals

Type of operation	Mines producing	Material treated	Gold			Silver			Total value
			Fine ounces	Percent of total		Fine ounces	Percent of total		
				1940	1939		1940	1939	
Lode mines	73	[1] 4,885,023	214,097	28	31	116,931	61	87	$7,576,546
Floating connected-bucket dredges	[2] 49	[3] 23,393,453	354,806	47	45	47,700	25	8	12,452,130
Placers (dragline and dry-land dredges, hydraulic, drift mining, and sluicing)	[4] 1,020	([5])	187,067	25	24	27,048	14	5	6,566,579
	1,142		755,970	100		191,679	100		26,595,255
Total, 1939	1,187		676,737		100	201,054		100	23,822,268

[1] Short tons of ore.
[2] Number of dredges, including 2 single-dipper dredges. In addition, a floating dredge was operated primarily to produce platinum.
[3] Cubic yards of gravel (average recovered per yard, $0.53).
[4] Includes all types and sizes of placer operations excluding floating connected-bucket dredges.
[5] Cubic yards of gravel; figures not available.

Gold.—The value of the gold output of Alaska in 1940 was over 99 percent of the total gross value of the gold, silver, copper, and lead produced. The source of gold has been divided in this report into only three types of operations—placers using floating connected-bucket dredges; other placer operations, large and small; and lode mines. The output from dredges was by far the largest, followed in order by lode mines and by other placer mines. The increased output from floating connected-bucket dredges was due directly to the 18-percent increase in cubic yards of gravel washed in 1940 compared with 1939. The average tenor of the gravels washed in the Territory as a whole was about the same in 1940 as in 1939. The output of gold from lode mines was 4,931 ounces more than in 1939. The steady increase in use of mechanical equipment—such as draglines, slackline scrapers, bulldozers, portable washing plants, pumps, and hydraulic machinery—caused the output from placer mines, other than those with bucket dredges, to increase 24,491 ounces over 1939. The wider use of mechanical moving equipment has lengthened the operating season for hydraulic miners by allowing them to prepare ground in advance by removing overburden formerly hydraulicked, by transferring some of the gold-bearing gravel into position for hydraulicking, and by removing tailings. Thus they can make more efficient use of available water, whether seasonal rain or run-off.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Alaska in 1940, by regions, in terms of recovered metals

Region	Ore treated	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Cook Inlet-Susitna	63,902	43,398	2,518	1,464	8,874	728	6,176	200
Copper River	514	286	71	2	8	1		
Kenai Peninsula	2,110	2,177	694	5	14	6		
Seward Peninsula	30	41	4					
Southeastern Alaska	4,788,518	110,271	22,700	3,194	27,251	79,384	41,201	1,547,062
Yukon River Basin	22,299	19,529	6,854	104	635	1,697	500	4,100
	4,877,373	175,702	32,841	4,769	36,782	81,816	47,877	1,551,362
Total, 1939	4,729,057	172,035	29,877	4,046	32,257	94,029	62,962	1,839,450

Silver.—All the silver produced in Alaska in 1940 was a byproduct of gold mining.

Copper.—The output of recoverable copper in Alaska in 1940, produced only as a byproduct of gold mining, was negligible compared with that in 1938 and was less than half that in 1939.

Lead.—The bulk of the recovered lead output of Alaska in 1940 came from lead concentrates produced at the flotation mill of the Alaska Juneau Gold Mining Co. at Juneau.

MARKETS AND METALLURGY

More than 95 percent of the gold and about 56 percent of the silver produced from Alaska ores and gravels in 1940 were obtained in the form of gold-silver bullion, which was sold finally to the Seattle Assay Office and the San Francisco Mint. As there are no smelters or refineries in Alaska, all the remaining gold and silver produced and all the lead and copper were obtained from high-grade ore and concentrates shipped to smelters and refineries in the States, largely to the Tacoma (Wash.) and Selby (Calif.) smelters.

More than 190,000 ounces of fine gold were handled in 1940 by banks and bullion buyers throughout the Territory. The gold-silver bullion was either sent direct to the mints or cast into bars for shipping; in many instances the banks acted merely as agents for the lode and placer operators. The six largest purchasers (or agents) of bullion (handling over 182,000 fine ounces of gold) were: The First National Bank of Fairbanks, Fairbanks; the Miners and Merchants Bank of Alaska, Nome; the Miners and Merchants Bank of Iditarod, Flat; the First National Bank, Anchorage; and the Northern Commercial Co. and the Seattle First National Bank, Seattle, Wash.

Sixty-six mines in Alaska in 1940 were equipped with amalgamation or cyanidation plants (with the exception of the Alaska Juneau none had a mill with a daily capacity of over 75 tons); of these, 28 were equipped also with flotation, table, or jig concentrators. Five properties were equipped with straight concentration mills, chiefly flotation. Virtually all the lead concentrates produced in 1940 were obtained from concentration by flotation of the dry gold ore of the Alaska Juneau Gold Mining Co. property at Juneau. Most of the copper came from copper concentrates produced by the Alaska Gold and Metals Co. in Southeastern Alaska. Concentrates obtained from the amalgamation-concentration and cyanidation-concentration mills averaged 8 ounces of gold and 17 ounces of silver to the ton and were shipped chiefly to the Tacoma (Wash.) plant; concentrates from the straight concentration mills averaged 7 ounces of gold and 13 ounces of silver to the ton. Dry gold ore shipped direct to smelters averaged more than 1 ounce of gold and less than 1 ounce of silver to the ton. Mill heads averaging more than 1 ounce of gold to the ton were not uncommon.

The United States Assay Office at Seattle, Wash., reports the following receipts from Alaska in 1940.

Bullion of Alaskan origin deposited at United States Assay Office, Seattle, Wash., during year ended December 31, 1940, in fine ounces

District	Gold	Silver	District	Gold	Silver
Circle	17,376.819	1,803.33	Kuskokwim	23,997.896	2,735.90
Cook Inlet	58,561.650	5,873.27	Nome	136,006.960	14,959.11
Copper River	3,892.042	541.24	Southeastern Alaska	111,410.297	22,888.33
Eagle	4,318.074	728.76	Tanana [1]	281,587.892	45,694.17
Iditarod	66,090.856	10,000.07			
Koyukuk	2,114.042	271.32		705,356.528	105,495.50

[1] Includes mainly Bonnifield, Fairbanks, Hot Springs, Kantishna, and Tolovana districts in the Yukon Basin region.

REVIEW BY REGIONS

Cook Inlet-Susitna region.—This region, which includes the Prince William Sound, Valdez Creek, Willow Creek, and Yentna-Cache Creek districts, produced 24 percent of the total gold output from lode mines of Alaska in 1940. Although the number of producing mines in the region was 1 less than the 18 operating in 1939, the output of gold was 33 percent greater than in 1939.

The Alaska-Pacific Consolidated Mining Co., operating the Independence, Martin, and Free Gold mines, all on the west branch of Fishhook Creek, in the Willow Creek district, was the largest producer of gold in the Cook Inlet-Susitna region and the second-largest producer of lode gold in Alaska. The company amalgamation-flotation mill, which has operated continuously since its completion in 1937, treated an average of 72 tons of ore daily during 1940. An ore sorting and washing plant was being constructed during the year. Additional Diesel power equipment was installed, which brought the total power available to 735 hp., and a new bunkhouse and dry room were constructed. The mine produced 30,654 tons of ore averaging 1.2 ounces of gold to the ton. Development work in the mine consisted of 330 feet of shaft work, 4,719 feet of drifts, and 2,140 feet of diamond drilling; also, 1,506 feet were driven in a new low-level tunnel. The ore produced was transported to the mill by a ¼-mile aerial tram.

The Willow Creek Mines Co. operated the Lucky Shot mine in conjunction with the Lucky Shot 60-ton amalgamation-flotation-cyanidation mill. The mine is on Cragie Creek approximately 1½ miles above the junction of Cragie Creek and Willow Creek and is connected with the mill by a ¼-mile aerial tram. The output of ore in 1940 was 15,270 tons, averaging about 0.64 ounce of gold to the ton. In treatment the ore is crushed and sent to a closed circuit consisting of a ball mill, rake classifiers, and gold jigs. The jig concentrates are amalgamated. The classifier overflow passes into the flotation cells. The flotation concentrate goes to a regrind circuit (where more gold is amalgamated) and is then thickened, sacked, and shipped to the Tacoma (Wash.) smelter. The tails from the flotation cells are either sent to the cyanide plant or discharged into the creek.

Rapp & Till continued to operate their 35-ton cyanide mill in 1940 and treated 3,335 tons of gold tailings from the Willow Creek mines.

Other leading lode-gold producers in the Cook Inlet-Susitna region were the Fern Gold Leasing Co. (operating the Fern, Goodel, and Talkeetna groups), Al Renshaw (operating the Gold Cord mine), and Mabelle Mines, Inc. (operating the Mabelle mine), all in the Willow Creek district, and Cliff Gold Mines, Inc., operating the Cliff mine in the Prince William Sound district. No lode mines were operated in the Valdez Creek or Yentna-Cache Creek districts.

No floating connected-bucket dredges were operated in the Cook Inlet-Susitna region during 1940. Placer operations, using principally hydraulic giants, produced considerable gold from stream and bench gravel and gravels of ancient river beds. Among the larger placer-gold producers in the region were John E. Carlson and partners on Valdez Creek (operating on the Jopplin Bench and other claims) and L. S. Wickersham (operating on White Creek, a tributary of Valdez Creek), both in the Valdez Creek district; and Ray Jenkins (operating on Willow Creek), the Dutch Creek Mining Co. (operating on Dutch Creek), the Alaska Exploration & Mining Co. (operating on Bird Creek—hydraulic mining), and Devault, Devault & Seitz (operating on Pass Creek—hydraulic mining), all in the Yentna-Cache Creek district.

Copper River region.—The Copper River region includes the Chistochina, Nabesna, Nelchina, and Nizina districts. There were four operating lode mines in the region in 1940. The largest lode operator was the Nabesna Mining Corporation, in the Nabesna district. The ore reserves in old workings were depleted, and development work on the Golden Eagle group was begun in 1940; 1,972 tons of dry and siliceous gold ore and 2,102 tons of old tailings from the Nabesna mine were treated in the 60-ton flotation mill, producing 89 tons of copper concentrates which were sent to the Tacoma (Wash.) smelter. The Yellow Band Gold Mines, Inc., operated the Yellow

Band group of claims in the Nizina district and treated 461 tons of dry gold ore in an amalgamation mill. Other lode operations were carried on in the Copper River region by Nunatak Gold Mines, Inc., in the Nizina district, and McKinley Gold, Inc., in the Nelchina district.

Gravels were worked by hydraulic giants, sluices, and dragline dredges in the Copper River region in 1940. The largest producer of placer gold in the region was the Chititu Mines Co., operating on bench ground in Rex Gulch (a tributary of Chititu Creek) in the Nizina district. Two 3-inch Fisher hydraulic giants moved approximately 180,000 cubic yards of gravel, recovering 1,615.50 ounces of bullion with an average fineness of 0.906 in gold and 0.089½ in silver. Other producers were Green Mining Associates on Dan Creek in the Nizina district and Belanger, Cameron & Sullivan on Albert Creek in the Nelchina district.

Kenai Peninsula region.—The Kenai Peninsula region includes the Girdwood, Moose Pass-Hope, and Nuka Bay districts. The bulk of the gold and silver output in 1940 came from lode mining, principally in the Moose Pass-Hope district.

The United Mining & Development Co., operating the Gilpatrick mine and a small amalgamation mill in the Moose Pass-Hope district, treated 440 tons of dry gold ore; some new equipment was installed at this mine and mill in 1940. Other lode operators in the district included George Lindsay, operating the Alaska Oracle Extension; Case & Edwards, operating the Gladiator; and the Crown Point Mining Co., operating the Crown Point mine. In the Girdwood district, the only lode mining done was by the Crow Creek Gold Corporation on the Monarch and Jewel claims.

No floating connected-bucket dredges were in operation in the Kenai Peninsula region. The placer output came from small-scale operations throughout the region, the largest being the Palmer Creek Mining Co. on Resurrection Creek in the Moose Pass-Hope district.

Kodiak Island region.—The output of metals from Kodiak Island during 1940 came entirely from beach placering carried on by individuals.

Kuskokwim region.—The Kuskokwim region includes the Goodnews Bay, Nixon Fork, and Tuluksak-Aniak mining districts. No lode operations were carried on in the region in 1940.

Placers were worked in all the districts. Two dredges were operated in the Goodnews Bay district and two in the Tuluksak-Aniak district.

The New York Alaska Gold Dredging Co., largest gold producer in the region in 1940, operated two floating connected-bucket dredges (one 2-cubic foot and one 4-cubic foot) in the Tuluksak-Aniak district.

The Bristol Bay Mining Co. operated a floating connected-bucket dredge with sixty-four 2½-cubic foot buckets and a washing plant (both built by the W. W. Johnson Co.). On Wattamuse Creek in the Goodnews Bay district, this company was the second-largest producer of gold in the region. Dredging was carried on from May 1 to November 15.

Platinum was recovered by the Goodnews Bay Mining Co., operating on Salmon River and Squirrel and Platinum Creeks (tributaries of Salmon River). A Yuba floating connected-bucket dredge with ninety-two 8-cubic foot buckets and a sluice fed by a 1½-cubic yard dragline moved over a million yards of gravel during 1940. Of the total metals produced by these operations, 68 to 72 percent was platinum and 0.78 to 2.00 percent gold. The Goodnews Bay Mining Co. also operated a gold placer in Snow Gulch on the Arolic River, using a Joshua Hendy 3-inch hydraulic giant, a Bucyrus-Erie ¼-cubic yard Diesel-operated dragline, and an RD–8 caterpillar Diesel bulldozer. All the Goodnews Bay Mining Co. operations were in Goodnews Bay district.

Among the other larger operators in the region were: John B. Huff, using a Hydraulic Supply Co. 1-inch hydraulic giant and ID–40 Diesel International bulldozer on ground at Butte Creek, a tributary of the Arolic River, in the Goodnews Bay district; Strandberg & Sons, Inc., on Candle Creek in the Nixon Fork district; and the Garrison Co., with a Diesel-operated dragline, two bulldozers, and dry-land washing plant, working ground on Tuluksak River and Granite Creek, and Al Jones, using two bulldozers and sluice boxes, working ground on Rainey Creek, both in the Tuluksak-Aniak district.

Northwestern Alaska region.—Mining in the Northwestern Alaska region—comprising the Kiana and Shungnak districts and covering the area of the Kobuk River Valley—was confined to small placer operations in 1940.

Seward Peninsula region.—The Seward Peninsula region—comprising the Bluff, Council, Fairhaven, Kougarok, Koyuk, Nome, Port Clarence, and Solomon districts—had 22 floating connected-bucket dredges, numerous placer operations other than floating connected-bucket dredges, and only 1 operating lode mine in 1940. Gold recovered by dredges increased 26 percent in 1940 over 1939, and one more dredge was put into operation during the season. The average value of the gravel worked by dredges was about 50 cents a cubic yard—a slight increase over 1939. The active season for the average dredge operator started during the first week of June and lasted until the first week of October. The longest dredge operation began about the middle of May and continued until the middle of November. Preparation of dredging ground is started well ahead of actual dredging, and in some instances preparation of ground and general repair work are carried on throughout the year. Other types of placer operations averaged about 120 days for mines mechanically equipped, except hydraulic mines which averaged 10 to 20 days less. In rare instances, drift mining was done during the entire year.

The United States Smelting, Refining & Mining Co., in the Nome district, was the largest producer of gold in the region. The company operated three electrically powered Yuba dredges (one with 112, one with 103, and one with 78 9-cubic foot buckets). A small amount of hydraulicking also was done. Gravel washed in 1940 totaled 3,700,000 cubic yards—an increase of 19 percent over 1939; the gold production increased 21 percent. The Thirty-fifth Annual Report of the United States Smelting, Refining & Mining Co. for the year ended December 31, 1940 (dated March 19, 1941), says—

At Nome, Alaska, dredging operations started for the season on May 12 and continued until November 21. The three dredges on this property aggregated 567 dredging days compared with 483 dredging days in 1939. The yardage handled was considerably greater than in the previous year with average grade about the same. The new large deep-digging dredge which was ordered in 1940 is now under construction and, barring delays in delivery, should be put to work before the end of the 1941 season.

Arctic Circle Exploration, Inc., operated two dredges, each with seventy 4-cubic foot buckets, on Candle Creek in the Fairhaven district and ranked second in production of gold in the region in 1940.

Castleton & Keenan, operating a Washington Iron Works Diesel-powered dredge equipped with eighty-five 2¼-cubic foot buckets and a dragline on the Kougarok River in the Kougarok district, began dredging June 1 and ceased October 6.

Lee Brothers Dredging Co. operated two floating connected-bucket dredges on the Solomon River in the Solomon district. Dredge No. 1 operated from June 7 to November 12 and dredge No. 2 from June 30 to November 6. The combined production of the two dredges was over 5,000 fine ounces of gold and about 500 fine ounces of silver.

Other companies operating floating connected-bucket dredges in the Seward Peninsula region were: The Alaska Placer Co., Camp Creek Dredging Co., Council Dredging Co., Inland Dredging Co., and Ophir Gold Dredging Co., all in the Council district; Dry Creek Dredging Co. (flume dredge) and Forsgren Dredging Co., both in the Fairhaven district; Fox Bar Dredging Co. (Yuba dredge with 53 3-cubic foot buckets) in the Kougarok district; Dime Creek Dredging Co. and Ungalik Syndicate, both in the Koyuk district; Osborn Creek Dredging Co. and Tolbert Scott (Kimball type dredge with 29 2½-cubic foot buckets), both in the Nome district; Bartholomae Oil Co. (flume type dredge) in the Port Clarence district; and Casa de Paga Gold Co. in the Solomon district.

There were several large placer operations, other than those worked by floating connected-bucket dredges, in the Seward Peninsula region in 1940. Worthy of mention were the following: Topkuk Chief Mining Co. and Crabtree & Sullivan in the Bluff district; Grant Mining Co. and Laurin Bros. in the Kougarok district; Arthur W. Johnson in the Koyuk district; Arctic Mines, Inc., in the Port Clarence district; and E. W. Quigley in the Solomon district. The Topkuk Chief Mining Co., in the Bluff district, used a slackline cable outfit and the others mentioned used hydraulic giants with some combination of bulldozers, draglines, and pumping equipment in addition.

Southeastern Alaska region.—Southeastern Alaska—including the Admiralty Island, Chichagof Island, Hyder, Juneau, Ketchikan, and Windham Bay districts—produced 64 percent of the total lode gold and most of the silver, copper, and lead output of Alaska as a whole. There were 23 active mines in 1940—2 more than in 1939.

The Alaska Juneau was by far the largest producer of silver and lead and was second only to the United States Smelting, Refining & Mining Co. in output of gold in the Territory in 1940. The Twenty-sixth Annual Report of the Alaska Juneau Gold Mining Co. for the year ended December 31, 1940 (dated February 1, 1941), says—

During 1940 the amount of rock trammed from the mine was 4,739,790 tons, which is slightly in excess of the 1939 tonnage. The North ore body furnished 16 percent of this tonnage, the South ore body, 43 percent, while the Perseverance section of the mine supplied 41 percent of the total.

During the year 504,150 pounds of powder were used in blasting powder drifts; 55,250 pounds were used in Deep stoping in the blasting of long hole stations, making a total of 559,400 pounds of powder for primary breaking, or 0.12 pound per ton. Total powder consumption for primary and secondary breaking was 0.32 pound per ton trammed in 1940, as against 0.32 pound in 1939, and 0.36 in 1938.

In the North ore body, the main shaft extension of 450 feet from 10 level to 13 level was finished during the year. Work on the ore pockets and skip loading apparatus on 13 level still remains to be done. The main haulage drift on 13 level will be enlarged later to accomodate 10-ton box-type cars. Hoisting and haulage facilities, as well as stope preparation, should all be completed and ready for production before the end of 1941. The outlining of ore in the western part of the Deep workings between 13 and 9 levels was continued throughout the year. In the 91 winze area, on the east end of the Deep North ore body, an ore-way raise from 10 level to 6 level is being driven to expedite closer exploratory work and probable future preparatory mining.

In the Upper Perseverance Mine, work is still being done to gain access to the old Alaska Gastineau Co.'s workings for the purpose of further exploration, drainage, and actual mining. Many of these upper levels have been lost entirely, and other parts have become isolated by caving, which took place many years ago. During the year 740 feet of small size drain tunnel was driven in the Perseverance Mine, thus completing 10,000 feet of main haulage-level drainage system.

Mill.—The only alteration to the flow sheet during the year was the completion of a 6-foot by 12-foot regrind mill installation started during the previous year. Part of the hillside water system, providing a supply of fresh water for the mill, steam power plant, and for fire protection, was replaced with a 2,500-foot water tunnel and new pipe lines. The new system is entirely free from the danger of slides and is a decided improvement over the old in many other ways.

Power plants.—The work of relocating part of the Annex Creek electric transmission line was continued throughout the summer months, and while good progress was made, the job will not be completed until the summer of 1941. During the summer of 1940, a good start was made on the repairing of the top 30 feet of the upper face of Salmon Creek Dam. This dam has been in operation for 27 years, during which time the weather has caused a deterioration of the concrete, especially during the winter months when the water is drawn down from the top. The repair job is about one-third finished and will be continued this summer.

Labor.—In general, the supply of unskilled labor was ample, but there was a shortage of skilled labor during most of the year. Labor turn-over was higher for the year 1940 than for the past several years.

In May 1940 a new contract and wage agreement with the Union, which is the certified bargaining agent for all employees, was signed. From that date, all time worked in excess of 40 hours per week was paid for at the overtime rate. The average wage per day was $6.69 in 1940, as against $6.63 in 1939.

The over-all cost per man per day was $10.87 in 1940, as against $11.22 for 1939. (See page 184 for tables of metal recoveries, production, and operating costs.)

Gold content of ore from Alaska Juneau mine, 1936–40, and total, 1893–1940

Year	Rock to mill from mine (tons)		Gold (ounce)				
			Recovery per ton fine-milled		Losses per ton of tailings		Content of rock from mine to mill
	Ore fine-milled	Coarse tailings rejected	In bullion	In galena concentrates	Fine	Coarse	
1936	2,462,046	1,904,754	0.0544	0.0061	0.0089	0.0069	0.0422
1937	2,251,079	2,191,681	.0594	.0080	.0116	.0082	.0441
1938	2,478,928	2,184,952	.0515	.0081	.0090	.0071	.0398
1939	2,377,718	2,270,342	.0454	.0088	.0083	.0066	.0352
1940	2,308,397	2,431,393	.0442	.0089	.0081	.0065	.0331
Total and average, 1893–1940	42,217,033	37,288,455	.0510	.0115	.0121	.0086	.0436

The Hirst-Chichagof Mining Co. on Chichagof Island operated its mine continuously and, according to its report, produced 12,552 tons of crude ore which was treated in the company 35-ton amalgamation-flotation mill. The bullion product was sent direct to the Seattle Assay Office and the concentrates were shipped to the Tacoma (Wash.) smelter. The company was again the second-largest producer of gold in the region.

Gold, silver, and lead recoveries from Alaska Juneau mine, 1893–1940

Year	Gold		Silver		Lead		Total value recovered
	Fine ounces	Value	Fine ounces	Value	Pounds	Value	
1893–1913	34,239.49	$707,730.15	(1)	(1)	(1)	(1)	$707,730.15
1914–35	1,903,589.57	43,581,134.13	1,190,106.61	$675,700.10	27,366,149	$1,525,127.88	45,781,962.11
1936	149,235.23	5,223,231.16	101,590.59	78,794.94	2,102,594	98,594.68	5,400,620.78
1937	151,670.64	5,308,471.55	120,691.21	91,528.49	1,980,405	116,414.16	5,516,414.20
1938	148,103.14	5,183,542.98	121,473.25	78,999.04	2,152,714	101,945.80	5,364,487.82
1939	129,011.74	4,515,410.28	111,494.24	75,165.90	2,040,280	104,961.22	4,695,537.40
1940	122,469.96	4,286,448.37	100,633.39	71,154.36	1,666,016	89,568.57	4,447,171.30
Total	2,638,319.77	68,805,968.62	1,745.989.29	1,071,342.83	37,308,158	2,036,612.31	71,913,923.76

[1] Lost in tailings.

Summary of production and operating costs, Alaska Juneau mine, 1914–40, inclusive

	4,739,790 tons		4,648,060 tons		78,998,234 tons	
	1940	Per ton trammed	1939	Per ton trammed	1914–40	Per ton trammed
Production (gross recovered gold, silver, and lead values):						
Bullion	$3,584,827.33	$0.756	$3,793,169.67	$0.816	$56,585,734.60	$0.716
Concentrates	862,343.97	.182	902,367.73	.194	14,620,459.01	.185
	4,447,171.30	.938	4,695,537.40	1.010	71,206,193.61	.901
Costs:						
Mining	1,744,652.26	.368	1,756,081.05	.378	23,523,824.92	.298
Milling	1,069,494.51	.226	1,135,029.75	.244	19,175,958.88	.243
Other Juneau operating and marketing costs	212,896.29	.045	225,142.08	.048	3,737,324.75	.047
General corporation and pay roll taxes	236,678.76	.050	235,413.03	.051	1,506,892.39	.019
Total Juneau operating and marketing costs	3,263,721.82	.689	3,351,665.91	.721	47,944,000.94	.607
All other costs	59,422.14	.013	69,850.99	.015	3,461,123.78	.043
Total operating costs and expenses	3,323,143.96	.702	3,421,516.90	.736	51,405,124.72	.650
Juneau operating profit	1,183,449.48	.249	1,343,871.49	.289	23,262,192.67	.294
Net operating profit	1,124,027.34	.236	1,274,020.50	.274	19,801,068.89	.251
Other revenue (interest, etc.)	41,052.43	----------	55,735.56	----------	669,147.91	----------
Profit before depreciation, depletion, and income taxes	1,165,079.77	----------	1,329,756.06	----------	20,470,216.80	----------

The Chichagof Mining Co. at Klag Bay, in the Chichagof Island district, worked old tailings and produced bullion that was sent to the Seattle Assay Office and dry gold concentrates that were shipped to the Tacoma (Wash.) smelter.

Other lode-mining companies operating in the region were: Nelson & Tift, working the N & T mine in the Ketchikan district; Alaska Gold and Metals Co., (which produced nearly half of the copper output from Alaska in 1940) working the Salt Chuck, Rush, and Brown mines, and Wendell Dawson, working the Davis claim, both in the Ketchikan district; and Howard C. Hayes, working old tailings of the Alaska Juneau mine, and Polson & Lundgren, working old tailings from the Ready Bullion and Homestead mines, both in the Juneau district.

No large placer operations were carried on in the region during 1940. The placer output came chiefly from small sluicing operations in the Juneau and Windham Bay districts.

Yukon River Basin region.—The Yukon River Basin—comprising the Bonnifield, Chandalar, Chisana, Circle, Eagle, Fairbanks, Fort Gibbon, Fortymile, Hot Springs, Iditarod, Innoko, Kantishna, Koyukuk, Marshall, Rampart, Richardson, Ruby, and Tolovana districts—yielded 67 percent of the total output from connected-bucket dredges in Alaska during 1940; it ranked first in gold recovered from other placers, and third in that from lode mines.

Twenty-four floating connected-bucket dredges (including two single-dipper dredges) were operating in the region, five more than in 1939.

The United States Smelting, Refining & Mining Co., operating eight floating connected-bucket dredges (two more than in 1939), was by far the largest producer of gold and silver in the Yukon River Basin region. The company operated two 10-cubic foot Bethlehem dredges (with 111 and 93 buckets, respectively), one 10-cubic foot new Yuba dredge (with 106 buckets), three 6-cubic foot Bethlehem dredges (with 78, 78, and 68 buckets, respectively), one new 5-cubic foot Yuba dredge (with 84 buckets), and one 3-cubic foot Yuba dredge (with 68 buckets); all the dredges are electrically operated. More than 300 Joshua Hendy hydraulic giants were used to remove the bulk of the overburden; some of the material moved by hydraulic giants was washed. At the open pit on Cripple Creek a Bucyrus walking dragline with 8- and 12-cubic yard buckets fed a movable, self-propelling loading plant connected with a belt-conveyor system 1 mile or more long; a carry-all stacks the material handled. At the Cripple Creek operation the banks of the dredge cut, which are 50 to 100 feet high, are frozen so they will stand.

The Thirty-fifth Annual Report of the United States Smelting, Refining & Mining Co. for the year ended December 31, 1940 (dated March 19, 1941), says—

At Fairbanks, Alaska, dredging operations started for the season on March 13 and continued until December 7. All of the eight dredges were operated, including the two new dredges referred to in last year's report, the newly acquired small dredge starting on May 3, and the newly constructed large dredge starting on August 8. In all, the dredges aggregated 1,799 dredging days compared with 1,462 dredging days in 1939. The yardage handled in 1940 was larger and of higher average grade than in the previous year.

At both the Fairbanks and Nome properties the gold output for the season was the highest in their history, due to the fact that the two new dredges at Fairbanks operated a part of the season. Acquisition and development of additional dredging ground and preparation of ground ahead of the dredges have been actively continued, with the result that the gold reserves and the yardage of prepared ground are greater at the end of 1940 than at any time in the past.

In the Circle district three dredges were again operated in 1940. During the season from May 30 to October 13, at its properties on Coal Creek, Gold Placers, Inc., operated its W. W. Johnson Co. dredge equipped with sixty 4-cubic foot buckets; the dredge washed 356,000 cubic yards of gravel, and eight 2-inch Joshua Hendy hydraulic giants moved 317,000 cubic yards of overburden. The C. J. Berry Dredging Co. operated on lower Mammoth Creek. Alluvial Golds, Inc., operating six 2-inch Joshua Hendy hydraulic giants and a W. W. Johnson Co. dredge (with seventy-two 4-cubic foot buckets) on Woodchopper Creek, moved 261,000 cubic yards of overburden and washed 372,800 cubic yards of gravel. The output by these three dredges ranked the Circle district second in gold produced by dredges in the Yukon River Basin in 1940.

In the Hot Springs district the American Creek Operating Co., Inc., mining on American Creek, operated the only dredge active in 1940. The company has a Diesel-powered Yuba dredge equipped with 2½-cubic foot buckets.

In the Bonnifield district two dredges, both of the Becker-Hopkins single-dipper type, were operated in 1940. The dipper is mounted on a steel framework at the digging end of the dredge in such a manner as to permit it to be elevated to an angle that allows the gold-bearing gravel to be discharged into a trommel screen on the floating washing plant. The washing plant and stacker unit are similar to those used on lightweight dredges. The Triple X Placers Co. worked one of the dredges on Moose Creek, and Standard Mines, Inc., worked the other on Eva Creek; both operations were managed by C. W. Pringle.

On Wade Creek in the Fortymile district the Wade Creek Dredging Co. continued to operate its Risdon steam-powered dredge equipped with seventy 3½-cubic foot buckets; the dredge washed 160,600 cubic yards of gravel, and a caterpillar RD–7 Diesel-powered bulldozer moved 40,000 cubic yards of overburden during the 1940 season, beginning June 20 and ending October 11. The other dredge in the district—a W. W. Johnson Co. dredge with fifty-nine 2⅝-cubic foot buckets—was operated by the Boundary Dredging Co. on Canyon Creek.

In the Iditarod district two dredges were operated on Otter Creek in 1940—one by the J. E. Riley Investment Co. and the other by the North American Dredging Co.

In the Innoko district four dredges were operating in 1940—one by the Ganes Creek Dredging Co. on Ganes Creek and in Mack Gulch, one by Moss & Larson on Ganes Creek, one (flume type) by Nels J. Vibe on Yankee Creek, and one by Waino F. Puntilla on Little Creek.

In the Tolovana district the Nome Creek Mining Co. operated a W. W. Johnson Co. dredge having 4-cubic foot buckets and washed 692,000 cubic yards of gravel in 1940; work was begun May 11 and ended November 3. The Livengood Placers, Inc., operated on Livengood Creek the only other dredge in the district. The company has a Yuba dredge with eighty-eight 6-cubic foot buckets.

Placer operations of all types—other than floating connected-bucket dredges—were to be found throughout the Yukon River Basin region, some with production as large as or larger than the average dredge and many producing over 500 fine ounces of gold. The combined production of these operations was over 90,000 fine ounces of gold in 1940.

In the Bonnifield district the Gold King Mining Co., using three hydraulic giants and a hydraulic elevator, washed 36,000 cubic yards of gravel on Gold King Creek between May 15 and September 20 and was the largest operator among the other types of placers.

In the Circle district, some of the larger placer operators included: The C. J. Berry Dredging Co., hydraulicking on Mastodon Creek; the Berry Holding Co., using a slackline scraper and bulldozer on Eagle Creek; the Central Mining Co. (property purchased from the Deadwood Mining Co. April 9, 1940), hydraulicking on Deadwood Creek; Johnston & Blondo, operating a dragline and bulldozer in conjunction with a dry-land washing plant; and the Mastodon Mining Co., hydraulicking with dragline and bulldozer as auxiliary equipment on Deadwood Creek.

Among the larger placer producers in the Fairbanks district, which was the largest gold-producing district in the Yukon River Basin region, were: The Alder Creek Mining Co., with a dragline and bulldozer, operating on Butte Creek; Blake & Larson, operating a drift mine in lower Chatanika River; the Faith Creek Mining Co., hydraulicking on Faith Creek; the Gilmore Mining Co., using a dragline on Gilmore Creek; Helmer Johnson, with bulldozer and highline stacker, operating on upper Cleary Creek; William Basham & E. F. Schrieber, operating on Nome Creek; and the Wolf Creek Mining Co., operating a dry-land washing plant in conjunction with a dragline, bulldozers, and hydraulic giants (the company washed about 140,000 cubic yards of gravel and recovered over 3,000 fine ounces of gold).

On Utopia Creek in the Fort Gibbon district L. McGee (Utopia Creek Mining Co.) operated a dragline and bulldozer in conjunction with hydraulic giants, washed 70,000 cubic yards of gravel, moved 110,000 cubic yards of overburden, and recovered over 2,000 fine ounces of gold.

In the Fortymile district Skoland & Kirkpatrick working bench gravels for 5 months and using hydraulic giants and a bulldozer on Lost Chicken Hill, Oliver & Dodson hydraulicking on Jack Wade Creek, and the Central Development Syndicate, also hydraulicking on Jack Wade Creek, were large producers among these types of placer operations.

In the Hot Springs district, the larger placer operators included: The Montana Mining Co., using hydraulic giants with a dragline and bulldozer on Omega Creek and Alpha Creek; J. R. Frank & Co., hydraulicking on Pioneer Creek; and the Cleary Hill Mines Co., hydraulicking on Sullivan Creek.

In the Iditarod district, the larger producers from these types of placer operations were: The Awe Mining Co., operating two draglines, bulldozers, highline scraper, and hydraulic giants in conjunction with a dry-land washing plant on Chicken Creek; Peter Miscovich & Sons, hydraulicking on Otter Creek; Uotila & Ogriz, operating with dragline, hydraulic giants, and a bulldozer in conjunction with a dry-land washing plant on Slate Creek; Sakow & Tomoff, hydraulicking with dragline and bulldozer auxiliary equipment on Willow Creek; and the Northland Development Co. on Willow Creek.

In the Innoko district, the larger of these placer operations included: Degnan & Rosander, operating a dry-land washing plant on Little Creek; Sid Paulson, hydraulicking on Colorado Creek; the Cripple Creek Mining Co., with a dry-land washing plant on Cripple Creek; Hard, Uotila & Hansen, hydraulicking on Beaver, lower Cripple, Bear, and Graham Creeks; Uotila & Hard, operating a dry-land washing plant on Ophir Creek; Three Miners, Inc., operating a dry-land washing plant during the season (April 15 to October 15) on Madison Creek; and Nels J. Vibe & Andrew Schwaesdall (Vibe bought Schwaesdall's interest in October 1940), operating a dry-land washing plant on Spaulding Creek.

In the Kantishna district, the Caribou Mines operated a dry-land washing plant on Caribou Creek.

John Repo & Andrew Schwaesdall, operating hydraulic giants and two RD-8 bulldozers on Myrtle Creek, were the largest gold producers of all types of operation in the Koyukuk district.

Large gold producers in the Marshall district included: Johnston & Ostnes, hydraulicking on Willow Creek; Vance Hitt, hydraulicking on Stuyohok Creek (moved in August 1940 to Flat Creek, a tributary of Poorman Creek, in the Ruby district); the Wilson Creek Mining Co., operating a dry-land washing plant in Elephant Gulch, a tributary of Wilson Creek; and the Yukon Mining Co., operating a dry-land washing plant on Bobtail, Windy, and Buster Creeks.

In the Rampart district Minook, Ltd., operating a dry-land washing plant with a shovel and a bulldozer on Little Minook Creek, was the only large producer.

In the Ruby district, the two largest placer operators were A. J. Burk (Midnight Mining Co.) and the Long Creek Mining Co., each operating bulldozers and a dragline on Long Creek.

The second-largest gold producer in the Tolovana district was Parker & Sons, operating on Olive Creek and using hydraulic giants and bulldozers.

The season of operation for the average dry-land washing plant began between May 1 and May 15 and closed about October 1; the season for hydraulicking and sluicing operations was about the same.

Lode mining in the Yukon River Basin region produced 20,164 fine ounces of gold and 8,551 fine ounces of silver in 1940, increases of 3 percent in gold and 55 percent in silver over 1939.

Of the 20 lode mines operating in the region in 1940, the leading producers were: The Cleary Hill Mines, Inc., working the Cleary Hill mine, the United States Smelting, Refining & Mining Co. operating the McCarty mine, and the Hi Yu Mining Co. operating the Hi Yu mine, all in the Fairbanks district; and the Red Top Mining Co., operating the Banjo vein in the Red Top mine, in the Kantishna district.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN ARIZONA

(MINE REPORT)

By G. E. Woodward and Paul Luff

SUMMARY OUTLINE

The total value of the output of recoverable metals from mines in Arizona was $82,167,759 in 1940, compared with $72,616,408 in 1939—an increase of 13 percent (see fig. 1); it was the greatest (with the exception of 1937) since 1929, when the total value was $155,567,133. There were substantial increases in both quantity and total value of copper, lead, and zinc in 1940 but decreases in gold and silver. The total value of the copper was $9,024,898 more than in 1939, lead $314,126, and zinc $1,249,512; gold declined $757,610 and silver $279,575. The total value of the metals recovered from copper ore was $70,731-122 in 1940, or 86 percent of the State total. Since 1869, Arizona has produced 9,120,479 short tons of net copper; the peak year was 1929, when 415,314 tons were produced. The output of copper in 1940 has been exceeded only in 1937 during the past decade, the output of zinc was the largest in the history of the State, and the output of lead has been exceeded in only 1 year (1916, with 27,062,087 pounds). The increase in the average sales price of copper to 11.3 cents a pound in 1940 caused substantial increases in output of copper in nearly all the copper-producing districts, and the rise in the average sales price of silver, lead, and zinc resulted in a marked increase in output of zinc-lead ore. The decline in output of gold and silver resulted from the drop in output of siliceous ores and from the lower content of gold and silver in copper ore.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1936–40

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1936	$35.00	$0.7745	$0.092	$0.046	$0.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052
1940	35.00	[6] .711+	.113	.050	.063

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+ ($20.671835) per fine ounce.
[2] 1936–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–40: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787. [6] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Arizona, 1936–40, and total, 1860–1940, in terms of recovered metals

Year	Mines producing: Lode	Mines producing: Placer	Ore (short tons)	Gold (lode and placer): Fine ounces	Gold (lode and placer): Value	Silver (lode and placer): Fine ounces	Silver (lode and placer): Value
1936	847	787	13,819,838	322,408.20	$11,284,287	8,386,043	$6,494,990
1937	888	376	20,976,359	332,694.00	11,644,290	9,422,552	7,288,344
1938	885	329	14,203,164	305,043.00	10,676,505	7,479,153	4,835,008
1939	976	142	18,793,260	316,453.00	11,075,855	7,824,004	5,310,839
1940	1,024	276	21,572,175	294,807.00	10,318,245	7,075,215	5,031,264
1860–1940	--------	--------	(1)	9,858,897.00	232,556,550	261,189,778	194,549,673

Year	Copper: Pounds	Copper: Value	Lead: Pounds	Lead: Value	Zinc: Pounds	Zinc: Value	Total value
1936	422,550,000	$38,874,600	21,376,000	$983,296	7,178,000	$358,900	$57,996,073
1937	576,956,000	69,811,676	24,708,000	1,457,772	10,052,000	653,380	90,855,462
1938	421,594,000	41,316,212	21,142,000	972,532	11,628,000	558,144	58,358,401
1939	524,224,000	54,519,296	21,542,000	1,012,474	13,422,000	697,944	72,616,408
1940	562,338,000	63,544,194	26,532,000	1,326,600	30,912,000	1,947,456	82,167,759
1860–1940	[2] 9,120,479	2,764,244,404	[2] 266,416	30,716,918	[2] 109,810	16,668,851	3,238,736,396

[1] Figures not available. [2] Short tons.

Gold and silver produced at placer mines in Arizona, 1936–40, in fine ounces, in terms of recovered metals

Year	Sluicing [1]: Gold	Sluicing [1]: Silver	Drift mining: Gold	Drift mining: Silver	Dredges: Dry-land [2]: Gold	Dredges: Dry-land [2]: Silver	Dredges: Dragline floating [2]: Gold	Dredges: Dragline floating [2]: Silver	Total: Gold	Total: Silver
1936	[3] 2,083.69	[3] 286	(3)	(3)	(4)	(4)	[4] 4,403.91	[4] 604	6,487.60	890
1937	1,275.00	212	258.00	34	(4)	(4)	[4] 2,866.00	[4] 403	4,399.00	649
1938	1,624.00	213	328.00	35	(4)	(4)	[4] 3,033.00	[4] 380	4,985.00	628
1939	1,919.00	227	1,850.00	125	(4)	(4)	[4] 2,640.00	[4] 339	6,409.00	691
1940	1,625.00	207	646.00	41	1,186.00	464	2,784.00	396	6,241.00	1,108

[1] Includes placer sands treated by dry concentration plants.
[2] A floating washing plant supplied with gravel by a dragline excavator is called a "dragline dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."
[3] Figures for sluicing include those for drift mining.
[4] Figures for dragline floating dredges include those for dry-land dredges.

Gold.—The output of recoverable gold in Arizona in 1940 was 294,807 fine ounces—a decline of 7 percent from 1939. Gold from siliceous ores (chiefly dry and siliceous gold ore) decreased 13,937 ounces, owing to marked decreases in gold ore treated by cyanidation in the Oatman section of the San Francisco district and in the Weaver district in Mohave County. Gold from copper ore declined 10,807 ounces, principally because of the large decrease in output of gold from the Verde district, but gold from zinc-lead ore increased 3,437 ounces as a result of the gain in output of zinc-lead ore from the Tennessee mine at Chloride and the Shattuck Denn mine at Bisbee. Gold from placers decreased slightly; 42 percent of the total placer gold was recovered by dragline dredging at properties on Lynx Creek and Big Bug Creek in Yavapai County. The Copper Queen (Bisbee) branch of the Phelps Dodge Corporation was, as usual, the leading gold producer in Arizona; it was followed by the New Cornelia mine in Pima County, the Mammoth-St. Anthony Limited property in Pinal County, the Goldroad mine (United States Smelting, Refining & Mining Co.) in Mohave County, and the United Verde mine in

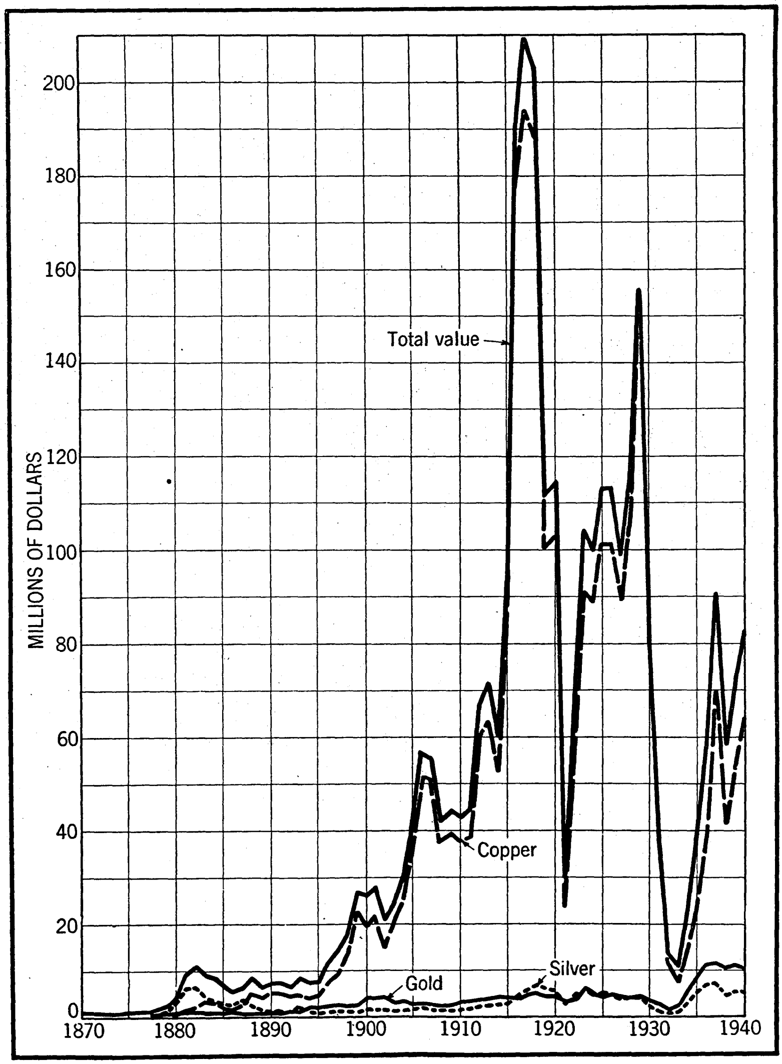

FIGURE 1.—Value of mine production of gold, silver, and copper and total value of gold, silver, copper, lead, and zinc in Arizona, 1870–1940. The value of lead and zinc has been less than $2,000,000 annually, except in a few years.

Yavapai County. These five properties produced more than 55 percent of the State total output. Other large gold producers were the Octave mine (American Smelting & Refining Co.) in Yavapai County, the Shattuck Denn mine in Cochise County, the Tyro mine (Gold Standard Mines Corporation) in Mohave County, the Magma mine in Pinal County, and the Iron King mine in Yavapai County. Siliceous ore yielded 49 percent of the State total gold, copper ore nearly 44 percent, and zinc-lead ore more than 4 percent. The chief gold-producing districts in Arizona were the Warren (mostly copper ore), San Francisco (nearly all gold ore), Ajo (copper ore), Old Hat (gold ore), Verde (mostly copper ore), and Weaver (Yavapai County) (gold ore).

Silver.—The output of recoverable silver in Arizona in 1940 was 7,075,215 fine ounces—a decline of 10 percent from 1939. Silver from siliceous ores declined 560,999 ounces, that from copper ore 356,767 ounces, and that from lead ore 15,832 ounces, but silver from zinc-lead ore increased 179,706 ounces. Copper ore yielded 63 percent of the State total silver, siliceous ores 19 percent, zinc-lead ore nearly 14 percent, zinc-copper ore nearly 3 percent, and lead ore 1 percent. The Phelps Dodge Corporation continued to be the chief silver producer in Arizona, although its output was 12 percent less than in 1939; its three properties (Copper Queen, United Verde, and New Cornelia) produced nearly half of the State total. Other large silver producers in 1940 were the Magma, Shattuck Denn, Reymert, Trench, and Iron King mines. Silver output decreased substantially in the Oro Blanco, Ash Peak (Duncan), Verde, Wallapai (Chloride), and Warren districts but increased sharply in the Harshaw, Vulture, Pioneer, and Patagonia districts. The chief silver-producing districts were the Warren (Bisbee), Verde (Jerome), Pioneer (Superior), Harshaw, Ajo, and Wallapai (Chloride).

Copper.—The output of recoverable copper in Arizona in 1940 was 562,338,000 pounds—a 7-percent gain over 1939. There was a general increase in five of the seven chief copper-producing districts, as follows: Mineral Creek (Ray) district increased 20,292,974 pounds; Globe-Miami district, 16,011,483 pounds; Ajo (New Cornelia) district, 3,388,528 pounds; Warren (Bisbee) district, 1,274,783 pounds; and Pioneer (Superior) district, 989,708 pounds; the output of copper from the Copper Mountain (Morenci) district declined 4,750,252 pounds and that from the Verde (Jerome) district 970,595 pounds. These seven districts contributed 99 percent of the State total copper, and the Globe-Miami district continued as the leading producer. Copper ore and its products yielded 557,900,895 pounds of copper, as follows: 15,530,822 tons of copper ore treated by concentration yielded 56 percent; 1,555,100 tons of copper ore shipped crude to smelters, 25 percent; and 3,198,904 tons of copper ore leached and 20,460 tons of cement copper (from mine-water precipitates and underground leaching operations), 19 percent. The New Cornelia property continued to be the largest copper producer in Arizona; its output was 3 percent greater than in 1939, and it was followed in order by the Copper Queen, Inspiration, United Verde, Miami, Ray (Nevada Consolidated Copper Corporation), Magma, and Morenci (Phelps Dodge Corporation).

Lead and zinc.—The output of recoverable lead in Arizona in 1940 was 26,532,000 pounds—an increase of 23 percent over 1939; the output of recoverable zinc was 30,912,000 pounds—largest in any year in the history of the State and more than double that in 1939. About 45 percent of the State total lead and 27 percent of the zinc came from Santa Cruz County, 18 percent of the lead and 28 percent of the zinc from Mohave County, and 16 percent of the lead and 21 percent of the zinc from Pinal County; nearly all the remainder of the lead and zinc came from Yavapai and Cochise Counties. More than 72 percent of the total lead and more than 79 percent of the total zinc came from zinc-lead ore; nearly all the rest of the lead came from siliceous ores, lead ore, and zinc-copper ore, and the rest of the zinc from zinc-copper ore. The Trench mine of the American Smelting & Refining Co. near Patagonia in Santa Cruz County was the largest producer of lead in the State; it was followed by the Tennessee mine at Chloride, Mammoth-St. Anthony Limited property at Tiger, Flux mine near Patagonia, Montana mine at Ruby, Iron King mine at Humboldt, Duquesne property near Patagonia, and Shattuck Denn mine at Bisbee. The largest producer of zinc in the State was the Tennessee mine; it was followed by the Magma, Trench, Shattuck Denn, Iron King, Duquesne, Flux, and Montana properties. The marked increase in output of lead and zinc from the Tennessee, Trench, Flux, Shattuck Denn, and Duquesne properties more than offset the large decrease from the Montana mine.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1940, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Cochise	63	8	65,064	$2,277,240	2,574,564	$1,830,801
Coconino	7		4	140	218	155
Gila	73	6	4,961	173,635	144,336	102,639
Graham	7		48	1,680	2,333	1,659
Greenlee	16	8	1,185	41,475	83,859	59,633
Maricopa	65	25	6,729	235,515	122,518	87,124
Mohave	191	18	59,037	2,066,295	369,734	262,922
Pima	72	20	33,525	1,173,375	394,581	280,591
Pinal	78	3	43,227	1,512,945	1,061,107	754,565
Santa Cruz	59	1	2,545	89,075	640,710	455,616
Yavapai	320	130	75,210	2,632,350	1,651,555	1,174,439
Yuma	73	57	3,272	114,520	29,700	21,120
	1,024	276	294,807	10,318,245	7,075,215	5,031,264
Total, 1939	976	142	316,453	11,075,855	7,824,004	5,310,839

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Cochise	110,592,000	$12,496,896	2,673,300	$133,665	3,643,000	$229,509	$16,968,111
Coconino	84,000	9,492					9,787
Gila	142,048,000	16,051,424	100,000	5,000			16,332,698
Graham	6,000	678	37,600	1,880			5,897
Greenlee	27,019,000	3,053,147	26,600	1,330	18,000	1,134	3,156,719
Maricopa	273,000	30,849	14,600	730			354,218
Mohave	329,000	37,177	4,674,700	233,735	8,589,000	541,107	3,141,236
Pima	104,375,000	11,794,375	99,500	4,975			13,253,316
Pinal	100,446,000	11,350,398	4,209,700	210,485	6,350,000	400,050	14,228,443
Santa Cruz	647,000	73,111	11,941,300	597,065	8,376,000	527,688	1,742,555
Yavapai	76,402,000	8,633,426	2,712,000	135,600	3,936,000	247,968	12,823,783
Yuma	117,000	13,221	42,700	2,135			150,996
	562,338,000	63,544,194	26,532,000	1,326,600	30,912,000	1,947,456	82,167,759
Total, 1939	524,224,000	54,519,296	21,542,000	1,012,474	13,422,000	697,944	72,616,408

Gold and silver produced at lode mines in Arizona in 1940, by counties, in terms of recovered metals

County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
Cochise	1,164,720	64,863	2,574,540
Coconino	532	4	218
Gila	8,779,127	4,923	144,329
Graham	694	48	2,333
Greenlee	552,497	1,159	83,859
Maricopa	66,609	6,612	122,504
Mohave	388,205	58,911	369,720
Pima	6,472,874	33,440	394,560
Pinal	2,708,088	43,223	1,061,107
Santa Cruz	126,895	2,538	640,710
Yavapai	1,305,902	70,843	1,650,946
Yuma	6,032	2,002	29,281
	21,572,175	288,566	7,074,107
Total, 1939	18,793,260	310,044	7,823,313

Gold and silver produced at placer mines in Arizona in 1940, by counties, in fine ounces, in terms of recovered metals

County	Sluicing [1]		Drift mining		Dredges: Dry-land [2]		Dredges: Dragline floating [2]		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Cochise	21	1			180	23			201	24
Gila	12				26	7			38	7
Greenlee	24		2						26	
Maricopa	117	14							117	14
Mohave	126	14							126	14
Pima	85	21							85	21
Pinal	4								4	
Santa Cruz	7								7	
Yavapai	898	125	1		684	88	2,784	396	4,367	609
Yuma	331	32	643	41	296	346			1,270	419
	1,625	207	646	41	1,186	464	2,784	396	6,241	1,108
Total, 1939	1,919	227	1,850	125	(3)	(3)	[3] 2,640	[3] 339	6,409	691

[1] Includes placer sands treated by dry concentration plants.

[2] A floating washing plant supplied with gravel by a dragline excavator is called a "dragline dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."

[3] Figures for dragline floating dredges include those for dry-land dredges.

MINING INDUSTRY

The increased sales price of copper, silver, lead, and zinc in 1940 caused substantial improvement in the mining industry of Arizona, especially in the mining of copper ore and zinc-lead ore. The output of copper ore increased to 20,284,826 tons (the greatest since 1929), and that of zinc-lead ore increased to 271,000 tons (the largest in any year in the history of the State). The output of siliceous ores, however, declined 11 percent. Nearly all the copper ore came from Gila, Pima, Pinal, Cochise, Yavapai, and Greenlee Counties; virtually all the zinc-lead ore came from Santa Cruz, Yavapai, Mohave, and Cochise Counties; 92 percent of the gold ore came from Mohave, Yavapai, and Pinal Counties; 58 percent of the silver ore came from Pinal County; 59 percent of the gold-silver ore came from Yavapai County; nearly half the lead ore came from Cochise County; and all the zinc-copper ore came from Pinal County.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Arizona in 1940, with content in terms of recovered metals

Source	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	620	783, 234	129, 938	210, 312	334, 107	3, 979, 458	
Dry and siliceous gold-silver ore	77	104, 235	13. 660	570, 363	433, 072	998, 109	
Dry and siliceous silver ore	102	40, 979	863	597, 643	221, 594	140, 611	
	[1] 759	928, 448	144, 461	1, 378, 318	988, 773	5, 118, 178	
Copper ore	164	20. 284, 826	128, 720	4, 463, 702	[2] 557, 900, 895	178, 667	
Lead ore	120	8, 813	895	68, 376	43, 494	1, 879, 819	
Lead-copper ore	3	44	7	1, 350	2, 407	16, 917	
Zinc-copper ore	1	79, 044	982	191, 800	2, 348, 000	200, 000	6, 350, 000
Zinc-lead ore	12	271, 000	13, 501	970, 561	1, 054, 431	19, 138, 419	24, 562, 000
Total, lode mines	[1] 1, 024	21, 572, 175	288, 566	7, 074, 107	[2] 562, 338, 000	26, 532, 000	30, 912, 000
Total, placers	276		6, 241	1, 108			
	1, 300	21, 572, 175	294, 807	7, 075, 215	[2] 562, 338, 000	26, 532, 000	30, 912, 000
Total, 1939	1, 118	18, 793, 260	316, 453	7, 824, 004	[3] 524, 224, 000	21, 542, 000	13, 422, 000

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[2] Includes 103,327,137 pounds recovered from ore leached and mine-water precipitates.
[3] Includes 86,058,553 pounds recovered from ore leached and mine-water precipitates.

METALLURGIC INDUSTRY

The output of ore of all classes treated in Arizona increased from 18,793,260 tons in 1939 to 21,572,175 in 1940—the greatest output since 1929; copper ore increased from 17,468,926 to 20,284,826 tons and zinc-lead ore from 204,778 to 271,000 tons. About 94 percent of the total in 1940 was copper ore, nearly 4 percent gold ore, and the rest principally zinc-lead ore, gold-silver ore, zinc-copper ore, and silver ore.

Gold ore treated at amalgamation mills decreased from 5,000 tons in 1939 to 4,162 in 1940, but siliceous material treated at cyanidation plants increased from 733,943 to 742,801 tons. Cyanidation plants were operated continuously in 1940 at the Goldroad, Gold Standard, Producers Mines, Inc., Vivian, Congress, Octave, Mammoth-St. Anthony, Alvarado, Yarnell, and Vulture properties. Cyanidation plants used 195,000 pounds of sodium cyanide, 636,900 pounds of Aero Brand calcium cyanide, 75,000 pounds of zinc dust, 121,000 pounds of zinc shavings, 2,260,000 pounds of lime, and 515 pounds of lead acetate.

Ore treated at concentration plants increased from 14,017,765 tons in 1939 to 15,941,271 in 1940; the ore concentrated in 1940 comprised 6,296 tons of gold ore, 47,540 of gold-silver ore, 4,353 of silver ore, 15,530,822 of copper ore (compared with 13,542,200 in 1939), 2,357 of lead ore, 79,044 of zinc-copper ore, and 270,859 of zinc-lead ore. Copper ore from the Miami property (5,300,604 tons) was treated by a combination of leaching and concentration, and this tonnage is included in figures for ore treated at straight concentration plants. Ore from the Inspiration mine in 1940 was treated by straight leaching, but 237,274 tons of slimes discarded from the leaching-plant feed were concentrated. The concentrator at Ajo (20,000-ton-a-day), the ferric sulfate leaching plant at Inspiration (9,000-ton), the concentrator (18-000-ton) and leaching plant (3,000-

ton) at Miami, the concentrator at Clarkdale (1,600-ton), the concentrator at Hayden (12,000-ton), the concentrator at Superior (850-ton), and the test concentrator at Morenci (1,500-ton) were operated continuously on copper ore in 1940 at an increased rate over 1939. Copper-smelting plants at Douglas (5,000-ton), Clarkdale (5,000-ton), Hayden (1,000-ton), Miami (1,500-ton), and Superior (450-ton) were operated throughout the year.

The following tables give details of the treatment of all ores produced in Arizona in 1940.

Mine production of metals in Arizona in 1940, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore amalgamated	4,162	882	321			
Ore, old tailings, and slimes cyanided	742,801	72,141	125,009			
Concentrates smelted	862,160	101,451	2,658,647	318,549,746	24,115,117	30,874,492
Ore smelted	1,685,544	114,092	4,290,130	140,461,117	2,416,883	37,508
Copper precipitates smelted	20,460			[1] 32,737,425		
Copper ore leached	[2] 3,198,904			70,589,712		
Placer		6,241	1,108			
		294,807	7,075,215	562,338,000	26,532,000	30,912,000
Total, 1939		316,453	7,824,004	524,224,000	21,542,000	13,422,000

[1] Distributed as follows: Cochise County, 2,626,000 pounds; Gila County, 4,406,837 pounds; Greenlee County, 18,740,000 pounds; Pinal County, 6,218,000 pounds; and Yavapai County, 746,588 pounds.
[2] Treated by straight leaching at 1 plant in Gila County.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Arizona in 1940, by types of mills and by counties, in terms of recovered metals

County	Material treated (short tons)	Recovered in bullion: Gold (fine ounces)	Recovered in bullion: Silver (fine ounces)	Concentrates smelted and recovered metal: Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
AMALGAMATION MILLS								
Cochise	323	47	17	11	25	75		134
Gila	3	2	1					
Maricopa	1,407	125	60					
Mohave	393	93	33					
Pima	458	144	78	10	15	28		318
Pinal	21	27	12					
Santa Cruz	189	19	11	7	11	73		1,170
Yavapai	690	172	70	17	52	56		614
Yuma	678	253	39					
	4,162	882	321	45	103	232		2,236
Total, 1939	5,000	1,087	308	89	206	434	455	2,456
CYANIDATION MILLS								
Cochise	150	6	634					
Gila	25	22	3	13	3	1		
Maricopa	45,220	2,174	1,966	110	669	282		
Mohave	310,443	49,935	85,055					
Pima	395	78	645					
Pinal	187,610	3,885	9,053	4,510	25,320	30,008	7,008	3,815,600
Yavapai	198,451	15,941	27,597	636	8,019	8,969	9,136	89,000
Yuma	507	100	56					
	742,801	72,141	125,009	5,269	34,011	39,260	16,144	3,904,600
Total, 1939	733,943	77,823	144,713	5,090	33,050	36,318	18,320	3,757,000
Grand total: 1940		73,023	125,330	5,314	34,114	39,492	16,144	3,906,836
1939		78,910	145,021	5,179	33,256	36,752	18,775	3,759,456

Mine production of metals from concentrating mills in Arizona in 1940, by counties, in terms of recovered metals

County	Material treated (short tons)	Concentrates smelted and recovered metal					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Cochise	17,929	5,447	247	37,347	244,000	1,128,720	3,623,492
Gila	5,537,878	95,021	1,669	66,232	65,576,074		
Graham	650	83	43	1,471	4,584	27,443	
Greenlee	546,173	21,612	493	27,025	8,229,038		
Maricopa	3,390	635	15	27,512	109,451		
Mohave	70,725	18,957	5,457	180,688	225,441	4,472,683	8,589,000
Pima	6,468,192	167,829	32,192	366,292	104,130,447	6,095	
Pinal	2,420,051	242,033	7,054	507,460	82,644,193	329,322	6,350,000
Santa Cruz	120,056	18,382	1,887	543,841	534,798	11,715,980	8,376,000
Yavapai	755,727	286,766	18,235	859,357	56,815,300	2,528,038	3,936,000
Yuma	500	81	45	1,930	20,276		
	15,941,271	856,846	67,337	2,619,155	318,533,602	20,208,281	30,874,492
Total, 1939	14,017,765	662,962	76,415	2,991,985	269,115,493	15,522,918	13,338,249

Gross metal content of concentrates produced from ores mined in Arizona in 1940, by classes of concentrates smelted

Class of concentrates	Concentrates produced (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	345	1,592	3,324	1,500	8,980	
Dry gold-silver	144	207	7,648	1,268	7,600	
Dry silver	710	197	32,696	25,360	35,150	
Copper	785,856	47,172	1,410,937	328,244,576	786,222	2,585,400
Lead	33,101	48,795	910,157	548,693	21,877,618	3,526,770
Lead-copper	2,999	194	81,720	490,180	2,312,616	594,710
Zinc	32,357	1,398	169,655	587,599	1,275,800	34,309,882
Dry iron (from zinc-lead ore)	6,648	1,896	42,510	35,245	279,594	505,760
	862,160	101,451	2,658,647	329,934,421	26,583,580	41,522,522
Total, 1939	668,141	109,671	3,028,737	277,812,461	20,650,300	20,273,064

Mine production of metals from Arizona concentrates shipped to smelters in 1940, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Cochise	5,458	272	37,422	244,000	1,128,854	3,623,492
Gila	95,034	1,672	66,233	65,576,074		
Graham	83	43	1,471	4,584	27,443	
Greenlee	21,612	493	27,025	8,229,038		
Maricopa	745	684	27,794	109,451		
Mohave	18,957	5,457	180,688	225,441	4,472,683	8,589,000
Pima	167,839	32,207	366,320	104,130,447	6,413	
Pinal	246,543	32,374	537,468	82,651,201	4,144,922	6,350,000
Santa Cruz	18,389	1,898	543,914	534,798	11,717,150	8,376,000
Yavapai	287,419	26,306	868,382	56,824,436	2,617,652	3,936,000
Yuma	81	45	1,930	20,276		
	862,160	101,451	2,658,647	318,549,746	24,115,117	30,874,492
Total, 1939	668,141	109,671	3,028,737	269,134,268	19,282,374	13,338,249

BY CLASSES OF CONCENTRATES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	345	1,592	3,324	970	5,399	
Dry gold-silver	144	207	7,648	810	7,288	
Dry silver	710	197	32,696	24,340	28,120	
Copper	785,856	47,172	1,410,937	317,236,695		
Lead	33,101	48,795	910,157	438,638	20,716,760	
Lead-copper	2,999	194	81,720	397,587	2,200,030	
Zinc	32,357	1,398	169,655	416,870	934,520	30,874,492
Dry iron (from zinc-lead ore)	6,648	1,896	42,510	33,836	223,000	
	862,160	101,451	2,658,647	318,549,746	24,115,117	30,874,492

Gross metal content of Arizona crude ore shipped to smelters in 1940, by classes of ore

Class of ore	Ore (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	39,421	21,333	61,801	324,821	54,807	
Dry and siliceous gold-silver	47,787	8,885	406,586	422,100	410,262	
Dry and siliceous silver	36,595	619	554,337	203,502	128,384	
Copper	1,555,100	82,381	3,203,988	149,145,003	250,584	
Lead	6,456	867	62,068	45,023	1,774,331	
Lead-copper	44	7	1,350	3,028	17,807	
Zinc-lead	141				24,176	42,135
	1,685,544	114,092	4,290,130	150,143,477	2,660,351	42,135
Total, 1939	1,922,003	121,463	4,649,538	179,564,083	2,445,463	96,269

Mine production of metals from Arizona crude ore shipped to smelters in 1940, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Cochise	1,146,318	64,538	2,536,467	107,722,000	1,544,446	19,508
Coconino	532	4	218	84,000		
Gila	42,317	3,227	78,092	1,475,377	100,000	
Graham	44	5	862	1,416	10,157	
Greenlee	6,324	666	56,834	49,962	26,600	18,000
Maricopa	16,592	3,629	92,684	163,549	14,600	
Mohave	6,644	3,426	103,944	103,559	202,017	
Pima	3,829	1,011	27,517	244,553	93,087	
Pinal	100,406	6,937	514,574	11,576,799	64,778	
Santa Cruz	6,650	621	96,785	112,202	224,150	
Yavapai	351,034	28,424	754,897	18,830,976	94,348	
Yuma	4,854	1,604	27,256	96,724	42,700	
	1,685,544	114,092	4,290,130	140,461,117	2,416,883	37,508
Total, 1939	1,922,003	121,463	4,649,538	169,031,179	2,259,626	83,751

BY CLASSES OF ORE

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	39,421	21,333	61,801	313,715	47,146	
Dry and siliceous gold-silver	47,787	8,885	406,586	404,849	362,508	
Dry and siliceous silver	36,595	619	554,337	194,583	107,069	
Copper	1,555,100	82,381	3,203,988	139,509,459	178,667	
Lead	6,456	867	62,068	36,104	1,685,219	
Lead-copper	44	7	1,350	2,407	16,917	
Zinc-lead	141				19,357	37,508
	1,685,544	114,092	4,290,130	140,461,117	2,416,883	37,508

REVIEW BY COUNTIES AND DISTRICTS

COCHISE COUNTY

California district (Hilltop).—The metal output of the California district in 1940 was mostly lead ore from the Hilltop and Solution properties.

Cochise district.—In 1940, as in 1939, a little copper ore was produced from the Centurion mine.

Dos Cabezas and Tevis district.—The most important production in the Dos Cabezas and Tevis district in 1940 was placer gold recovered by a dry-land dredge at the Inspiration property and lode gold from the Dives and Gold Prince mines.

Golden Rule (Dragoon) district.—Virtually all the output of the Golden Rule district in 1940 was gold ore from the Golden Rule mine, which was treated by amalgamation.

Hartford (Huachuca Mountains) district.—The Armistice group near Hereford was worked in 1940, and several cars of crude lead ore were shipped to a smelter. The rest of the output from the Hartford district was chiefly gold ore from various prospects and placer gold from the Gold Nugget claim.

Swisshelm district (Elfrida).—The value of the metal output of the Swisshelm district was much greater in 1940 than in 1939, due largely to increased output of lead ore from the Scribner mine; the Chance and Great American mines also produced lead ore.

Tombstone district.—The Tombstone Development Co. continued in 1940 to be the most important producer in the Tombstone district; 6,680 tons of gold-silver-lead ore were shipped to the smelter at El Paso, Tex. The remainder of the district output was chiefly old tailings (gold-silver) from the Contention dump, lead ore from the Tombstone Extension mine, and silver ore from the Mellgren, Old Guard, and Solstice properties.

Turquoise district (Courtland, Pearce, Gleeson).—Several hundred tons of lead-silver ore were shipped in 1940 from the Defiance mine, by far the largest producer in the Turquoise district.

Warren district (Bisbee, Warren).—In 1940, as in 1939, the value of metal output in the Warren district was the greatest in any district of Arizona; it gained 10 percent over 1939. Crude copper ore (more than 1,000,000 tons) from the Copper Queen branch of the Phelps Dodge Corporation was, as usual, the principal output; the property also yielded 491 tons of lead ore and 1,924 tons of copper precipitates. It remained the largest producer of gold and silver in the State and again ranked second in copper.

The Bisbee mines of the Copper Queen branch of the Phelps Dodge Corporation, according to the annual report of the corporation for 1940, produced 804,926 tons of ore from the Limestone division. In comparison with 1939, a larger tonnage of ore was mined, the copper content of the ores mined was lower, and the production of copper increased slightly. From the Porphyry ore body, 187,539 tons were mined and shipped to the Douglas reduction works as siliceous flux. Production by leasers was greatly curtailed and, including a small tonnage of lead ore, totaled 16,381 tons. The surface and underground precipitation plants produced 1,924 tons of copper precipitates. The advance in exploration, development, and stope preparation amounted to 65,646 feet; in addition, 19,427 feet of diamond drilling were done. The results of the year's exploration and development campaign are considered encouraging, according to the report, as important ore extensions were developed in several known ore areas of the mine and scattered but extensive mineralization was encountered in drifting east of the Campbell fault on levels between the 2,000 and 2,566. In the Cole mine, the Dallas fault zone has opened up in a very satisfactory way. Pockets and skip-hoisting facilities were installed at the Cole shaft late in the year. Two 2,000-gallon centrifugal pumps were installed on the 2,700 level of the Campbell shaft to hasten drainage of the area east of the Campbell fault and permit necessary exploration in that area. This installation was ready for service in December. The average pumping rate at the Junction shaft was 6,379 gallons a minute, or slightly less than in 1939.

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1940, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pouuds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Cochise County:													
California	7		81	2		2	547		547	770	25,680		$1,830
Cochise	1		22							3,602			407
Dos Cabezas and Tevis	11	3	208	84	187	271	419	24	443	9,699	1,760		10,984
Golden Rule (Dragoon)	4		217	35		35	159		159	1,239	2,480		1,602
Hartford (Huachuca Mountains)	5	3	120	24	12	36	1,149		1,149	336	65,520		5,391
Rincon [1]	2		5	6		6	21		21	168			244
Swisshelm	3		1,114	117		117	5,452		5,452	991	331,240		24,646
Tombstone	13		9,526	1,342		1,342	113,130		113,130	41,885	551,800		159,741
Turquoise	13		1,824	93		93	20,856		20,856	24,575	310,280	19,508	37,606
Warren	4	2	1,151,603	63,160	2	63,162	2,432,807		2,432,807	110,508,735	1,384,540	3,623,492	16,725,660
Coconino County:													
Francis	3		22				7		7	6,752			768
Jacob Canyon and Warm Springs	3		500	4		4	204		204	75,106			8,772
Valle	1		10				7		7	2,142			247
Gila County:													
Banner and Dripping Springs	11	3	27,949	1,444	27	1,471	6,736	7	6,743	1,218,274	5,980		194,244
Globe-Miami	31	1	8,750,269	3,164	1	3,165	128,818		128,818	140,811,637	86,440		16,118,416
Green Valley	16	2	455	256	10	266	623		623	3,655			10,166
Pioneer (Pinal Mountains)	12		382	58		58	7,754		7,754	6,124	7,580		8,615
Summit	3		72	1		1	398		398	8,310			1,257
Graham County:													
Aravaipa	5		537	1		1	2,264		2,264	5,858	37,600		4,187
Rattlesnake	2		157	47		47	69		69	142			1,710
Greenlee County:													
Ash Peak	3		4,655	183		183	55,028		55,028	7,823			46,420
Copper Mountain (Morenci)	6	4	547,567	887	7	894	28,260		28,260	27,005,681	9,260		3,103,491
Metcalf (Greenlee)	6		251	89		89	564		564	1,558	17,340	18,000	5,693
Red Hill	1		24				7		7	3,938			450
San Francisco		4			19	19							665
Maricopa County:													
Big Horn	4	8	807	84	39	123	45	7	52				4,342
Cave Creek and Camp Creek	9	2	4,626	222	6	228	31,057		31,057	133,717			45,175
Eagle Tail	1		4	5		5							175
Ellsworth (Harqua Hala) [2]	5		217	67		67	104		104	8,142			3,339
McDowell	1		90	5		5	512		512	2,159			783
New River	3		62	1		1	38		38	6,221			765
Osborn	3		1,926	290		290	5,715		5,715	71,133	14,600		22,982
Pikes Peak (Morgan City)	8	3	588	716	10	726	381		381	531			25,741
Salt River Mountains	3		3,108	1,165		1,165	900		900				41,415
San Domingo	1	5	2	3	33	36							1,260

Sunflower	2	1	746	101	2	103	31	--------	31	265	--------	--------	3,657
Vulture	15	6	53,980	3,762	27	3,789	83,641	7	83,648	50,443	--------	--------	197,798
Webb (Gila Bend Mountains)	2	--------	10	11	--------	11	14	--------	14	327	--------	--------	432
White Tanks	3	--------	6	5	--------	5	7	--------	7	62	--------	--------	187
Winifred	5	--------	437	175	--------	175	59	--------	59	--------	--------	--------	6,167
Mohave County:													
Cedar Valley	8	--------	154	86	--------	86	6,729	--------	6,729	79,009	--------	--------	16,723
Chemehuevis	6	7	44	33	26	59	14	--------	14	--------	300	--------	2,090
Cottonwood	3	--------	35	58	--------	58	173	--------	173	--------	500	--------	2,178
Gold Basin	17	8	14,418	1,537	84	1,621	1,004	14	1,018	283	7,200	--------	57,851
Greenwood	4	--------	14	11	--------	11	45	--------	45	--------	--------	--------	417
Indian Secret (White Hills)	2	--------	114	14	--------	14	1,426	--------	1,426	--------	--------	--------	1,504
Lost Basin	1	3	12	--------	16	16	135	--------	135	--------	--------	--------	656
Maynard and McConnico	1	--------	4	3	--------	3	--------	--------	--------	--------	--------	--------	105
Minnesota	8	--------	1,346	293	--------	293	7,598	--------	7,598	443	--------	--------	15,708
Music Mountain	6	--------	533	608	--------	608	1,859	--------	1,859	1,115	13,620	--------	23,409
Owens	15	--------	1,899	247	--------	247	5,376	--------	5,376	23,929	45,100	--------	17,427
San Francisco (Oatman, Goldroad, Katherine, Vivian)	39	--------	252,744	41,609	--------	41,609	46,831	--------	46,831	--------	--------	--------	1,489,617
Wallapai	65	--------	76,317	8,135	--------	8,135	284,760	--------	284,760	224,221	4,607,480	8,589,000	1,284,039
Weaver	16	--------	40,571	6,277	--------	6,277	13,770	--------	13,770	--------	500	--------	229,512
Pima County:													
Ajo	1	--------	6,443,980	32,155	--------	32,155	350,003	--------	350,003	103,131,115	--------	--------	13,028,132
Amole	2	--------	100	--------	--------	--------	52	--------	52	6,168	380	--------	753
Arivaca	18	3	171	148	10	158	3,143	--------	3,143	1,221	5,700	--------	8,188
Baboquivari	5	2	1,992	878	5	883	17,446	--------	17,446	2,584	--------	--------	43,603
Cababi (Comobabi)	6	--------	610	154	--------	154	2,814	--------	2,814	6,575	21,240	--------	9,196
Catalina	--------	2	--------	--------	3	3	--------	--------	--------	--------	--------	--------	105
Cerro Colorado	1	--------	1	--------	--------	--------	128	--------	128	--------	--------	--------	91
Empire	6	--------	141	4	--------	4	1,485	--------	1,485	2,142	47,660	--------	3,821
Greaterville	8	4	62	13	25	38	249	7	256	168	13,100	--------	2,186
Helvetia (Rosemont)	2	--------	1,115	8	--------	8	1,409	--------	1,409	163,080	--------	--------	19,710
Old Baldy	1	--------	19	--------	--------	--------	83	--------	83	5,699	--------	--------	703
Old Hat [3]	3	--------	24,259	41	--------	41	16,093	--------	16,093	1,045,646	--------	--------	131,037
Pima (Sierritas, Papago, Twin Buttes)	9	--------	301	11	--------	11	1,402	--------	1,402	7,062	11,420	--------	2,751
Quijotoa	6	9	107	26	42	68	194	14	208	--------	--------	--------	2,528
Rincon [1]	1	--------	4	--------	--------	--------	7	--------	7	1,301	--------	--------	152
Roskruge and Waterman	1	--------	3	--------	--------	--------	14	--------	14	1,363	--------	--------	164
Santa Rosa	2	--------	9	2	--------	2	38	--------	38	876	--------	--------	196
Pinal County:													
Bunker Hill	3	--------	1,035	23	--------	23	5,573	--------	5,573	15,885	138,900	--------	13,508
Casa Grande	11	--------	2,064	131	--------	131	16,394	--------	16,394	22,690	3,900	--------	19,002
Cottonwood and Black Mountain	5	--------	50	24	--------	24	45	--------	45	451	--------	--------	923
Goldfields	4	--------	1,966	170	--------	170	675	--------	675	4,673	--------	--------	6,958
Hackberry	2	--------	69	22	--------	22	391	--------	391	965	--------	--------	1,157
Martinez Canyon	1	--------	91	1	--------	1	1,056	--------	1,056	752	19,300	--------	1,836
Mineral Creek	6	--------	2,105,861	1,931	--------	1,931	44,609	--------	44,609	63,458,637	22,900	--------	7,271,278
Mineral Hill	11	--------	1,981	698	--------	698	6,196	--------	6,196	10,504	2,000	--------	30,123
Old Hat [3]	12	3	186,520	29,306	4	29,310	39,285	--------	39,285	8,743	3,816,900	--------	1,245,619
Picacho	1	--------	168	16	--------	16	83	--------	83	1,027	5,800	--------	1,025
Pioneer (Superior)	8	--------	407,121	10,748	--------	10,748	940,223	--------	940,223	36,894,381	200,000	6,350,000	5,623,898

See footnotes at end of table.

311436—41——14

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1940, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Pinal County—Continued.													
Ripsey	2		940	113		113	4,739		4.739	16,204			$9,156
Riverside	2		26	7		7	7		7	159			268
Rockhouse	2		32				14		14	2,389			280
Roger	1		33	1		1	1,187		1,187	681			956
Saddle Mountain	6		124	32		32	412		412	5,673			2,054
Summit	1		7				218		218	2,186			402
Santa Cruz County:													
Harshaw	12		53,533	69		69	360,329		360,329	117,000	9,162,920	5,428,603	1,072,018
Nogales (Gold Hill)	7		291	64		64	526		526	2,832	4,900		3,179
Oro Blanco	22		54,564	2,342		2,342	214,477		214,477	183,513	1,582,200	967,397	395,280
Palmetto	2		356				135		135	52,549	700		6,069
Patagonia	5	1	17,619	37	7	44	57,181		57,181	273,221	1,134,740	1,980,000	254,553
Redrock	3		10				38		38	1,345	460		202
Tyndall	6		496	25		25	6,217		6,217	16,354	55,080		9,898
Wrightson	2		26	1		1	1,807		1,807	186	300		1,356
Yavapai County:													
Agua Fria	1		208	19		19	253		253	31,885			4,448
Ash Creek	4		358	192		192	1,215		1,215	4,540			8,097
Big Bug	21	20	73,282	6,544	1,404	7,948	213,120	180	213,300	158,354	1,380,000	3,480,000	735,994
Black Canyon	13	7	43,659	4,293	40	4,333	143,415	7	143,422	16,000	605,000		285,702
Black Rock	18	5	134	119	15	134	45		45	3,867			5,159
Blue Tank	2		16	9		9	7		7	416			367
Bullard (Pierce)	3		2,179	781		781	720		720	82,690			37,191
Castle Creek	7	4	225	120	26	146	329		329	12,938			6,806
Cherry Creek	20		757	510		510	1,367		1,367	5,186			19,408
Copper Basin	5	8	74	25	61	86	97	14	111	4,053	7,600		3,927
Eureka	20	1	85,718	2,509	2	2,511	53.491		53,491	1,515,708	554,780	456,000	353,665
Granite Creek		3			16	16							560
Hassayampa	71	12	2,512	1,700	367	2,067	11,416	69	11,485	7,718	19,160		82,342
Humbug	6	7	147	130	45	175	301	7	308				6,344
Kirkland	4	2	228	202	4	206	28		28				7,230
Lynx Creek		14			2,030	2,030		291	291				71,257
Martinez	9		91,395	5,091		5,091	13,275		13,275				187,625
Mineral Point	2		530	208		208	606		606	1,177			7,844
Mint Valley	2		11	8		8	7		7				285
Oak Creek		3			3	3							105
Peck	4		116	16		16	7,456		7,456	292	1,180		5,954
Pine Grove	11		5,182	2,849		2,849	26,917		26,917	42,239	7,900		124,024
Silver Creek	1		1	2		2							70
Silver Mountain	4		40	5		5	457		457		1,240		562
Thumb Butte	3	2	85	41	2	43	52		52	947			1,649

Tiger	6		346	226		226	457		457	1,407			8,394
Tip Top	7	1	20	9	3	12	1,350		1,350		340		1,397
Turkey Creek	7	1	104	69	11	80	872		872	106	7,020		3,783
Verde	6		896,727	24,652		24,652	1,144,028		1,144,028	74,459,646			10,090,291
Walker	28	10	1,668	1,220	76	1,296	8,782	17	8,799	34,655	29,280		56,997
Walnut Grove	6	12	72	67	52	119	31	7	38				4,192
Weaver	25	18	99,713	19,109	210	19,319	19,530	17	19,547	10,052	90,000		695,701
White Picacho	4		395	118		118	1,322		1,322	8,124	8,500		6,413
Yuma County:													
Castle Dome	3	2	682	269	256	525	3,939	343	4,282		40,300		23,435
Cienega	5		95	54		54	45		45	7,912			2,816
Dome (Gila City)		6			42	42		7	7				1,475
Ellsworth (Harqua Hala) [2]	32		599	294		294	353		353	16,947			12,456
Fortuna	1	2	327	138	2	140	45		45				4,932
Kofa	3	4	922	237	9	246	3,548		3,548				11,133
Laguna		4			30	30							1,050
La Paz and Middle Camp	3	11	22	58	160	218	796	17	813	9,956			9,333
La Posa (Copper Mountains)	2		5	2		2	14		14	221			105
Las Flores	1		180	100		100	38		38				3,527
Little Horn		1			3	3							105
Mohawk		2			1	1							35
Muggins		2			6	6							210
Plomosa and La Cholla	17	19	3,017	830	742	1,572	20,444	52	20,496	71,345	1,860		77,750
San Pablo		2			10	10							350
Santa Maria (Planet, Bill Williams)	4		116	13		13	59		59	10,619	540		1,724
Trigo		2			9	9							315
Yuma	2		67	7		7							245
Total Arizona	1,024	276	21,572,175	288,566	6,241	294,807	7,074,107	1,108	7,075,215	562,338,000	26,532,000	30,912,000	82,167,759

[1] Rincon district lies in both Cochise and Pima Counties.
[2] Ellsworth district lies in both Maricopa and Yuma Counties.
[3] Old Hat district lies in both Pima and Pinal Counties.

The output of copper ore from the Denn mine increased to 124,811 tons, and the property was also a large producer of zinc-lead ore. The Shattuck Denn Mining Corporation remodeled its 100-ton flotation plant during the year and treated 17,789 tons of zinc-lead ore. Most of the remainder of the district output was gold ore from the Sure Thing mine.

COCONINO COUNTY

Francis district.—Small lots of copper ore were produced in 1940 from various prospects.

Jacob Canyon and Warm Springs district.—Lessees operated the Mackin, Petoskey, and Brown Derby properties in 1940 and shipped carbonate copper ore to the smelter at Garfield, Utah.

GILA COUNTY

Banner and Dripping Springs district.—The principal output in the Banner and Dripping Springs district in 1940 was crude copper ore from the Christmas mine and crude gold ore from the Columbia and Gold Queen-Gold Nugget properties. Virtually all the placer gold produced in the district was recovered by a dry-land dredge at the Bywater claim.

Globe-Miami district.—The Globe-Miami district continued in 1940 to be the chief copper-producing area in Arizona on account of the large output of copper ore from the Inspiration and Miami properties. The Inspiration property, with a yield of 76,119,435 net pounds of copper, was the largest producer of copper in the district. According to the printed annual report of the Inspiration Consolidated Copper Co. for the year ended December 31, 1940, 3,187,037 tons of copper ore from which the slimes had been removed were treated by ferric sulfate leaching. The ore averaged 1.25 percent copper, of which 0.651 percent was oxide and 0.60 percent sulfide; extraction was 98.464 percent of the oxide and 77.629 percent of the sulfide. The slimes (237,274 tons) removed from the ore were treated at the concentrator to recover the sulfide copper, and the tailings were treated with sulfuric acid to dissolve the oxide copper. The Miami Copper Co. operated its 18,000-ton concentrator and 3,000-ton leaching plant throughout the year and treated 5,300,604 tons of ore containing an average of 0.736 percent copper; according to the printed annual report of the company, the net yield of copper was 64,129,683 pounds, and 383,124 pounds of molybdenum were recovered in the copper sulfide concentrates. Most of the district gold and silver output was recovered from copper ore from the Miami mine and from gold-silver ore (10,680 tons) shipped from the Continental mine. The rest of the district output was chiefly silver ore from the Rescue mine and copper ore from the Old Dominion mine.

Green Valley district (Payson).—The principal output in the Green Valley district in 1940 was crude gold ore from the Blue Goose, Rodeo, Royal Flush, Squatter, Planet, and Quertzel properties.

Pioneer (Pinal Mountains) district.—Gold-silver ore was produced from the Bobtail and Samsel mines in 1940, silver ore was produced chiefly from the Vindicator, Greater Republic, and Pioneer properties, and small lots of gold ore, lead ore, and copper ore were mined at various prospects.

Summit district.—A little copper ore was produced in 1940 from the Arizona-Globe, Gibson, and Yan properties.

GRAHAM COUNTY

The output of Graham County in 1940 was principally lead-silver ore from the Grand Reef mine in the Aravaipa district and gold ore from the Powers mine in the Rattlesnake district.

GREENLEE COUNTY

Ash Peak district (Duncan).—The Ash Peak mine was taken over early in 1940 by the Ash Peak Mines Co., and during the year 4,035 tons of silver ore were shipped to a smelter; silver ore was shipped also from the Hardy mine.

Copper Mountain district (Morenci).—Production in the Copper Mountain district in 1940 was, as usual, chiefly copper concentrates and copper precipitates from the Morenci branch of the Phelps Dodge Corporation; the rest of the district output was mostly crude gold ore from the Gold Belt and Keating mines. The corporation treated 546,173 tons of copper ore in its testing concentrator, shipped 11,425 tons of copper precipitates, continued developing a large open pit, and began building a new 25,000-ton concentrator and a smelting plant.

At the Morenci branch of the Phelps Dodge Corporation, according to the annual report of the corporation for 1940, the work of stripping the overburden in the open-pit mine proceeded on schedule. A total of 12,349,165 tons was removed compared with 8,868,278 tons in 1939. The total tonnage stripped to date, beginning with 1937, amounts to 28,916,706 tons. Approximately 17,500,000 tons of waste remain to be moved before mining is begun. Stripping operations were largely in the Clay Mountain, Colorado, and Liverpool areas. Disposal of the waste material was planned to tie in with railroad construction by dumping to preliminary alinement of the Coronado waste track and to sections of the railroad between the pit and the reduction works. After July 1 truck haulage was supplemented by rail service, and trains handled over 4,000,000 tons of material. Five benches are now serviced by rail. New pit equipment purchased in 1940 included electric shovels, Diesel electric locomotives, and 30- and 40-yard dump cars. A locomotive- and car-repair shop and an oil storage house were constructed near the pit. In all, 748,727 wet tons of material were mined from the area in which ore has been exposed in the pit. Of this, 565,968 tons of ore were delivered to the test mill, and the rest of the tonnage was waste and heap-leach material. The test mill treated 546,173 dry tons of ore. All major equipment tests were completed, and the flow sheet for the new mill was decided upon in September. Excavation and grading at the site of the reduction works were begun in December 1939 and continued through 1940, although the main yard was completed by the end of March. General excavation comprised 559,000 yards of natural surface and 52,000 yards of tailings. In early September a contract was awarded for the concrete work, and during the remainder of the year 13,836 yards of concrete were placed. In addition, a contract was let for steel erection, and steel has been placed as rapidly as foundations were ready. Nearing completion at the end of the year were the machine shop, carpenter shop, electric shop, warehouse, change room, and time office.

Metcalf (Greenlee) district.—Zinc-lead ore was shipped from the Lime Cap mine in 1940, gold ore from the Polaris and South Sycamore properties, and lead ore from the Midnight mine.

Red Hill district.—A little copper ore was produced in 1940 from the Chonga prospect near Clifton.

San Francisco district.—Placer operators continued in 1940 to recover a little gold from various claims along the San Francisco River.

MARICOPA COUNTY

Big Horn district.—The output of the Big Horn district in 1940 was chiefly gold ore from the Alice (Pump) and Tiger mines and placer gold, largely from the Borian and Davenport claims.

Cave Creek and Camp Creek district.—Copper-silver ore (3,465 tons) from the Red Rover mine on Camp Creek was the principal output in the Cave Creek and Camp Creek district in 1940; nearly all the ore was concentrated. The rest of the district output was mostly old tailings (gold) from the Van Buskirk dump cyanided, crude copper ore from the Black Mountain mine, and crude gold ore from the Maricopa mine.

Ellsworth (Harqua Hala) district.—Nearly all the output of the Ellsworth district in 1940 was gold-copper ore from the Copper Prince mine.

McDowell district.—Silver ore from the Dixie mine was treated in a concentration mill in 1940.

New River district.—Copper ore was shipped to a smelter in 1940 from the Orizaba, Lucky Strike, and Daisy properties.

Osborn district.—A new group of lessees took over the Belmont-McNeil mine in 1940 and shipped 1,352 tons of gold-silver ore and 108 tons of lead ore to various smelters. The remainder of the Osborn district output was largely old tailings (gold) shipped from the Belmont-McNeil dump.

Pikes Peak (Morgan City) district.—The value of the metal output of the Pikes Peak district increased greatly in 1940 owing to the large output of crude gold ore from various properties. The chief producers were the Keystone-Pikes Peak, Prince of Arizona, and Beacon properties.

Salt River Mountains district.—The Delta mine (most important producer in the Salt River Mountains district) was taken over in 1940 by the Park View Mining Co., and during the year 2,782 tons of gold ore were shipped to a smelter; other producers of gold ore were the North Delta and Young America mines.

San Domingo.—Placer gold recovered by various small-scale operators continued in 1940 to be the chief output of the San Domingo district.

Sunflower district.—In 1940, as in 1939, the principal output of the Sunflower district was gold ore from the Little Daisy mine.

Vulture district.—The value of the metal output of the Vulture district increased from $19,507 in 1939 to $197,798 in 1940. This large gain resulted from increased output of gold ore from the Vulture mine and from operation of the Newsboy (Pitt) mine; 35,272 tons of gold ore and 7,573 tons of old tailings from the Vulture property were treated by cyanidation and concentration, and 9,265 tons of crude gold-silver ore were shipped from the Newsboy mine. The rest of the district output was mostly old tailings (gold) from the Last Chance dump and gold ore from the Sunrise mine.

Webb (Gila Bend Mountains) district.—A little gold ore was produced in 1940 from the High Five mine and a small lot of copper ore from the Digmore prospect.

Winifred district.—The principal output of the Winifred district in 1940 was crude gold ore from the Jack White mine.

MOHAVE COUNTY

Cedar Valley district.—The Boriana mine was operated throughout 1940 by the Molybdenum Corporation of America, and several thousand tons of tungsten ore were concentrated; tungsten concentrates were shipped to a smelter in the East and copper concentrates to a smelter in Arizona. The remainder of the output from the Cedar Valley district was mostly crude gold-silver ore from the Arnold mine.

Chemehuevis district.—A little gold ore was produced in 1940 from various claims in the Chemehuevis district; placer gold was recovered principally from the Chief claim.

Cottonwood district.—The North Star, Bill George, and Deer Trail properties were producers of gold ore in 1940.

Gold Basin district.—The production of gold in the Gold Basin district was greater in 1940 than in 1939, due chiefly to operation of the Cyclopic mine; about 7,000 tons of gold ore and 4,200 tons of old tailings were treated in a cyanide plant. The Malco Gold Mining Co. operated its 25-ton concentration mill on gold ore from company mines and on custom ores; 3,007 tons of gold ore, largely from the O. K.-Excelsior group owned by the company, were treated. Other producers included the Climax, Eldorado, Cold Hill, M. O., Morning Star, Narrow Gauge (Fry), and Queen Anne properties. Placer gold and silver were recovered by various small-scale operators.

Greenwood district.—Small lots of gold ore were produced in 1940 from various prospects near Wikieup.

Indian Secret (White Hills) district.—The output of the Indian Secret district in 1940 was gold-silver ore from the Accident and White Hills properties.

Lost Basin district.—Placer gold recovered by various small-scale operators was the principal output in the Lost Basin district in 1940.

Minnesota district.—The value of the metal output of the Minnesota district declined from $60,832 in 1939 to $15,708 in 1940 owing to decreased output of gold ore from the Pope mine; the mine was idle in 1940, but about 800 tons of gold ore were shipped from the waste dump. The rest of the district production was largely silver ore from the Horn Silver mine.

Music Mountain district.—Lessees operated the Roosevelt mine in 1940 and shipped 334 tons of rich gold ore to a smelter. Other producers of gold ore included the Music Mountain, North Star, and Portland & Mizpah properties.

Owens (McCracken and Potts Mountain) district.—The output of the Owens district in 1940 was principally old tailings (lead) from the McCracken dump, gold-copper ore from the New England mine, silver ore and gold ore from the North Star mine, and gold ore from the Double Eagle and Gold Leaf properties.

San Francisco (Oatman, Goldroad, Katherine, Vivian) district.—Siliceous gold ore from the Goldroad mine of the United States Smelting, Refining & Mining Co. continued in 1940 to be the most important output in the San Francisco district; 153,280 tons of gold ore were treated in the company 300-ton cyanide plant, and the mine ranked fourth in gold production in the State.

Production of gold at Oatman, Goldroad, and Vivian in 1940 was 32,044 fine ounces compared with 37,403 in 1939, and that at Katherine was 9,565 ounces compared with 7,354; 92 percent of the gold output at Katherine came from the Tyro mine worked by the Gold Standard Mines Corporation. The company operated its 300-ton cyanide mill throughout the year on ore from company mines and on custom ores; 76,100 tons of gold ore and gold-silver ore were treated. About 74,000 tons of gold ore came from the Tyro mine—a substantial increase over 1939—and the remainder, largely from the Katherine, Pyramid, Minnie, and Philadelphia properties. The chief producers of gold ore at Oatman and Vivian were the Western, Vivian, Telluride, Tin Cup, Gold Dust, Pioneer, Moss, and Mossback properties. The Vivian Mining Co. worked the Western mine the first 6 months of the year and treated 9,954 tons of gold ore in the Vivian custom cyanide mill; 1,782 tons of gold ore produced by lessees from the Vivian-Lelande group and 6,596 tons of old tailings from the Vivian dump were treated also in the Vivian mill. The closing in November 1939 of the 300-ton custom cyanide mill of the Tom Reed Gold Mines Co. was a severe loss to many small gold producers at Oatman.

Wallapai district (Cerbat, Chloride, Mineral Park, Stockton Hill).—The value of the metal output of the Wallapai district was $1,284,039 in 1940—a gain of 62 percent over 1939; the principal output was zinc-lead ore from the Tennessee mine. The Tennessee-Schuylkill Corporation operated the mine continuously and treated 55,521 tons of zinc-lead ore in its 150-ton flotation plant—an increase of 43,933 tons over 1939; the mine was the largest producer of zinc in Arizona in 1940 and ranked second in lead. The Keystone mine was operated the first 6 months of the year by H. K. Ward Mines, and 3,410 tons of silver ore were treated in the company flotation plant—a decided decrease from 1939. Gold ore (2,810 tons) from the Golden Gem mine was concentrated; gold-silver ore (2,441 tons) from the White Eagle mine was shipped to a smelter; gold-silver ore (1,900 tons) from the Golconda group was concentrated; gold ore (1,142 tons) from the Golden Eagle mine was treated in the custom cyanide mill of Producers Mines, Inc.; and zinc-lead ore (855 tons) from the Juno mine was concentrated. Other fairly important producers were the Blue Bell, Rainbow, Columbus, Rico, Silver Hill, Summit, Minnesota-Connor, Tuckahoe, and Shooting Star properties. The Diana property (a large producer of gold-silver ore from 1935 to 1939, inclusive) was closed in January 1940 after the flotation mill had treated about 1,500 tons of ore.

Weaver (Mocking Bird, Pilgrim, Portland) district.—The production of gold in the Weaver district declined sharply in 1940 owing chiefly to idleness of the Klondyke and Portland mines, both large producers of gold ore in 1939. More than 92 percent of the district gold output in 1940 and nearly all the silver output came from the Pilgrim mine near Chloride operated by Producers Mines, Inc. The company operated its 300-ton custom cyanide plant throughout the year and treated a total of 50,000 tons of siliceous ores, mostly gold ore (39,027 tons) from the Pilgrim mine. Other producers of gold ore included the Dixie Gold, Dixie Queen, and Pershing properties.

PIMA COUNTY

Ajo district.—The output of copper ore (6,443,980 tons) from the New Cornelia mine in 1940 was nearly 6 percent greater than that in 1939, resulting in a substantial increase in production of copper; however, production of silver was less and that of gold virtually the same as in 1939. The property was again the largest producer of copper in Arizona and ranked second in gold.

Operations at the New Cornelia branch of the Phelps Dodge Corporation, according to the annual report of the corporation for 1940, were on a continuous basis throughout the year, broken only by a summer shut-down of 2 weeks. There were mined at the open pit 6,438,740 tons of ore and 6,491,333 tons of waste, of which 1,082,120 tons came from Arkansas Mountain stripping operations. The waste ratio was 1.01, of which 0.84 was in the pit proper. The reserves of broken ore were slightly reduced. Mining costs were well-maintained. Better ore breakage was achieved, with correspondingly improved crushing results. All loading was done by full-revolving electric shovels. The Diesel electric locomotives were taken out of service in July and transferred to Morenci. Twenty 30-cubic yard cars were purchased during the year. The concentrator treated 6,443,980 tons of ore. Metallurgy remained about constant, but costs improved, largely owing to improved ore breakage in the mine and to the adoption of single-stage grinding in the mill. Mechanical department, power-plant, and pumping operations were largely routine, according to the report.

Amole district.—Copper ore was produced from the Gould mine in 1940 and lead ore from the Old Yuma property.

Arivaca district.—Most of the output of the Arivaca district in 1940 was gold ore from the Oreona, Ajax, and Mother Lode properties.

Baboquivari district.—Production of gold and silver in the Baboquivari district was much greater in 1940 than in 1939 due to shipments of crude gold-silver ore from the Allison mine by the Tombstone Mining Co. In December the company completed building a 100-ton cyanide plant, and during the month treated about 400 tons of gold ore. The remainder of the district output was principally gold ore from the Allison waste dump, which was amalgamated.

Cababi (Comobabi) district.—Lessees operated the Wayne mine in 1940 and shipped crude gold ore, gold-silver ore, and lead-silver ore to various smelters; however, the chief output of the Cababi district was gold ore from the Jaeger mine, which was treated by amalgamation and concentration.

Empire district.—Nearly all the output of the Empire district in 1940 was lead ore from the Chief and Bonnie Jean mines and silver ore from the Dutchman group.

Greaterville district.—Small lots of lead ore and gold ore were produced in 1940 from various prospects in the Greaterville district, and placer gold was recovered chiefly from the Jones claim.

Helvetia (Rosemont) district.—Virtually all the output of the Helvetia district in 1940 was crude copper ore from the Helvetia property, operated by lessees.

Old Baldy district.—Copper ore was produced in 1940 from the Parber group.

Old Hat district (Oracle).—The value of the metal output of the Old Hat district in Pima County increased from $11,175 in 1939 to $131,037 in 1940 as a result of steady operations at the Daily and Geesaman groups by Control Mines, Inc.; about 24,000 tons of copper ore were treated in a flotation plant, and some crude copper ore was shipped to a smelter.

Pima (Sierritas, Papago, Twin Buttes) district.—The principal output of the Pima district in 1940 was silver-lead ore from the Paymaster mine.

Quijotoa district.—Gold ore was produced in 1940 from the Cara Voca and Valley View mines. The rest of the Quijotoa district output was largely placer gold recovered chiefly from the Right Spot claim.

PINAL COUNTY

Bunker Hill district (Copper Creek).—There was a substantial decrease in production of copper in the Bunker Hill district in 1940 owing to idleness of the Childs mine. Nearly all the output of the district was lead ore from the Bluebird property, which was treated by concentration.

Casa Grande district.—The output of the Casa Grande district in 1940 was mostly gold-silver ore from the Greenback mine, silver ore from the Orizaba and Silver Reef mines, gold ore from the Turning Point and Mammon mines, and copper ore from the Reward mine.

Cottonwood and Black Mountain district.—Gold ore was produced in 1940 principally from the Grand View and Mountain View properties.

Goldfields (Superstition Mountains) district.—About 1,500 tons of old tailings (gold) from the Bulldog dump were cyanided in 1940, and 462 tons of first-class gold ore from the Superstition mine were shipped to a smelter.

Hackberry district.—Gold ore was produced in 1940 from the Venado mine and a small lot of copper-silver ore from the Deer claim.

Martinez Canyon district.—Lessees continued in 1940 to work the Silver Bell mine and shipped 1 car of silver ore and 1 car of lead ore.

Mineral Creek district (Ray).—The gain of $2,686,510 in value of metal output in the Mineral Creek district in 1940 resulted from the increase in output of copper ore from the Ray mine. The Nevada Consolidated Copper Corporation operated the mine throughout the year and shipped 127,837 tons of copper concentrates and 3,519 tons of copper precipitates to the smelter at Hayden; 2,103,004 tons of copper ore were treated by flotation. The remainder of the district output was chiefly gold ore (2,685 tons) shipped from the Broken Hill mine.

Mineral Hill district.—There was a substantial gain in production of gold in the Mineral Hill district in 1940 due to increase in output of gold ore from the Sunset and Horace properties. The chief producers of silver ore were the Gorham & Hall and Silver Pick mines.

Old Hat district (Oracle).—In 1940, as in 1939, the principal output of the Old Hat district was gold-molybdenum-lead ore from the Mammoth-St. Anthony & New Year-Mohawk groups. The Mammoth-St. Anthony, Ltd., operated both groups and treated a total of 186,110 tons of mixed ores compared with 191,892 tons in 1939.

The ore was treated by gravity concentration followed by flotation, and the flotation tailings were treated by cyanidation. Lead concentrates containing considerable gold, molybdenum, and vanadium were smelted in the company 20-ton lead furnace, and gold precipitates were shipped to an eastern refinery; the property ranked third in both gold and lead production in Arizona in 1940. The remainder of the district output was largely crude gold ore from the Old Gold Camp and Southern Belle properties.

Picacho district.—Lessees operated the Better Pay mine in 1940 and shipped 141 tons of gold ore and 27 tons of lead ore.

Pioneer district (*Superior*).—The output of ore and the production of each of the five metals in the Pioneer district were greater in 1940 than in 1939 due chiefly to increases in output of copper ore and zinc-copper ore from the Magma mine. The Magma Copper Co. operated its mine, 850-ton concentrator, and 450-ton copper smelter continuously, except for the usual summer shut-down. According to the company printed annual report, the mill treated 237,003 tons of copper ore averaging 5.16 percent copper and 79,044 tons of zinc-copper ore averaging 1.74 percent copper and 7.31 percent zinc; in addition, 62,158 tons of copper ore were sent direct to the smelter. Production, after all losses (including refining) were deducted, was 11,307 ounces of gold, 629,417 ounces of silver, 34,281,249 pounds of copper, and 5,992,796 pounds of zinc. The average net cost of producing copper after deduction of gold, silver, and zinc concentrate values was 7.8 cents a pound. Lessees continued to work the Lake Superior & Arizona group of the Magma Copper Co. and shipped 6,357 tons of gold ore to a smelter. Wm. J. Forbach operated the Reymert mine continuously and shipped 20,700 tons of silver ore to various smelters. The rest of the district output was chiefly silver ore from the Belmont and Picket Post properties.

Ripsey district.—Nearly all the output of the Ripsey district in 1940 was crude gold-silver ore from the Norman group (Old Ripsey), but the output was much less than in 1939.

Riverside district.—A little gold ore was produced in 1940 from the Arizona Gold and Mendoza properties.

Rockhouse district.—Copper ore was produced in 1940 from claims 17 miles southeast of Coolidge Dam.

Roger district.—The Iron Mountain mine was operated in 1940 and 33 tons of silver ore were shipped to a smelter.

Saddle Mountain district.—The chief output of the Saddle Mountain district in 1940 was copper ore from the Senator mine and gold ore from the Hoosier and Columbia properties.

Summit district.—A small lot of copper-silver ore from the American mine was sold in 1940.

SANTA CRUZ COUNTY

Harshaw district.—The value of the metal output of the Harshaw district increased from $492,490 in 1939 to $1,072,018 in 1940 owing chiefly to the large gain in output of zinc-lead-silver ore from the Trench mine operated by the American Smelting & Refining Co. The mine was the largest producer of lead in the State in 1940 and ranked third in zinc; about 42,000 tons of zinc-lead-silver ore were treated in the company 200-ton flotation plant. The Flux mine was operated under lease the first 8 months of the year by the Flux Mining Co. and the last 4 months by the American Smelting & Refining Co.; 7,147 tons of zinc-lead-silver ore were treated in the Trench mill. Lessees continued working the American mine and shipped 3,386 tons of silver ore to various smelters. The remainder of the district output was largely lead-silver ore from the Hardshell and World's Fair properties and silver ore from the Salvador mine.

Nogales (Gold Hill) district.—The output of the Nogales district in 1940 was mostly gold ore from the Bacon, Hardscrabble, Silent Friend, and Golden properties.

Oro Blanco district (Ruby).—The output of ore and the production of each of the five metals in the Oro Blanco district were much less in 1940 than in 1939 due to exhaustion of ore reserves at the Montana mine. During the first 4½ months of the year, the mill treated 53,038 tons of zinc-lead-silver-gold-copper ore; both the mine and 300-ton flotation plant were closed May 15. The property was the largest producer of lead and zinc in Arizona from 1935 to 1939, inclusive. The rest of the district output was principally crude silver ore from the Rubiano and Brick mines, gold ore from the Oro Blanco, Austerlitz, and Brown Bird properties, and gold-silver ore from the Old Soldier mine.

Palmetto district.—Several cars of copper ore from the Three R mine were shipped to a smelter in 1940, and a small lot of silver-lead ore was produced from the La Palma prospect.

Patagonia (Duquesne) district.—The output of silver, copper, lead, and zinc from the Patagonia district increased greatly in 1940 owing to output of zinc-lead-copper ore from the Duquesne group. The Callahan Zinc-Lead Co. operated the property throughout the year and in March completed building a 100-ton flotation plant; about 17,500 tons of zinc-lead-copper ore were treated during the remainder of the year. Nearly all the rest of the district output was copper ore from the Gladstone mine.

Tyndall district.—The principal output of the Tyndall district in 1940 was crude copper-silver ore and lead-silver ore from the Alto group operated by the Long Contact Mining Co.

Wrightson district.—A little lead-silver ore was produced in 1940 from the Armada and El Rosario prospects.

YAVAPAI COUNTY

Agua Fria district.—A lessee worked the old Binghampton mine in 1940 and shipped several cars of copper ore to a smelter.

Ash Creek district.—Nearly all the output of the Ash Creek district in 1940 was crude gold ore from the Gold Coin, Bird, and Red Bird properties.

Big Bug district.—The increase in production of zinc and lead in the Big Bug district in 1940 resulted from the gain in output of zinc-lead ore from the Iron King mine; the output of placer gold was greater owing to the operation of a dragline dredge at the Hill property. The Iron King Mining Co. operated its mine and 225-ton flotation plant continuously and shipped 5,389 tons of lead concentrate, 3,847 tons of zinc concentrate, and 6,648 tons of iron concentrate; 65,812 tons of zinc-lead-iron ore were treated in the mill. During the last quarter of the year the company built a cyanide plant and treated 6,900 tons of current flotation tailings. The remainder of the district lode output was chiefly crude gold ore from the Wizard, Red Rock, Belcher, and Union Jessie properties. The Big Bug Dredging Co. operated a 2¼-yard dragline dredge at the Hill property the last 4 months of the year and recovered 1,100 fine ounces of gold. The rest of the placer gold was recovered chiefly by a dry-land dredge and a dragline dredge; each worked a few months at the Shanks & Savoy property.

Black Canyon district.—The principal output of the Black Canyon district in 1940 was, as usual, gold-silver-lead ore from the Golden Turkey group; 43,544 tons of ore were treated by flotation. Placer gold was recovered from various claims near Bumble Bee.

Black Rock district.—Small lots of gold ore and copper ore were produced in 1940 from various prospects and sold to the Wickenburg Ore Market. A little placer gold was recovered from gravel along the Hassayampa River.

Blue Tank district.—A little gold ore was produced in 1940 from the Franklin D. and Lone Star claims.

Bullard (Pierce) district.—Nearly all the output of the Bullard district in 1940 was crude gold-copper ore from the Bullard mine operated by Bullard Gold Mines, Inc.

Castle Creek district.—The chief production in the Castle Creek district in 1940 was lode gold from the Gold Rock mine and placer gold from the Buckhorn claim.

Cherry Creek district.—In 1940, as in 1939, virtually all the output of the Cherry Creek district was crude gold ore shipped to smelters; the principal producers were the Sitting Bull, Sunnybrook, Leghorn-Falls, Volcano, and Gold Eagle properties.

Copper Basin district.—The chief production in the Copper Basin district in 1940 was placer gold from the Queen of Sheba, Forback & Easton, Bennett, and Stoop properties and lode gold from the McNary mine.

Eureka district.—The Bagdad Copper Corporation operated its mine and 275-ton concentrator continuously in 1940 and shipped 1,728 tons of copper concentrate; 73,644 tons of copper ore were milled in 1940 compared with 14,196 tons in 1939. The Hillside mine and mill were leased to the Boulder Mining Co. in 1940, and during the last 5 months of the year the 125-ton mill treated 10,956 tons of zinc-lead-gold-silver ore—a substantial decrease from 1939. The remainder of the district output was largely crude gold ore from the Doughboy, Anarchist, and Southern Cross mines.

Granite Creek district.—Placer gold was recovered in 1940 from gravel along Granite Creek.

Hassayampa (Groom Creek, Hassayampa River, Senator, Prescott) district.—The principal output of the Hassayampa district in 1940 was crude gold ore from the Oro Flame, Evergreen, Nevada, U. P., Alma, Hidden Treasure, Ibex, Independence, Railroad, and Sundown properties and old tailings (gold-silver) from the Big Pine dump treated by cyanidation. Numerous small lots of ore from various prospects were sold to ore buyers in Prescott. Most of the placer gold produced in the district was recovered by a dragline dredge working at the Hobbs property.

Humbug district.—Nearly all the output in the Humbug district in 1940 was lode gold from the Little Joseph mine and placer gold recovered from gravel along Cow, French, and Humbug Creeks.

Kirkland district.—Crude gold ore (221 tons) from the Venus mine was the chief output of the Kirkland district in 1940.

Lynx Creek district.—The Lynx Creek Placer Mine Co. operated its two draglines and floating washer in 1940 from January to September 1, when the property and equipment were taken over by Placer King Mines, Inc.; the total output of gold during the year was 1,393 fine ounces compared with 2,350 in 1939. The remainder of the district output was placer gold and silver, recovered principally by dry-land dredges working at the Fitzmaurice and Pioneer properties.

Martinez (*Congress*) district.—The most important output in the Martinez district in 1940 was, as usual, old tailings and waste-dump ore containing gold and silver from the Congress dumps; 51,576 tons of old tailings and 39,731 tons of ore were treated in a 300-ton cyanide plant.

Mineral Point district.—Virtually all the output in the Mineral Point district in 1940 was crude gold ore from the Buster mine.

Mint Valley district.—Small lots of gold ore were produced in 1940 from the Lobo and Tip Top claims.

Peck district.—The output of the Peck district in 1940 was crude gold ore from the Black Jack, E. H. C., and Good Hope properties and high-grade silver ore from the Swastika mine.

Pine Grove district (*Crown King*).—Operations at the Gladiator-War Eagle group were continuous throughout 1940, and 4,378 tons of crude gold ore containing some silver and copper were shipped to a smelter. The rest of the district output was mostly gold-silver ore concentrated from the Union & Eagle property and crude gold ore from the Del Pasco mine.

Silver Mountain district (*Wagoner*).—A little gold ore was produced in 1940 from the Fenton and Golden Wizard claims, silver ore from the Little Joker mine, and lead ore from the Silver King prospect.

Thumb Butte district.—In 1940, as in 1939, nearly all the output of the Thumb Butte district was crude gold ore from the Last Chance Extension mine.

Tiger district.—The chief output of the Tiger district in 1940 was gold ore from the Southern Belle, Fortuna, Oro Belle, and Pilgrim properties.

Tip Top district.—Small lots of rich silver ore were produced in 1940 from the "76", Bramlet, Ensign, Chloride, and Silver Basin claims and gold ore from the Midway and San Domingo prospects.

Turkey Creek district.—The principal production in the Turkey Creek district in 1940 was lode gold from the Cumberland and Parker mines and placer gold from the Barnes property.

Verde district (*Jerome*).—The output of ore and the production of gold, silver, and copper in the Verde district in 1940 were less than in 1939 owing to decline in output of copper ore from the United Verde mine. The Phelps Dodge Corporation operated the mine and concentrator continuously and shipped 263,773 tons of copper concentrate, 306,915 tons of crude copper ore (694,716 tons in 1939), 14,094 tons of old tailings (copper), and 448 tons of copper precipitates to the company smelter at Clarkdale; 561,310 tons of copper ore were concentrated in 1940 compared with 294,933 tons in 1939. The property ranked second in the State in production of silver and fourth in copper. Lessees continued to work the Iron King Equator group and shipped 9,122 tons of gold-silver ore to a smelter. The remainder of the district output was mostly crude copper ore from the United Verde Extension mine dump.

Walker district.—The chief output of the Walker district in 1940 was crude gold-silver ore from the Sheldon mine and gold ore from the Oro-Plata, Virgin Mary, Lucky Strike, Alturas, Alturas Extension, Emma, Last Chance, and Mohawk properties. Numerous small lots of ore from various prospects were sold to ore buyers in Prescott. Placer gold and silver were recovered by various small-scale operators working on Lynx Creek near Walker.

Walnut Grove district.—The principal production in the Walnut Grove district in 1940 was lode gold from the Granite and Moyer mines and placer gold recovered from various claims on Placeritas Gulch, French Gulch, Blind Indian Creek, and Mill Creek.

Weaver district (*Octave*).—Production of gold in the Weaver district increased from 17,847 ounces in 1939 to 19,319 in 1940; nearly 97 percent of the total came from three properties—the Octave, Alvarado, and Yarnell. The most important producer was, as usual, the Octave mine operated by the American Smelting & Refining Co.; 29,099 tons of gold ore were treated by flotation, and the flotation tailings were cyanided. About 37,300 tons of gold ore from the Alvarado mine were treated in a 100-ton cyanide plant operated by Liberty Hill Gold Mines, Ltd. The Yarnell mine was worked continuously by the Winslow Gold Mining Co., and 32,379 tons of gold ore were treated in the company cyanide plant compared with 1,200 tons treated by concentration in 1939. Other producers of gold ore included the Alto, Beehive, George Myers, Leviathan, and Rincon properties. Placer gold was recovered chiefly from the Merrill, June, McIntosh, Lucero, and Johns properties.

White Picacho district.—Nearly all the output of the White Picacho district in 1940 was crude gold ore from the Young mine and lead-silver ore from the Independence mine.

YUMA COUNTY

Castle Dome district.—Lessees worked the Big Eye mine in 1940 and shipped 441 tons of first-class gold ore and 206 tons of old tailings to the smelter at Hayden. The remainder of the output of the Castle Dome district was chiefly placer gold recovered at the Ocatilla property by a Stebbins dry concentrator.

Cienega district.—The output of the Cienega district in 1940 was copper-gold ore from the Black Hill, Golden Ray, Sue, White Cloud, and Yuma Chief properties.

Dome (*Gila City*) *district.*—Placer gold and silver were recovered by various operators working along the Gila River near Dome.

Ellsworth district (*Salome*).—The principal output of the Ellsworth district in 1940 was crude gold ore from the Alaskan, Blue Eagle, Blue Jay, Centroid, and Golden Treasurer properties and gold-copper ore from the Critic, Copper Belt, and Oro Fino mines. Numerous small lots of gold ore from prospects were sold to an ore buyer in Wickenburg.

Fortuna district.—Lessees continued in 1940 to operate the Fortuna mine; 327 tons of gold ore were treated by amalgamation and cyanidation.

Kofa district.—Nearly all the output of the Kofa district in 1940 was gold-silver ore from the Sheep Tanks mine and gold ore from the Quartette and Verdstone mines.

Laguna district.—Placer gold was recovered by various small-scale operators working in the Laguna Dam area.

La Paz and Middle Camp district.—The chief production in the La Paz and Middle Camp district in 1940 was placer gold recovered principally by a dry-land dredge at the Golden Anchor (Jones) property and lode gold from the Copper Bottom mine.

Las Flores district.—Lessees operated the Las Flores mine in 1940 and hauled 180 tons of gold ore to the Burton custom mill at Blaisdell.

Plomosa and La Cholla district.—The output of gold and silver from lode mines in the Plomosa and La Cholla district increased substantially in 1940, but that of gold from placer properties declined sharply. The chief output from lode mines was crude gold-copper ore from the Little Butte mine, silver ore from the R. & A. mine, and copper ore from the Apache mine. The Arizona Drift property was by far the largest producer of placer gold in the district, but its output of gold was much less than in 1939. The remainder of the district output was largely gold ore from the Dutchman, Moon Mountain, and Julius properties.

San Pablo district.—A little placer gold was recovered in 1940 from gravel along the Colorado River near San Pablo.

Santa Maria (Planet, Bill Williams) district.—Gold ore was produced in 1940 from the Diana Mae and Townsend mines and copper ore from the Oversight mine.

Trigo district.—Placer gold was recovered in 1940 chiefly from the Trigo claim.

Yuma district.—In 1940 gold ore from the Jude and McIntyre properties was treated by amalgamation in the Burton custom mill at Blaisdell.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN CALIFORNIA

(MINE REPORT)

By Charles White Merrill and H. M. Gaylord

SUMMARY OUTLINE

The total value of the gold, silver, copper, lead, and zinc recovered from ores, old tailings, and gravels in California in 1940—$54,268,690—was greater than in any year since 1856 (see fig. 1); the increase over 1939, however, was only $1,350,678 or 3 percent. Most of the increase was due to the advance in gold and copper production.

Gold increased 1 percent in both quantity and value; silver decreased 9 percent in quantity and 5 percent in value; and copper increased 54 percent in quantity and 67 percent in value, lead 237 percent in quantity and 258 percent in value, and zinc 1,217 percent in quantity and 1,495 percent in value. Of the total value of the five metals in 1940, gold represented 94 percent, silver 3 percent, copper almost 3 percent, and lead and zinc combined less than 0.4 percent.

Nevada County, despite a 1-percent decline in 1940 in total value of production, continued to be the largest contributor to the metal-mining output of California; it supplied 21 percent of the State total value of the five metals, 22 percent of the total gold, and 40 percent of the lode gold. Sacramento County (largely from gold dredging) contributed 10 percent of the total value of the five metals; Amador County (two-thirds from gold ore and one-third from placer gravels), 8 percent; Yuba County (largely from gold dredging), 7 percent; Kern County (largely from gold and gold-silver ores), 6 percent; Calaveras County (almost two-thirds from gold ore and one-third from placer gravels), 6 percent; Plumas County (largely from gold and copper ores), 5 percent; Butte County (largely from placer gravels), 5 percent; and Siskiyou County (largely from placer gravels), 4 percent. Thus, the foregoing 9 of the 44 counties producing the metals in California in 1940 contributed over $2,000,000 each to the State total value and supplied over 71 percent of that total.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

Yardage figures used in measuring material treated in placer operations are "bank measure"; that is, the material is measured in the ground before treatment.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1936–40

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1936	$35.00	$0.7745	$0.092	$0.046	$0.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4].646+	.098	.046	.048
1939	35.00	[5].678+	.104	.047	.052
1940	35.00	[6].711+	.113	.050	.063

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January, 18, 1837, to January 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] 1936–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–40: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787. [6] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in California, 1936–40, and total, 1848–1940, in terms of recovered metals

Year	Mines producing [1]		Ore, old tailings, etc. (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1936	903	639	4,635,691	1,077,442	$37,710,470	2,103,799	$1,629,392
1937	913	838	4,925,014	1,174,578	41,110,230	2,888,265	2,234,073
1938	927	676	4,648,249	1,311,129	45,889,515	2,590,804	1,674,863
1939	1,028	749	5,577,853	1,435,264	50,234,240	2,599,139	1,764,264
1940	1,030	836	4,669,433	1,455,671	50,948,485	2,359,776	1,678,063
1848–1940	--------	--------	(2)	98,853,966	2,161,992,462	100,878,000	81,804,036

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1936	8,762,000	$806,104	964,000	$44,344	16,000	$800	$40,191,110
1937	10,502,000	1,270,742	2,372,000	139,948	40,000	2,600	44,757,593
1938	1,612,000	157,976	990,000	45,540	------------	------------	47,767,894
1939	8,360,000	869,440	1,052,000	49,444	12,000	624	52,918,012
1940	12,876,000	1,454,988	3,544,000	177,200	158,000	9,954	54,268,690
1848–1940	[3] 588,627	191,273,020	[3] 122,388	14,370,025	[3] 52,043	9,389,464	2,458,829,007

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Figures not available.
[3] Short tons.

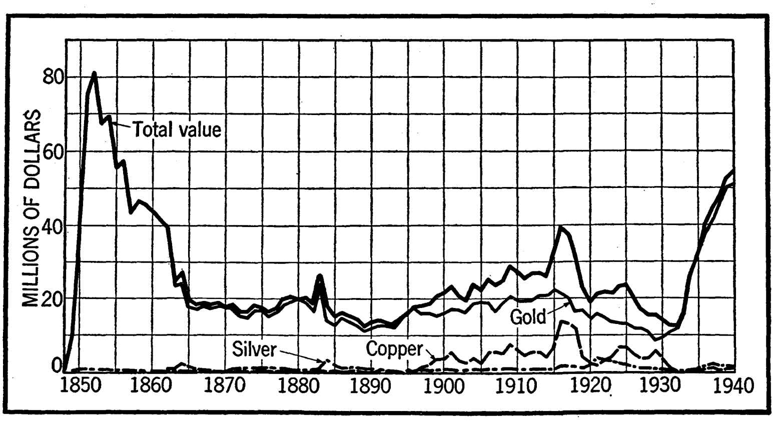

FIGURE 1.—Value of mine production of gold, silver, and copper and total value of gold, silver, copper, lead, and zinc in California, 1848–1940. The value of lead and zinc has exceeded $1,000,000 in only a few years.

Gold produced at placer mines in California, 1903–40, by classes of mines and by methods of recovery, and total, 1848–1940

Class and method	Mines producing [1]	Washing plants (dredges)	Material treated (cubic yards)	Gold recovered		
				Fine ounces	Value	Average per cubic yard
Surface placers:						
Gravel mechanically handled:						
Connected-bucket dredges:						
1898 [2]	2	[3] 2	(4)	913.66	$18,887	(4)
1899	8	8	(4)	9,979.86	206,302	(4)
1900	9	[3] 11	(4)	13,236.80	273,629	(4)
1901	14	[3] 17	(4)	22,821.49	471,762	(4)
1902	20	29	(4)	41,973.29	867,665	(4)
1903	27	31	(4)	71,389.36	1,475,749	(4)
1904	27	42	(4)	105,797.96	2,187,038	(4)
1905	26	50	(4)	158,483.32	3,276,141	(4)
1906	24	59	(4)	246,633.11	5,098,359	(4)
1907	23	57	(4)	245,040.51	5,065,437	(4)
1908	29	69	(4)	316,188.14	6,536,189	(4)
1909	33	63	(4)	357,150.20	7,382,950	(4)
1910	41	72	(4)	365,243.53	7,550,254	(4)
1911	34	65	(4)	370,865.04	7,666,461	(4)
1912	35	65	(4)	359,424.07	7,429,955	(4)
1913	36	63	(4)	391,367.96	8,090,294	(4)
1914	35	60	(4)	376,521.68	7,783.394	(4)
1915	34	58	(4)	377,153.99	7,796,465	(4)
1916	33	60	(4)	375,836.35	7,769,227	(4)
1917	30	55	(4)	402,166.86	8,313,527	(4)
1918	28	49	(4)	359,519.46	7,431,927	(4)
1919	24	46	70,600,000	373,305.95	7,716,919	$0.109
1920	24	40	(4)	333,805.20	6,900,366	(4)
1921	19	35	(4)	375,234.56	7,756,787	(4)
1922	20	35	62,000,000	241,837.04	4,999,215	.081
1923	14	29	59,300,000	293,429.92	6,065,735	.102
1924	13	27	46,300,000	208,279.59	4,305,521	.093
1925	13	24	49,552,000	229,821.98	4,750,842	.096
1926	13	23	52,084,000	239,482.59	4,950,545	.095
1927	15	25	51,327,000	264,220.81	5,461,929	.106
1928	12	24	49,142,000	214,345.43	4,430,913	.090
1929	14	25	43,435,000	173,630.38	3,589,259	.083
1930	14	24	42,724,000	166,980.85	3,451,801	.081
1931	13	22	44,424,000	175,086.28	3,619,355	.082
1932	13	22	48,723,000	188,830.89	3,903,481	.080
1933	16	25	55,427,000	201,710.32	5,155,716	.093
1934	17	28	59,210,000	193,773.38	6,772,380	.114
1935	20	36	75,014,000	236,403.70	8,274,130	.110
1936	26	40	78,855,000	276,324.21	9,671,347	.123
1937	33	46	94,809,000	322,961.00	11,303,635	.119
1938	33	48	117,080,000	375,296.00	13,135,360	.112
1939	34	47	121,655,000	370,264.00	12,959,240	.107
1940	32	46	132,461,000	414,966.00	14,523,810	.110
Dragline dredges:						
1933 [2]	3	3	11,500	75.26	1,924	[5] .167
1934	4	4	604,000	3,466.04	121,138	.201
1935	24	23	3,906,000	22,191.47	776,701	.199
1936	30	26	10,016,000	49,967.54	1,748,864	.175
1937	51	47	19,364,000	94,142.00	3,294,970	.170
1938	77	68	24,560,000	118,108.00	4,133,780	.168
1939	142	109	31,618,000	172,519.00	6,038,165	.191
1940	198	106	42,747,000	205,181.00	7,181,335	.168
Becker-Hopkins dredges:						
1940 [2]	2	2	35,000	148.00	5,180	.148
Nonfloating washing plants:						
1915 [2]	1	1	(4)	24.09	498	(4)
1916	------	------	------	------	------	------
1917	1	1	(4)	120.31	2,487	(4)
1918	1	1	(4)	147.98	3,059	(4)
1919	1	1	(4)	52.00	1,075	(4)

See footnotes at end of table.

Gold produced at placer mines in California, 1903–40, by classes of mines and by methods of recovery, and total, 1848–1940—Continued

Class and method	Mines producing [1]	Washing plants (dredges)	Material treated (cubic yards)	Gold recovered: Fine ounces	Gold recovered: Value	Gold recovered: Average per cubic yard
Surface placers—Continued.						
Gravel mechanically handled—Continued.						
Nonfloating washing plants—Continued.						
1920	1	1	(4)	369.00	$7,628	(4)
1921	1	1	(4)	379.99	7,855	(4)
1922	1	1	(4)	282.84	5,847	(4)
1923	2	2	278,000	934.11	19,310	$0.069
1924	6	6	(4)	1,737.45	35,916	(4)
1925	4	4	(4)	1,546.56	31,970	(4)
1926	5	5	(4)	1,001.07	20,694	(4)
1927	4	4	(4)	1,113.81	23,024	(4)
1928	6	6	(4)	1,541.04	31,855	(4)
1929	8	8	77,000	1,898.67	39,249	.510
1930	7	7	(4)	925.68	19,135	(4)
1931	13	13	172,000	1,210.05	25,014	.145
1932	14	14	103,000	851.20	17,596	.171
1933	23	23	141,000	1,582.25	40,442	.287
1934	27	26	949,000	5,831.48	203,810	[5] .215
1935	54	51	1,466,000	11,892.57	416,240	.284
1936	50	50	1,433,000	12,059.39	422,079	.295
1937	58	53	2,338,000	17,079.00	597,765	.256
1938	74	71	3,538,000	23,046.00	806,610	.228
1939	114	101	5,512,000	41,694.00	1,459,290	.265
1940	131	105	5,908,000	28,232.00	988,120	.167
Gravel hydraulically handled:						
Hydraulic:						
1903	230	----------	(4)	42,222.28	872,812	(4)
1904	213	----------	(4)	49,738.35	1,028,183	(4)
1905	227	----------	(4)	47,172.40	975,140	(4)
1906	246	----------	(4)	50,995.57	1,054,172	(4)
1907	193	----------	(4)	43,973.41	909,011	(4)
1908	145	----------	(4)	35,981.18	743,797	(4)
1909	134	----------	(4)	29,296.29	605,608	(4)
1910	168	----------	(4)	30,742.22	635,498	(4)
1911	169	----------	(4)	32,676.63	675,486	(4)
1912	141	----------	(4)	33,363.37	689,682	(4)
1913	108	----------	(4)	15,929.89	329,300	(4)
1914	105	----------	(4)	34,002.01	702,884	(4)
1915	96	----------	(4)	20,354.75	420,770	(4)
1916	87	----------	(4)	18,866.98	390,015	(4)
1917	71	----------	(4)	12,921.11	267,103	(4)
1918	87	----------	(4)	10,314.95	213,229	(4)
1919	86	----------	4,459,000	8,941.25	184,832	.041
1920	51	----------	(4)	3,204.02	66,233	(4)
1921	60	----------	(4)	7,875.84	162,808	(4)
1922	60	----------	1,031,000	7,656.57	158,275	.154
1923	92	----------	632,000	5,409.68	111,828	.177
1924	47	----------	217,000	2,911.93	60,195	.277
1925	98	----------	1,328,000	8,482.30	175,345	.132
1926	79	----------	521,000	3,344.62	69,139	.133
1927	105	----------	909,000	5,845.25	120,832	.133
1928	76	----------	635,000	4,426.90	91,512	.144
1929	103	----------	586,000	2,889.55	59,732	.102
1930	79	----------	1,478,000	4,324.88	89,403	.060
1931	62	----------	2,003,000	3,026.16	62,556	.031
1932	87	----------	944,000	5,944.15	122,876	.130
1933	56	----------	1,497,000	4,494.94	114,890	.077
1934	58	----------	1,614,000	9,281.75	324,397	.201
1935	93	----------	3,013,000	13,623.10	476,809	.158
1936	84	----------	1,878,000	7,670.01	268,450	.142
1937	82	----------	1,324,000	4,628.00	161,980	.122
1938	86	----------	1,719,000	7,061.00	247,135	.144
1939	74	----------	921,000	6,059.00	212,065	.230
1940	92	----------	2,401,000	12,059.00	422,065	.176

See footnotes at end of table.

Gold produced at placer mines in California, 1903–40, by classes of mines and by methods of recovery, and total, 1848–1940—Continued

Class and method	Mines producing [1]	Washing plants (dredges)	Material treated (cubic yards)	Gold recovered: Fine ounces	Gold recovered: Value	Gold recovered: Average per cubic yard
Surface placers—Continued.						
Small-scale hand methods:[6]						
Wet:						
1903	261		(4)	37,304.43	$771,151	(4)
1904	330		(4)	39,644.05	819,515	(4)
1905	283		(4)	39,191.93	810,169	(4)
1906	259		(4)	29,633.42	612,577	(4)
1907	259		(4)	14,571.08	301,211	(4)
1908	249		(4)	26,542.15	548,675	(4)
1909	241		(4)	18,192.78	376,078	(4)
1910	184		(4)	8,944.88	184,907	(4)
1911	209		(4)	7,927.42	163,874	(4)
1912	155		(4)	6,543.64	135,269	(4)
1913	129		(4)	10,798.99	223,235	(4)
1914	104		(4)	12,766.32	263,903	(4)
1915	70		(4)	5,664.81	117,102	(4)
1916	76		(4)	7,845.84	162,188	(4)
1917	68		(4)	5,962.41	123,254	(4)
1918	109		(4)	3,842.19	79,425	(4)
1919	78		(4)	2,172.48	44,909	(4)
1920	61		(4)	1,124.92	23,254	(4)
1921	121		(4)	4,816.70	99,570	(4)
1922	121		(4)	3,957.17	81,802	(4)
1923	147		(4)	6,635.54	137,168	(4)
1924	124		(4)	4,207.94	86,986	(4)
1925	162		(4)	3,457.05	71,464	(4)
1926	296		(4)	3,685.30	76,182	(4)
1927	234		(4)	4,290.60	88,695	(4)
1928	275		(4)	6,862.80	141,867	(4)
1929	272		(4)	4,678.63	96,716	(4)
1930	688		(4)	6,337.12	131,000	(4)
1931	318		319,600	9,636.45	199,203	$0.623
1932	550		1,420,100	24,591.98	508,361	.358
1933	764		2,122,200	36,310.57	928,098	.437
1934	1,569		2,748,500	48,495.54	1,694,919	.617
1935	1,132		2,895,500	44,147.24	1,545,153	.534
1936	326		2,523,600	39,132.00	1,369,620	.543
1937	463		2,209,000	25,612.00	896,420	.406
1938	292		2,863,500	41,686.00	1,459,010	.510
1939	267		2,534,100	38,815.00	1,358,525	.536
1940	282		2,017,200	39,110.00	1,368,850	.679
Dry:						
1903	8		(4)	1,324.02	27,370	(4)
1904	8		(4)	803.02	16,600	(4)
1905	3		(4)	744.29	15,386	(4)
1906	1		(4)	241.87	5,000	(4)
1907	3		(4)	79.97	1,653	(4)
1908	7		(4)	579.59	11,981	(4)
1909						
1910	1		(4)	58.39	1,207	(4)
1911	1		(4)	38.99	806	(4)
1912	2		(4)	133.76	2,765	(4)
1913	1		(4)	39.19	810	(4)
1914	1		(4)	34.83	720	(4)
1915	1		(4)	40.01	827	(4)
1916	2		(4)	141.74	2,930	(4)
1917	1		(4)	43.54	900	(4)
1918	3		(4)	131.53	2,719	(4)
1919						
1920	1		(4)	10.01	207	(4)
1921	3		(4)	19.01	393	(4)
1922	2		(4)	101.10	2,090	(4)
1923	19		(4)	182.41	3,771	(4)
1924	11		(4)	57.38	1,186	(4)
1925						
1926	5		(4)	29.35	607	(4)
1927	6		(4)	43.73	904	(4)
1928	6		(4)	52.96	1,095	(4)
1929	5		(4)	47.55	983	(4)
1930	6		2,000	57.51	1,189	.595

See footnotes at end of table.

Gold produced at placer mines in California, 1903–40, by classes of mines and by methods of recovery, and total, 1848–1940—Continued

Class and method	Mines producing [1]	Washing plants (dredges)	Material treated (cubic yards)	Gold recovered: Fine ounces	Gold recovered: Value	Gold recovered: Average per cubic yard
Surface placers—Continued.						
Small-scale hand methods [6]—Continued.						
Dry—Continued.						
1931	9	----------	3,400	165.40	$3,419	$1.006
1932	18	----------	9,900	352.21	7,281	.735
1933	21	----------	3,300	224.44	5,737	1.738
1934	13	----------	6,500	183.86	6,426	.989
1935	21	----------	6,500	128.40	4,494	.691
1936	10	----------	4,400	337.90	11,827	2.688
1937	30	----------	14,000	486.00	17,010	1.215
1938	15	----------	6,500	172.00	6,020	.926
1939	25	----------	11,900	169.00	5,915	.497
1940	17	----------	10,800	211.00	7,385	.684
Underground placers:						
Drift:						
1903	122	----------	(4)	43,812.22	905,679	(4)
1904	133	----------	(4)	45,180.02	933,954	(4)
1905	119	----------	(4)	39,437.23	815,240	(4)
1906	104	----------	(4)	29,306.40	605,817	(4)
1907	106	----------	(4)	27,253.65	563,383	(4)
1908	89	----------	(4)	18,892.61	390,545	(4)
1909	118	----------	(4)	35,787.68	739,797	(4)
1910	139	----------	(4)	25,006.44	516,929	(4)
1911	141	----------	(4)	23,215.16	479,900	(4)
1912	146	----------	(4)	18,769.11	387,992	(4)
1913	85	----------	(4)	9,314.03	192,538	(4)
1914	70	----------	(4)	15,961.23	329,948	(4)
1915	61	----------	(4)	13,204.20	272,955	(4)
1916	67	----------	(4)	12,156.49	251,297	(4)
1917	53	----------	(4)	17,741.97	366,759	(4)
1918	66	----------	(4)	5,244.82	108,420	(4)
1919	69	----------	41,000	4,128.37	85,341	2.081
1920	45	----------	(4)	3,044.00	62,925	(4)
1921	59	----------	(4)	6,163.51	127,411	(4)
1922	63	----------	68,000	12,220.79	252,626	3.715
1923	64	----------	155,000	8,938.31	184,771	1.192
1924	51	----------	55,000	4,768.22	98,568	1.792
1925	71	----------	25,000	3,218.07	66,523	2.661
1926	75	----------	30,000	5,381.06	111,236	3.708
1927	91	----------	32,000	6,865.82	141,929	4.435
1928	73	----------	46,000	7,420.05	153,386	3.334
1929	65	----------	62,000	4,095.82	84,668	1.366
1930	88	----------	84,000	3,029.01	62,615	.745
1931	82	----------	38,000	5,379.26	111,199	2.926
1932	146	----------	80,000	9,959.43	205,880	2.574
1933	110	----------	120,000	16,981.08	434,036	3.617
1934	96	----------	243,000	12,992.78	454,098	1.869
1935	143	----------	141,000	17,139.52	599,883	4.254
1936	113	----------	129,000	23,931.95	837,618	6.493
1937	121	----------	98,000	7,398.00	258,930	2.642
1938	99	----------	97,000	7,144.00	250,040	2.578
1939	94	----------	83,000	6,525.00	228,375	2.752
1940	96	----------	88,000	5,045.00	176,575	2.007
Grand total placer:						
1848–1902 [7]	----------	----------	(4)	50,359,638.00	1,041,026,131	(4)
1903	648	----------	(4)	196,052.31	4,052,761	(4)
1904	711	----------	(4)	241,163.40	4,985,290	(4)
1905	658	----------	(4)	285,029.17	5,892,076	(4)
1906	634	----------	(4)	356,810.37	7,375,925	(4)
1907	584	----------	(4)	330,918.62	6,840,695	(4)
1908	519	----------	(4)	398,183.67	8,231,187	(4)
1909	526	----------	(4)	440,426.95	9,104,433	(4)
1910	533	----------	(4)	429,995.46	8,888,795	(4)
1911	554	----------	(4)	434,723.24	8,986,527	(4)
1912	479	----------	(4)	418,233.95	8,645,663	(4)
1913	359	----------	(4)	427,450.06	8,836,177	(4)
1914	315	----------	(4)	439,286.07	9,080,849	(4)
1915	263	----------	(4)	416,441.85	8,608,617	(4)

See footnotes at end of table.

Gold produced at placer mines in California, 1903–40, by classes of mines and by methods of recovery, and total, 1848–1940—Continued

Class and method	Mines producing [1]	Washing plants (dredges)	Material treated (cubic yards)	Gold recovered: Fine ounces	Gold recovered: Value	Gold recovered: Average per cubic yard
Grand total placer—Contd.						
1916	265	----------	[4]	414,847.40	$8,575,657	[4]
1917	224	----------	[4]	438,956.20	9,074,030	[4]
1918	294	----------	[4]	379,200.93	7,838,779	[4]
1919	258	----------	[8]	388,600.05	8,033,076	[8]
1920	183	----------	[4]	341,557.15	7,060,613	[4]
1921	263	----------	[4]	394,489.61	8,154,824	[4]
1922	267	----------	[8]	266,055.51	5,499,855	[8]
1923	338	----------	[8]	315,529.97	6,522,583	[8]
1924	252	----------	[8]	221,962.51	4,588,372	[8]
1925	348	----------	[8]	246,525.96	5,096,144	[8]
1926	473	----------	[8]	252,923.99	5,228,403	[8]
1927	455	----------	[8]	282,380.02	5,837,313	[8]
1928	448	----------	[8]	234,649.18	4,850,629	[8]
1929	467	----------	[8]	187,240.60	3,870,607	[8]
1930	882	----------	[8]	181,655.05	3,755,143	[8]
1931	497	----------	46,960,000	194,503.60	4,020,746	$0.086
1932	828	----------	51,280,000	230,529.86	4,765,475	.093
1933	993	----------	59,322,000	261,378.86	6,680,843	.113
1934	1,784	----------	65,375,000	274,024.83	9,577,168	.146
1935	1,487	----------	86,442,000	345,526.00	12,093,410	.140
1936	639	----------	94,839,000	409,423.00	14,329,805	.151
1937	838	----------	120,156,000	472,306.00	16,530,710	.138
1938	676	----------	149,864,000	572,513.00	20,037,955	.134
1939	[9] 749	----------	162,335,000	636,045.00	22,261,575	.137
1940	[9] 836	----------	185,668,000	704,952.00	24,673,320	.133
1848–1940	----------	----------	[4]	63,822,129.40	1,369,512,161	[4]

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property worked. Total number of placers each year, 1907–30, inclusive, revised to include number of properties worked by dredges instead of number of dredges.
[2] First year for which this method was reported used in California.
[3] Revised figures.
[4] Data not available.
[5] Corrected figure.
[6] Includes all operations where hand labor is the principal factor in delivering gravel to sluices, long toms, dip boxes, pans, rockers, dry washers, etc.
[7] For division of total gold output prior to 1903 between lode and placer mines and authority therefor, *see* Mineral Resources of the United States, 1930, pt. 1, p. 964, and Bureau of Mines Econ. Paper 3, 1929, 22 pp.
[8] Complete data not available.
[9] A mine using more than 1 method of recovery is counted but once in arriving at total for all methods.

Gold.—Since 1929, when the value of the California gold output reached a low of $8,526,703, the value of production has expanded sixfold, although the gain in 1940 over 1939 was the smallest in a decade. In quantity, the 1940 output of gold was greater than in any year since 1862, and in value it was greater than in any year since 1856; the output was less in 1940 than in 1939. Placer-gold output in 1940 rose to a point where it nearly equaled lode output, and its total value was the highest since 1862.

The 25 leading gold-producing mines in California in 1940, listed in the following table, yielded 55 percent of the total gold output of the State in that year. Four lode mines (all gold ore) and one placer (connected-bucket dredge) in the 1939 list were displaced in 1940 by two lode mines (both gold ore) and three placers (two connected-bucket dredge and one dragline dredge). A dragline-dredge operation ranked in 1940 for the first time among the 25 leading gold producers in the State.

Twenty-five leading gold-producing mines in California in 1940, in order of output

Rank	Mine	District	County	Rank in 1939	Operator	Source of gold
1	Idaho Maryland-Brunswick.	Grass Valley-Nevada City.	Nevada	1	Idaho Maryland Mines Corporation.	Gold ore.
2	Empire Star mines	do	do	2	Empire Star Mines Co., Ltd.	Do.
3	Natomas Co	Folsom	Sacramento	3	Natomas Co	Dredge.
4	Yuba Unit	Yuba River	Yuba	4	Yuba Consolidated Gold Fields.	Do.
5	Lava Cap	Grass Valley-Nevada City.	Nevada	6	Lava Cap Gold Mining Corporation.	Gold ore.
6	Butte Unit	Oroville	Butte	11	Yuba Consolidated Gold Fields.	Dredge.
7	Central Eureka and Old Eureka.	Mother Lode	Amador	5	Central Eureka Mining Co.	Gold ore.
8	Capital dredges	Folsom	Sacramento	7	Capital Dreding Co	Dredge.
9	Carson Hill	Mother Lode	Calaveras	8	Carson Hill Gold Mining Corporation.	Gold ore.
10	Sheepranch	East Belt	do	18	St. Joseph Lead Co	Do.
11	Argonaut	Mother Lode	Amador	10	Argonaut Mining Co., Ltd.	Do.
12	Golden Queen	Mojave	Kern	9	Golden Queen Mining Co.	Do.
13	Cactus Queen	do	do	21	Cactus Mines Co	Gold-silver ore.
14	Iron Mountain	Flat Creek (Iron Mountain).	Shasta	15	The Mountain Copper Co., Ltd.	Gold ore and copper ore.
15	Alabama	Ophir	Placer	20	Alabama California Gold Mines Co.	Gold ore.
16	Snelling	Snelling	Merced	14	Snelling Gold Dredging Co.	Dredge.
17	Walker	Genesee	Plumas	22	Walker Mining Co	Copper ore.
18	Merced Unit	Snelling	Merced	16	Yuba Consolidated Gold Fields.	Dredge.
19	Original Sixteen to One.	Alleghany	Sierra	27	Original Sixteen to One Mine, Inc.	Gold ore.
20	Siskiyou Unit	Callahan	Siskiyou	33	Yuba Consolidated Gold Fields.	Dredge.
21	Golden Center	Grass Valley-Nevada City.	Nevada	28	Cooley Butler	Gold ore.
22	Carrville	Trinity Center	Trinity	147	Carrville Gold Co	Dredge.
23	Sliger	Mother Lode	Eldorado	19	Middle Fork Gold Mining Co.	Gold ore.
24	Starlight	Mojave	Kern	23	Lodestar Mining Co	Do.
25	Stockton Reservoir	Mother Lode	Calaveras	34	Lord & Bishop	Dragline.

Silver.—The bulk of the silver output of California in 1940 was more centralized than that of the gold; the 10 leading silver-producing mines, listed in the following table, yielded 75 percent of the State total recoverable silver in that year. The list is similar to that of 1939, except for some changes in rank and replacement of the Alabama mine (Placer County) by the Iron Mountain mine (Shasta County). In addition to the mines listed, some silver was reported recovered from almost every lode and placer mine operating in the State in 1940.

Ten leading silver-producing mines in California in 1940, in order of output

Rank	Mine	District	County	Rank in 1939	Operator	Source of silver
1	Cactus Queen	Mojave	Kern	1	Cactus Mines Co	Gold-silver ore.
2	Lava Cap	Grass Valley-Nevada City.	Nevada	4	Lava Cap Gold Mining Corporation.	Gold ore.
3	Walker	Genesee	Plumas	6	Walker Mining Co	Copper ore.
4	Golden Queen	Mojave	Kern	2	Golden Queen Mining Co.	Gold ore.
5	Starlight	do	do	5	Lodestar Mining Co	Do.
6	Grigsby (Palisade)	Calistoga	Napa	3	Graham Loftus Oil Corporation.	Gold-silver ore.
7	Kelly	Randsburg	San Bernardino.	7	F. Royer and lessees	Do.
8	Iron Mountain	Flat Creek (Iron Mountain).	Shasta	12	The Mountain Copper Co., Ltd.	Gold ore and copper ore.
9	Standard	Bodie	Mono	9	Roseklip Mines Co	Gold ore.
10	Empire Star mines	Grass Valley-Nevada City.	Nevada	8	Empire Star Mines Co., Ltd.	Do.

Copper.—The Walker mine in the Genesee district, Plumas County, continued to lead in copper production and supplied 82 percent of the total recoverable copper output of the State in 1940. The Iron Mountain mine in the Flat Creek (Iron Mountain) district, Shasta County, made a substantial shipment of high-grade copper ore during the year.

Lead.—Almost 60 percent of the small output of recoverable lead in California in 1940 came from Inyo County; and 30 percent came from Riverside County.

Zinc.—Production of zinc in California in 1940 was valued at $9,954.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in California in 1940, by counties, in terms of recovered metals

County	Mines producing [1]		Gold					
			Lode		Placer		Total	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Alpine	1		430	$15,050			430	$15,050
Amador	28	46	79,871	2,795,485	37,905	$1,326,675	117,776	4,122,160
Butte	19	41	8,576	300,160	64,105	2,243,675	72,681	2,543,835
Calaveras	41	73	52,694	1,844,290	34,060	1,192,100	86,754	3,036,390
Colusa	1		1	35			1	35
Del Norte		5			50	1,750	50	1,750
Eldorado	58	43	22,966	803,810	15,365	537,775	38,331	1,341,585
Fresno	2	9	79	2,765	905	31,675	984	34,440
Humboldt	1	10	2	70	589	20,615	591	20,685
Imperial	13	6	7,103	248,605	116	4,060	7,219	252,665
Inyo	100	8	11,771	411,985	102	3,570	11,873	415,555
Kern	134	23	82,085	2,872,975	408	14,280	82,493	2,887,255
Lassen	5		77	2,695			77	2,695
Los Angeles	22	4	7,178	251,230	206	7,210	7,384	258,440
Madera	16	22	232	8,120	1,168	40,880	1,400	49,000
Mariposa	70	26	22,864	800,240	4,270	149,450	27,134	949,690
Mendocino		1			2	70	2	70
Merced		8			51,907	1,816,745	51,907	1,816,745
Modoc	3		7	245			7	245
Mono	35	1	12,212	427,420	2	70	12,214	427,490
Monterey and Napa [2]	3		1,039	36,365			1,039	36,365
Nevada	36	50	297,373	10,408,055	15,896	556,360	313,269	10,964,415
Orange	1	2	41	1,435	2	70	43	1,505
Placer	36	75	24,576	860,160	27,230	953,050	51,806	1,813,210
Plumas	29	42	32,313	1,130,955	4,889	171,115	37,202	1,302,070
Riverside	41	3	2,331	81,585	45	1,575	2,376	83,160
Sacramento	1	18	36	1,260	158,201	5,537,035	158,237	5,538,295
San Bernardino	126	12	14,169	495,915	557	19,495	14,726	515,410
San Diego	15		485	16,975			485	16,975
San Francisco		(3)			70	2,450	70	2,450
San Joaquin		5			9,405	329,175	9,405	329,175
San Luis Obispo		2			10	350	10	350
Santa Barbara	1		1	35			1	35
Santa Cruz	2	(3)	4	140	15	525	19	665
Shasta	31	41	28,220	987,700	14,041	491,435	42,261	1,479,135
Sierra	20	42	19,016	665,560	8,375	293,125	27,391	958,685
Siskiyou	45	94	3,549	124,215	55,560	1,944,600	59,109	2,068,815
Stanislaus		11			36,464	1,276,240	36,464	1,276,240
Trinity	28	70	1,211	42,385	48,222	1,687,770	49,433	1,730,155
Tulare	2		16	560			16	560
Tuolumne	54	20	12,352	432,320	9,580	335,300	21,932	767,620
Ventura	3		44	1,540			44	1,540
Yuba	7	23	5,795	202,825	105,230	3,683,050	111,025	3,885,875
	1,030	836	750,719	26,275,165	704,952	24,673,320	1,455,671	50,948,485
Total, 1939	1,028	749	799,219	27,972,665	636,045	22,261,575	1,435,264	50,234,240

1 Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
2 Combined to avoid disclosure of individual output.
3 Output from property not classed as a "mine."

Mine production of gold, silver, copper, lead, and zinc in California in 1940, by counties, in terms of recovered metals—Continued

County	Silver					
	Lode		Placer		Total	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Alpine	1,160	$825			1,160	$825
Amador	18,457	13,125	4,624	$3,288	23,081	16,413
Butte	15,723	11,181	5,312	3,777	21,035	14,958
Calaveras	14,621	10,397	3,027	2,153	17,648	12,550
Colusa						
Del Norte			4	3	4	3
Eldorado	3,385	2,407	1,831	1,302	5,216	3,709
Fresno	69	49	162	115	231	164
Humboldt			86	61	86	61
Imperial	2,620	1,863	3	2	2,623	1,865
Inyo	86,649	61,617	9	6	86,658	61,623
Kern	831,869	591,551	80	57	831,949	591,608
Lassen	83	59			83	59
Los Angeles	2,884	2,051	73	52	2,957	2,103
Madera	138	98	340	242	478	340
Mariposa	8,601	6,116	702	499	9,303	6,615
Mendocino						
Merced			4,891	3,478	4,891	3,478
Modoc	4	3			4	3
Mono	146,682	104,307			146,682	104,307
Monterey and Napa [2]	129,259	91,918			129,259	91,918
Nevada	427,009	303,651	1,966	1,398	428,975	305,049
Orange	15,169	10,787	3	2	15,172	10,789
Placer	56,256	40,004	3,773	2,683	60,029	42,687
Plumas	254,527	180,997	429	305	254,956	181,302
Riverside	31,647	22,505	7	5	31,654	22,510
Sacramento	6	4	9,945	7,072	9,951	7,076
San Bernardino	145,267	103,301	52	37	145,319	103,338
San Diego	180	128			180	128
San Francisco			7	5	7	5
San Joaquin			911	648	911	648
San Luis Obispo						
Santa Barbara	7	5			7	5
Santa Cruz	3	2	3	2	6	4
Shasta	90,648	64,461	1,454	1,034	92,102	65,495
Sierra	3,337	2,373	676	481	4,013	2,854
Siskiyou	1,153	820	8,200	5,831	9,353	6,651
Stanislaus			2,597	1,847	2,597	1,847
Trinity	502	357	5,435	3,865	5,937	4,222
Tulare	7	5			7	5
Tuolumne	3,659	2,602	1,257	894	4,916	3,496
Ventura	7	5			7	5
Yuba	4,018	2,857	6,311	4,488	10,329	7,345
	2,295,606	1,632,431	64,170	45,632	2,359,776	1,678,063
Total, 1939	2,543,008	1,726,163	56,131	38,101	2,599,139	1,764,264

[2] Combined to avoid disclosure of individual output.

Mine production of gold, silver, copper, lead, and zinc in California in 1940, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Alpine							$15,875
Amador	20,000	$2,260	12,000	$600			4,141,433
Butte	6,000	678					2,559,471
Calaveras	8,000	904	2,000	100			3,049,944
Colusa							35
Del Norte							1,753
Eldorado	2,000	226	2,000	100			1,345,620
Fresno							34,604
Humboldt							20,746
Imperial	10,000	1,130					255,660
Inyo	234,000	26,442	2,082,000	104,100	106,000	$6,678	614,398
Kern	2,000	226	12,000	600			3,479,689
Lassen							2,754
Los Angeles							260,543
Madera			2,000	100			49,440
Mariposa	10,000	1,130	28,000	1,400			958,835
Mendocino							70
Merced							1,820,223
Modoc							248
Mono	118,000	13,334	138,000	6,900			552,031
Monterey and Napa [2]	6,000	678					128,961
Nevada	38,000	4,294	8,000	400			11,274,158
Orange	2,000	226	30,000	1,500	52,000	3,276	17,296
Placer	10,000	1,130	44,000	2,200			1,859,227
Plumas	10,586,000	1,196,218	86,000	4,300			2,683,890
Riverside	44,000	4,972	1,066,000	53,300			163,942
Sacramento							5,545,371
San Bernardino	54,000	6,102	30,000	1,500			626,350
San Diego							17,103
San Francisco							2,455
San Joaquin							329,823
San Luis Obispo							350
Santa Barbara	8,000	904					944
Santa Cruz							669
Shasta	1,712,000	193,456	2,000	100			1,738,186
Sierra	2,000	226					961,765
Siskiyou							2,075,466
Stanislaus							1,278,087
Trinity							1,734,377
Tulare							565
Tuolumne	4,000	452					771,568
Ventura							1,545
Yuba							3,893,220
	12,876,000	1,454,988	3,544,000	177,200	158,000	9,954	54,268,690
Total, 1939	8,360,000	869,440	1,052,000	49,444	12,000	624	52,918,012

[2] Combined to avoid disclosure of individual output.

MINING INDUSTRY

The tonnage of material from lode mines in California treated in 1940 decreased 16 percent compared with 1939, but the yardage at placer mines increased 14 percent; the output of lode gold declined 6 percent, but that of placer gold rose 11 percent. The average grade of lode material rose 15 percent, but the average gold content of gravels declined 3 percent. Of the State total gold output in 1940, 52 percent was from lode mines and 48 percent from placers.

Dredges of the connected-bucket type handled 71 percent of the gravel mined and recovered 59 percent of the State total placer gold in 1940.

The next most important method of placer mining—dragline dredging—continued in 1940 its spectacular rise as a means of recovering gold. The first dragline dredge production in the United States was reported in California in 1933, when two outfits began work late in the year and recovered less than 100 ounces of gold. In 1940, 106 dragline dredges worked 198 properties; they washed 23 percent of the total placer-gravel yardage worked and recovered 29 percent of the total placer gold. The following, taken from reports of 52 dragline operators for 1939 and 89 for 1940, summarizes the size of buckets and number of boats:

Size of buckets (cubic yards):	Number of boats 1939	Number of boats 1940	Size of buckets (cubic yards):	Number of boats 1939	Number of boats 1940
7½	--	1	2	10	15
6	1	--	1¾	2	3
5	--	2	1½	17	25
4	--	1	1¼	5	9
3½	1	--	1	4	9
3	3	4	¾	1	7
2½	4	8	½	2	3
2¼	2	1	⅜	--	1

The Becker-Hopkins type of dredge made its first appearance in California in 1940, when units were installed in Fresno and Sacramento Counties.

Nonfloating washing plants to which gravel was delivered by mechanical means washed about the same yardage in 1940 as in 1939, but recovery of gold fell 32 percent. Equipment was moved from one property to another, as was the practice with dragline dredges, and 105 plants worked 131 properties. Some of these nonfloating washing plants are stationary; others are built to move on skids, wheels, or tracks or by other means. Dragline excavators, power shovels, slackline excavators, trucks, bulldozers, and other machines were used to deliver gravel to these washing plants.

Hydraulic production of gold in 1940 was nearly twice that in 1939. Completion of Government-financed debris dams promises further expansion in hydraulic mining. Output by small-scale hand methods increased, but that by drift mining declined.

Consumption of quicksilver at California placer mines totaled 21,872 pounds in 1940 compared with 19,617 pounds in 1939. The following quantities of gold were recovered to the pound of quicksilver used in 1940 (1939 figures in parentheses): Connected-bucket dredging, 41 ounces (41); dragline dredging, 39 ounces (29); nonfloating washing plants with mechanical gravel handling, 10 ounces (31); hydraulicking, 12 ounces (21); small-scale hand operation, 15 ounces (13); and drift mining, 115 ounces (26).

ORE CLASSIFICATION

Of the 4,669,433 tons of ore (including 849,961 tons of old tailings) sold or treated in 1940, 89 percent was dry gold ore and old tailings, 10 percent copper ore, and most of the remainder dry gold-silver ore.

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore and old tailings sold or treated in California in 1940, with content in terms of recovered metals

Source	Material sold or treated		Gold	Silver	Copper	Lead	Zinc
	Ore	Old tailings					
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold ore	3,295,458	841,774	[1] 712,395	[1] 1,211,052	[1] 344,900	111,600	--------
Dry and siliceous gold-silver ore	66,865	--------	19,519	591,651	14,500	4,200	--------
Dry and siliceous silver ore	2,366	8,187	274	106,572	123,700	163,700	52,000
	3,364,689	849,961	[1] 732,188	[1] 1,909,275	[1] 483,100	279,500	52,000
Copper ore	446,392	--------	16,669	291,914	12,326,100	81,000	--------
Lead-copper ore	11	--------	--------	91	1,700	4,700	--------
Lead ore	8,199	--------	1,860	93,739	65,100	3,142,100	--------
Zinc-lead ore	181	--------	2	587	--------	36,700	106,000
Total, lode mines	3,819,472	849,961	[1] 750,719	[1] 2,295,606	[1] 12,876,000	3,544,000	158,000
Total, placers	--------	--------	704,952	64,170	--------	--------	--------
	3,819,472	849,961	[1] 1,455,671	[1] 2,359,776	[1] 12,876,000	3,544,000	158,000
Total, 1939	4,939,962	637,891	1,435,264	2,599,139	8,360,000	1,052,000	12,000

[1] Includes metals recovered from tungsten ore not included in material treated.

METALLURGIC INDUSTRY

During 1940, as in former years, most of the ore and virtually all the old tailings were treated at amalgamation and cyanidation mills (with or without concentrating equipment); 89 percent of the total ore and old tailings was treated at such mills in 1940. Almost all the remaining ore was treated at concentrating mills; only 25,380 tons of crude ore and 3,794 tons of old tailings were shipped for direct smelting. Smelters received 51,061 tons of flotation concentrates and 1,636 tons of gravity concentrates from California mine operators in 1940. Comparing 1940 with 1939, there was a 25-percent decrease in ore and a 33-percent increase in old tailings treated at amalgamation and cyanidation mills; ore and old tailings combined decreased 18 percent. The quantity of material treated at concentrating mills decreased 1 percent, and the quantity of crude ore smelted increased 129 percent.

Quicksilver consumption at California amalgamation mills was 7,876 pounds in the treatment of 2,429,974 tons of material to recover 339,707 ounces of gold and 97,618 ounces of silver in 1940. In the treatment of 1,196,267 tons of ore, 612,452 tons of old tailings, and 11,487 tons of concentrates to recover 163,680 ounces of gold and 660,420 ounces of silver, cyanide consumption was 507,443 pounds of 91-percent sodium cyanide and 1,520,235 pounds of commercial calcium cyanide (50-percent NaCN equivalent); in terms of 98-percent NaCN, the consumption was 1,216,112 pounds or 0.67 pound to the ton. A substantial part of the cyanide was consumed at custom mills in California.

Companies producing most of California's lode gold in 1940 owned and operated their own metallurgical plants, but a number of custom mills were active and served small-scale miners principally. The leading operators of metallurgical plants receiving custom material were: Burton Bros., Inc., Rosamond, Kern County; Golden Queen Mining Co., Mojave, Kern County; Mineral Reduction Co., Benton, Mono County; Gold Crown Mining Co., Ltd., east of Twentynine Palms, San Bernardino County; and F. W. Royer, Red Mountain, San Bernardino County. All these mills were cyanidation plants and accepted ore and old tailings for treatment. The Idaho Maryland

Mines Corporation and Empire Star Mines Co., Ltd., Grass Valley, Nevada County, cyanided some lots of concentrates during the period (July 1 to November 9) when the Selby smelter was closed by a labor strike. The largest metallurgical custom plant in California continued to be the State's only smelter—the Selby lead plant of the American Smelting & Refining Co. at Selby, Contra Costa County.

Mine production of metals in California in 1940, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore, old tailings, and concentrates amalgamated	2,429,974	339,707	97,618			
Ore, old tailings, sands, slimes, and concentrates cyanided	2,175,892	240,574	833,744			
Concentrates smelted:						
Flotation	[1] 51,061	[1] 154,289	[1] 1,074,287	[1] 10,888,700	233,100	158,000
Gravity	1,636	7,055	17,197	6,600	38,600	
Ore and old tailings smelted	29,174	9,094	272,760	1,980,700	3,272,300	
Total, lode mines		[1] 750,719	[1] 2,295,606	[1] 12,876,000	3,544,000	158,000
Total, placers		704,952	64,170			
		[1] 1,455,671	[1] 2,359,776	[1] 12,876,000	3,544,000	158,000
Total, 1939		1,435,264	2,599,139	8,360,000	1,052,000	12,000

[1] Includes concentrates and metals from tungsten ore.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in California in 1940, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Material treated		Recovered in bullion		Concentrates smelted and recovered metal				
	Ore [1]	Old tailings	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Amador	276,773		40,601	8,208	5,574	21,554	5,588	20,000	9,300
Butte	10,428	235	984	251	99	474	212		
Calaveras	485,021	10	25,481	2,947	2,587	10,517	4,938	5,000	600
Colusa	10		1						
Eldorado	80,697	1,776	11,059	1,167	2,844	9,383	1,298	2,000	2,000
Fresno	35	45	8						
Humboldt	25		2						
Imperial	109		258	120					
Inyo	6,193		1,640	290	13	52	23		900
Kern	51,111	885	6,189	2,619	705	3,146	7,173	300	11,400
Lassen	3,020	40	77	83					
Los Angeles	46,235		5,381	1,119	556	1,645	1,621		
Madera	928		229	71	1	3	4		
Mariposa	125,272		10,759	2,959	2,084	11,841	4,510	7,800	28,000
Modoc	42		7	4					
Mono	35,777		5,467	1,520					
Nevada	895,730		175,563	62,424	7,618	40,187	290,864	36,000	3,300
Placer	120,278	1,700	19,459	5,240	956	3,912	47,473	9,600	44,000
Plumas	45,772		2,970	615	26	413	91		
Riverside	874		308	74					
Sacramento	2		36	6					
San Bernardino	7,913	1,270	2,564	2,021	31	689	2,282	200	3,200
San Diego	482		240	60					
Santa Cruz	6		2	2					
Shasta	13,185	8,075	4,073	922	324	1,548	694	100	2,000
Sierra	72,149	5,370	16,508	2,710	506	2,182	533	2,000	
Siskiyou	32,202	24	2,803	723	4	22	3		
Trinity	3,576	2	908	240	1	3			
Tulare	27		16	7					
Tuolumne	95,865		6,022	1,203	2,717	5,879	2,242	4,000	
Ventura	65		21	1					
Yuba	740		71	12	3	17	3		
	2,410,542	19,432	339,707	97,618	26,649	113,467	369,552	87,000	104,700
Total, 1939	2,898,985	3,598	342,296	63,720	31,951	136,394	379,235	100,800	801,800

[1] Figures under "Ore" include both raw ore and concentrates amalgamated or cyanided, but not raw ore concentrated before amalgamation or cyanidation of concentrates.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in California in 1940, by types of mills and by counties, in terms of recovered metals—Continued

CYANIDATION MILLS

County	Material treated		Recovered in bullion		Concentrates smelted and recovered metal				
	Ore [1]	Old tailings	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Alpine	120		21	106					
Amador	27,808	432,052	14,567	3,433	434	3,022	1,126		
Butte	23,838		1,650	2,018	344	5,365	13,200	6,000	
Calaveras	385,079		16,660	6,225					
Eldorado	15,588		2,393	881					
Fresno		1,800	71	69					
Imperial	13,547	603	5,423	1,800					
Inyo	29,500	714	8,638	7,671	6	20	818		400
Kern	245,998	366,146	63,429	540,845	141	9,212	280,926	1,700	600
Los Angeles	252		139	123					
Mariposa		3,862	201	114					
Mono	95,629	26	6,506	89,620	29	11	7,574	3,400	1,200
Nevada	81,413	5,000	81,169	71,502	58	194	2,107	2,000	4,300
Placer	416		794	3,377					
Plumas	27,606	7,098	1,656	206	53	1,951	531		
Riverside	1,126	153	1,408	71					
San Bernardino	33,288	4,455	8,109	53,488	2	5	15		500
San Diego	215		221	55	1	2	3		
Shasta	365,714		21,441	48,024	1	42	97		
Sierra	8	3,666	201	65					
Siskiyou		750	41	21					
Trinity		400	83	15					
Tuolumne	1,000		30	8	65	225	60		
Ventura	22		23	6					
Yuba	1,000		5,700	4,001					
	1,349,167	826,725	240,574	833,744	1,134	20,049	306,457	13,100	7,000
Total, 1939	1,505,070	634,173	258,204	934,899	862	17,739	464,322	8,100	12,000
Grand total: 1940	3,759,709	846,157	580,281	931,362	27,783	133,516	676,009	100,100	111,700
1939	4,404,055	637,771	600,500	998,619	32,813	154,133	843,557	108,900	813,800

[1] Figures under "Ore" include both raw ore and concentrates amalgamated or cyanided, but not raw ore concentrated before amalgamation or cyanidation of concentrates.

Mine production of metals from concentrating mills in California in 1940, by counties, in terms of recovered metals

County	Material treated		Concentrates smelted and recovered metal					
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Short tons*	*Fine oz.*	*Fine oz.*	*Pounds*	*Pounds*	*Pounds*
Alpine	3,244		21	409	1,054			
Butte	160		19	91	19			
Eldorado	560		54	117	32			
Imperial	100		23	51	9	200		
Inyo, Mariposa, Monterey, and Napa [1]	10,799		[2] 869	[2] 1,142	[2] 145,365	[2] 217,200	36,700	106,000
Kern	90		7	19	163			
Nevada	550		92	210	79		400	
Orange	1,296		215	41	15,169	2,000	30,000	52,000
Placer	200		10	58	20	200		
Plumas	468,570		23,475	25,003	252,596	10,575,600	85,700	
San Bernardino	50		13	6	450		7,200	
Sierra	20		2	10	3			
Siskiyou	3,575		66	528	321			
Trinity	200		4	85	125			
Tuolumne	285	10	44	58	70			
	489,699	10	[2] 24,914	[2] 27,828	[2] 415,475	[2] 10,795,200	160,000	158,000
Total, 1939	493,573	120	23,199	36,599	494,869	8,133,100	20,800	12,000

[1] Combined to avoid disclosure of individual output.
[2] Includes concentrates and metals from tungsten ore not included in material treated.

Gross metal content of concentrates produced from ores mined in California in 1940, by classes of concentrates

Class of concentrates	Concentrates	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	30,481	134,461	388,198	140,134	91,881	9,387
Dry gold-silver	419	10,203	410,663	11,337	631	
Copper	21,325	15,516	273,479	11,123,617	109,861	
Lead	154	1,123	3,905	574	84,427	23,504
Zinc	103		70		3,537	118,445
Zinc-lead	215	41	15,169	2,900	38,715	77,195
	52,697	161,344	1,091,484	11,278,562	329,052	228,531
Total, 1939	56,012	190,732	1,338,426	8,557,384	885,160	25,783

Mine production of metals from California concentrates shipped to smelters in 1940, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Alpine	21	409	1,054			
Amador	6,008	24,576	6,714	20,000	9,300	
Butte	462	5,930	13,431	6,000		
Calaveras	2,587	10,517	4,938	5,000	600	
Eldorado	2,898	9,500	1,330	2,000	2,000	
Imperial	23	51	9	200		
Inyo	584	150	16,927	211,200	38,000	106,000
Kern	853	12,377	288,262	2,000	12,000	
Los Angeles	556	1,645	1,621			
Madera	1	3	4			
Mariposa	2,092	11,866	4,530	7,800	28,000	
Mono	29	11	7,574	3,400	1,200	
Monterey and Napa [1]	296	1,039	129,259	6,000		
Nevada	7,768	40,591	293,050	38,000	8,000	
Orange	215	41	15,169	2,000	30,000	52,000
Placer	966	3,970	47,493	9,800	44,000	
Plumas	23,554	27,367	253,218	10,575,600	85,700	
San Bernardino	46	700	2,747	200	10,900	
San Diego	1	2	3			
Shasta	325	1,590	791	100	2,000	
Sierra	508	2,192	536	2,000		
Siskiyou	70	550	324			
Trinity	5	88	125			
Tuolumne	2,826	6,162	2,372	4,000		
Yuba	3	17	3			
	52,697	161,344	1,091,484	10,895,300	271,700	158,000
Total, 1939	56,012	190,732	1,338,426	8,242,000	834,600	12,000

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
Dry gold	30,481	134,461	388,198	96,900	78,500	
Dry gold-silver	419	10,203	410,663	7,700	600	
Copper	21,325	15,516	273,479	10,788,300	82,200	
Lead	154	1,123	3,905	400	80,400	
Zinc	103		70			106,000
Zinc-lead	215	41	15,169	2,000	30,000	52,000
	52,697	161,344	1,091,484	10,895,300	271,700	158,000

[1] Combined to avoid disclosure of individual output.

Gross metal content of California crude ore shipped to smelters in 1940, by classes of ore

Class of ore	Ore	Gross metal content			
		Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry and siliceous gold	6,149	5,618	7,729	41,114	25,859
Dry and siliceous gold-silver	1,842	406	69,284	7,147	5,216
Dry and siliceous silver	502	10	25,356	4,894	10,352
Copper	8,884	1,083	41,370	1,809,149	
Lead-copper	11		91	2,147	4,922
Lead	7,992	1,786	91,263	80,541	3,241,609
	25,380	8,903	235,093	1,944,992	3,287,958
Total, 1939	11,078	7,987	205,963	128,348	234,018

Mine production of metals from California crude ore shipped to smelters in 1940, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Amador	45	127	102		2,700
Butte	32	12	23		
Calaveras	79	36	511	3,000	1,400
Eldorado	24	14	7		
Imperial	1,995	1,371	691	9,800	
Inyo	5,035	1,343	61,761	22,800	2,044,000
Kern	3	90	143		
Los Angeles	14	13	21		
Madera	6		63		2,000
Mariposa	162	38	998	2,200	
Mono	172	37	10,301	800	11,500
Nevada	52	50	33		
Placer	164	353	146	200	
Plumas	303	320	488	10,400	300
Riverside	3,204	615	31,502	44,000	1,066,000
San Bernardino	5,097	2,796	87,011	53,800	19,100
San Diego	39	22	62		
Santa Barbara	38	1	7	8,000	
Santa Cruz	1	2	1		
Shasta	8,706	1,116	40,911	1,711,900	
Sierra	54	115	26		
Siskiyou	32	155	85		
Trinity	69	132	122		
Tuolumne	48	138	76		
Yuba	6	7	2		
	25,380	8,903	235,093	1,866,900	3,147,000
Total, 1939	11,078	7,987	205,963	118,000	217,400

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead
Dry and siliceous gold	6,149	5,618	7,729	37,900	21,000
Dry and siliceous gold-silver	1,842	406	69,284	6,800	3,100
Dry and siliceous silver	502	10	25,356	4,500	7,200
Copper	8,884	1,083	41,370	1,752,200	
Lead-copper	11		91	1,700	4,700
Lead	7,992	1,786	91,263	63,800	3,111,000
	25,380	8,903	235,093	1,866,900	3,147,000

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in California in 1940, by counties and districts, in terms of recovered metals [1]

County and district [1]	Mines producing [2]		Ore and old tailings	Gold			Silver (lode and placer) [3]	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Alpine County: Monitor	1		3,364	430		430	1,160				$15,875
Amador County:											
East Belt [4]	10	6	10,776	4,703	6,155	10,858	4,052	5,300	9,300		383,975
Ione		11			12,255	12,255	1,309				429,856
Mother Lode [5]	18	28	702,079	75,168	12,697	87,865	16,990	14,700	2,700		3,089,153
Butte County:											
Butte Creek	3	(6)	8,800	1,104	(6)	[7] 1,104	[7] 388				[7] 38,916
Centerville		1			11	11	3				387
Enterprise		1			235	235	27				8,244
Forbestown	1	2	9	7	21	28	10				987
Golden Summit		3			235	235	27				8,244
Inskip	1		175	11		11	3				387
Magalia	3	7	819	163	2,135	2,298	215				80,583
Merrimac	2	1	169	92	3,897	3,989	633				140,065
Oroville	5	23	817	143	56,255	56,398	4,352				1,977,025
Yankee Hill	4	(6)	23,884	7,056	(6)	[7] 7,056	[7] 15,228	6,000			[7] 258,467
Calaveras County:											
Camanche [8]		10			2,420	2,420	239				84,870
Campo Seco		3			354	354	45				12,422
Copperopolis	8		54,465	5,651		5,651	3,800	1,200			200,623
East Belt [4]	14	3	37,863	20,716	42	20,758	2,503	3,800			728,739
Jenny Lind [9]		7			7,354	7,354	381				257,661
Mother Lode [5]	19	50	403,284	26,327	23,890	50,217	10,680	3,000	2,000		1,765,629
Colusa County: Upper Lake	1		10	1		1					35
Del Norte County:											
French Hill		4			28	28	3				982
Smith River		1			22	22	1				771
Eldorado County:											
East Belt [4]	6	5	7,324	1,458	618	2,076	892		2,000		73,394
Mother Lode [5]	42	32	74,267	18,132	11,027	29,159	2,776	1,800			1,022,742
West Belt	10	6	17,054	3,376	3,720	7,096	1,548	200			249,484
Fresno County:											
Auberry		1			16	16	3				562
Copper King	1		80	8		8					280
Friant		5			879	879	156				30,876
Kaiser Creek		1			7	7	3				247
Sycamore	1	2	1,800	71	3	74	69				2,639

Humboldt County:											
China Flat		2			13	13	3				457
Gold Bluff		1			17	17	3				597
Orleans	1	7	25	2	559	561	80				19,692
Imperial County:											
Cargo Muchacho	11	3	16,140	6,711	26	6,737	2,084	10,000			238,407
Mesquite	2	1	214	392	27	419	539				15,048
Picacho		1			58	58					2,030
Potholes		1			5	5					175
Inyo County:											
Alabama Hills	1		60	3		3					105
Carbonate	1		104	5		5	1,228	100	49,400		3,529
Cerro Gordo	10		455	39		39	5,422	3,300	108,500		11,019
Chidago [10]	3		16	21		21	14				745
Chloride Cliff	4		5,082	1,371		1,371	879		9,400		49,080
Coso	18	1	425	90	1	91	4,621		79,500		10,446
Fish Springs	5		394	129		129	665	200	10,200		5,521
Marble Canyon		6			85	85	6				2,979
Modoc	4		126	47		47	1,509		300		2,733
Resting Springs	6		4,075	1,079		1,079	46,277	16,800	1,739,600		159,551
Sherman	4		21,572	3,780		3,780	159				132,413
Sherwin	1		10	5		5	10				182
South Park	19		2,532	1,366		1,366	3,126	1,500	58,800	106,000	59,821
Ubehebe	2		8	10		10	225		6,600		840
Union	4	1	559	582	16	598	2,505		2,900		22,856
Waucoba	3		17				194				138
White Mountain [11]	3		42	58		58	32				2,053
Wild Rose	9		5,975	2,935		2,935	2,907		600		104,822
Kern County:											
Amalie (Agua Caliente)	7		3,491	287		287	156				10,156
China Gulch		1			131	131	24				4,602
Cove	3		41,659	6,051		6,051	8,395	300	11,400		218,359
Goler	1	2	54	16	52	68	10				2,387
Green Mountain	9		1,932	691		691	682				24,670
Greenhorn	4	6	56	7	12	19	10				672
Havilah	9	3	342	108	14	122	208				4,418
Keyes (Pioneer)	13	3	1,427	358	6	364	248				12,916
Long Tom	1		3	1		1	1				36
Mojave	34		239,299	60,630		60,630	817,681	1,700	600		2,703,734
Rademacher	5		297	315		315	297				11,236
Randsburg [12]	42	5	375,508	13,440	100	13,540	4,144				476,847
Red Rock	1	1	70	7	83	90	23				3,166
Sageland	5		95	174		174	69				6,139
Summit		2			10	10	1				351
Lassen County:											
Diamond Mountain	3		410	39		39	52				1,402
Hayden Hill	2		2,650	38		38	31				1,352

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1940, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore and old tailings	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Los Angeles County:											
Cedar	13	-	44,695	6,881	-	6,881	2,721	-	-	-	$242,770
Iron Mountain (Valyermo)	2	-	1,590	188	-	188	49	-	-	-	6,615
Neenach	3	-	155	59	-	59	79	-	-	-	2,121
Palomas	1	2	32	13	10	23	4	-	-	-	808
San Gabriel	1	2	12	4	196	200	86	-	-	-	7,061
Madera County:											
Dennis	-	11	-	-	573	573	183	-	-	-	20,185
Hildreth	5	2	108	99	16	115	39	-	-	-	4,053
North Fork	2	-	11	3	-	3	65	-	2,000	-	251
Potter Ridge	9	9	815	130	579	709	191	-	-	-	24,951
Mariposa County:											
East Belt [4]	26	7	18,666	4,981	249	5,230	2,267	200	28,000	-	186,085
Hunter Valley	14	7	9,944	4,055	3,086	7,141	3,278	4,100	-	-	252,729
Mother Lode [5]	30	12	101,048	13,828	935	14,763	3,758	5,700	-	-	520,021
Mendocino County: Hopland	-	1	-	-	2	2	-	-	-	-	70
Merced County: Snelling	-	8	-	-	51,907	51,907	4,891	-	-	-	1,820,223
Modoc County: High Grade	3	-	42	7	-	7	4	-	-	-	248
Mono County:											
Blind Springs	5	-	4,318	222	-	222	53,034	117,200	126,500	-	65,052
Chidago [10]	15	-	3,642	1,736	-	1,736	3,801	-	-	-	63,463
Homer (May Lundy)	(6)	1	(6)	(6)	2	[13] 2	(6)	-	-	-	[13] 70
Mammoth Lakes	4	-	1,652	822	-	822	13,421	-	-	-	38,314
Masonic	4	-	109	49	-	49	2,097	-	-	-	3,206
Patterson	1	-	6	-	-	-	290	-	4,300	-	421
West Walker River	1	-	125	4	-	4	-	-	-	-	140
White Mountain [11]	2	-	153	4	-	4	9,966	800	7,200	-	7,677
Nevada County:											
French Gulch	3	9	399	203	660	863	132	-	-	-	30,299
Grass Valley-Nevada City	26	24	894,558	295,983	7,551	303,534	425,388	36,000	2,800	-	10,930,396
Washington	7	5	7,364	1,187	1,235	2,422	2,894	2,000	5,200	-	87,314
You Bet	-	12	-	-	6,450	6,450	561	-	-	-	226,149
Orange County:											
Santa Rosa	1	-	1,296	41	-	41	15,169	2,000	30,000	52,000	17,224
Lucas Canyon	-	2	-	-	2	2	3	-	-	-	72
Placer County:											
Auburn	6	1	225	105	1,206	1,311	234	200	-	-	46,074
Cisco	1	-	7	1	-	1	-	100	-	-	46
Dutch Flat	4	4	10,224	1,609	1,071	2,680	329	-	-	-	94,034
Foresthill	9	9	2,598	526	1,450	1,976	260	-	-	-	69,345
Iowa Hill	-	9	-	-	2,143	2,143	211	-	-	-	75,155

Last Chance	4	8	405	70	759	829	118				29,099
Lincoln		18			8,012	8,012	1,070				281,181
Michigan Bluff		5			449	449	63				15,760
Ophir	12	21	108,883	22,265	12,140	34,405	57,744	9,700	44,000		1,248,533
Plumas County:											
Genesee	4	4	437,583	15,523	155	15,678	250,798	10,581,200	81,000		1,926,801
Granite Basin	5	2	272	46	68	114	14				4,000
Greenville (Crescent Mills)	13	(6)	73,812	5,870	(6)	[7] 5,870	[7] 1,368	3,000	4,700		[7] 206,997
Johnsville	3	6	1,847	725	116	841	180	100	300		29,589
La Porte		4			1,113	1,113	93				39,021
Lights Canyon		3			1,493	1,493	124				52,343
Quincy	2	9	4,529	623	1,391	2,014	207				70,637
Rich Bar	2	9	31,280	9,526	313	9,839	2,141	1,700			346,080
Seneca		4			155	155	20				5,439
Riverside County:											
Chuckawalla	11	(14)	203	108	5	113	28				3,975
Dale [15]	12	1	1,347	1,355	10	1,365	55				47,814
Eagle Mountain	4	1	3,221	630	4	634	31,504	44,000	1,066,000		102,865
Ironwood	2		75	33		33	7				1,160
Pinacate	7	1	430	161	26	187	56				6,585
Pinon	5		81	44		44	4				1,543
Sacramento County:											
Cosumnes River		6			29,824	29,824	2,136				1,045,359
Folsom	1	12	2	36	128,377	128,413	7,815				4,500,012
San Bernardino County:											
Amargosa	1		10	3		3	1				106
Black Hawk	3		5,277	3,669		3,669	2,083	3,100	100		130,251
Buckeye	6		2,754	792		792	7,907	21,100			35,727
Calico	7		4,596	49		49	11,493	300	1,200		9,982
Clark Mountain	2		46				59	6,600	11,800		1,378
Coolgardie		2			42	42	4				1,473
Dale [15]	19		19,849	5,951		5,951	6,923	200	2,800		213,371
Dry Lake		1			1	1					35
Fremont Peak	1		355	13		13	3				457
Goldstone	4		123	35		35	34				1,249
Hikorum	1		6	30		30	14				1,060
Holcomb Valley	2	5	1,122	196	277	473	55				16,594
Ivanpah	6		260	61		61	8,539	4,600	1,800		8,817
Kelso	5		85	56		56	222		100		2,123
Mid Hills	1		30	5		5	3				177
Morongo	1		10	10		10	3				352
Old Woman Mountain	7		239	167		167	1,384	300			6,863
Ord Mountain	1		77	61		61	17				2,147
Paradise	1		217	40		40	7				1,405
Providence	4		141	36		36	56	3,900	3,900		1,936
Randsburg [12]	5	(6)	11,247	1,026	(6)	[7] 1,026	[7] 102,694				[7] 108,937
Signal	5		56	30		30	11				1,058
Silver Mountain	14		364	302		302	865		7,200		11,545
Slate Range [16]	9		181	40		40	28	2,100	400		1,677
Solo	7		692	1,062		1,062	977	5,700	500		38,534
Summit Valley		2			3	3					105
Vanderbilt (Hart)	3		3,897	377		377	1,270				14,098
Whipple Mountain	9		419	140		140	509	6,100			5,951

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1940, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore and old tailings	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
San Diego County:											
El Cajon	2		79	35		35	7				$1,230
Julian	9		304	163		163	59				5,747
Pine Valley	4		353	287		287	114				10,126
San Francisco County: San Francisco		(14)			70	70	7				2,455
San Joaquin County: Camanche [8]		3			5,734	5,734	661				201,160
San Luis Obispo County: La Panza		2			10	10					350
Santa Barbara County: San Rafael Mountains	1		38	1		1	7	8,000			944
Santa Cruz County:											
Bonny Doone	2		7	4		4	3				142
Santa Cruz		(14)			15	15	3				527
Shasta County:											
Flat Creek	(6)	1	(6)	(6)	3	[13] 3		(6)			[13] 105
French Gulch	15	5	111,108	10,068	3,037	13,105	13,162	100	2,000		468,146
Igo	(6)	24	(6)	(6)	9,715	[13] 9,715	838				[13] 340,621
North Cow Creek		1			1	1					35
Old Diggings	2	3	15,311	1,003	266	1,269	802				44,985
Redding	7	4	1,449	512	688	1,200	246				42,175
Shasta	4	1	8,709	260	30	290	48				10,184
Slate Creek	1	2	1	9	301	310	149				10,956
Sierra County:											
Alleghany	11	10	75,165	18,202	1,241	19,443	3,303	2,000			683,080
Depot Hill		1			212	212	11				7,428
Downieville	2	19	38	14	2,244	2,258	173				79,153
Pike (Slate Range)	2	4	1,861	382	148	530	114				18,631
Poker Flat (Table Rock)		4			419	419	31				14,687
Port Wine		4			4,105	4,105	270				143,867
Sierra City	5	(14)	4,195	418	6	424	111				14,919
Siskiyou County:											
Callahan	6	7	3,780	828	17,512	18,340	2,728				643,840
Gazelle	1		750	41		41	21				1,450
Greenhorn	2	11	344	444	5,485	5,929	946				208,188
Humbug	5	5	231	107	3,690	3,797	620				133,336
Klamath River	10	30	1,212	579	25,281	25,860	4,239				908,114
Liberty	8	21	28,843	844	1,206	2,050	256				71,932
Quartz Valley	7	5	477	67	93	160	44				5,631
Salmon River	2	9	19	6	1,117	1,123	179				39,432
Scott River	4	6	927	633	1,176	1,809	320				63,543
Stanislaus County:											
Knights Ferry		5			7,728	7,728	627				270,926
La Grange		4			21,184	21,184	1,669				742,627
Orange Blossom		1			291	291	11				10,193

Trinity County:											
Big Bar	1	(6)	20	3	(6)	[7] 3					[7] 105
Coffee Creek	(6)	4	(6)	(6)	113	[13] 113	7				[13] 3,960
Hayfork	(6)	4	(6)	(6)	3,363	[13] 3,363	492				[13] 118,055
Helena	2	2	451	167	201	368	66				12,927
Junction City	2	9	104	12	11,826	11,838	1,150				415,148
Lewiston	11	12	2,540	311	6,170	6,481	858				227,445
New River	3	7	485	165	111	276	37				9,686
Salyer		5			668	668	59				23,422
Trinity Center	1	5	200	85	12,437	12,522	1,717				439,491
Weaverville	4	20	365	235	13,273	13,508	1,495				473,843
Tulare County: White River	2		27	16		16	7				565
Tuolumne County:											
East Belt [4]	42	5	12,552	4,406	1,303	5,709	1,223				200,685
Mother Lode [5]	12	15	84,656	7,946	8,277	16,223	3,693	4,000			570,883
Ventura County: Piru	3		87	44		44	7				1,545
Yuba County:											
Bear River		1			495	495	21				17,340
Camptonville	1	4	112	14	390	404	58				14,181
Challenge	2		293	41		41	7				1,440
Dobbins	3	5	341	40	417	457	45				16,027
Smartville		7			10,847	10,847	830				380,235
Strawberry Valley		5			1,016	1,016	87				35,622
Other counties and districts [17]	20	13	420,019	[18] 33,017	111,490	[18] 144,507	[18] 298,011	[18] 1,930,000	16,400		[18] 5,488,575
Total California	1,030	836	4,669,433	[18] 750,719	704,952	[18] 1,455,671	[18] 2,359,776	[18] 12,876,000	3,544,000	158,000	[18] 54,268,690

1 Only those counties and districts shown separately for which Bureau of Mines is at liberty to publish figures; others producing listed in footnote 17 and their output included under "Other counties and districts."

2 Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

3 Source of total silver as follows: 2,295,606 ounces from lode mines and 64,170 ounces from placers.

4 East Belt district lies in Amador, Calaveras, Eldorado, Mariposa, and Tuolumne Counties.

5 Mother Lode district lies in Amador, Calaveras, Eldorado, Mariposa, and Tuolumne Counties.

6 Included under "Other counties and districts."

7 Exclusive of placer output, which is included under "Other counties and districts."

8 Camanche district lies in Amador, Calaveras, and San Joaquin Counties.

9 Jenny Lind district lies in Calaveras and Stanislaus Counties.

10 Chidago district lies in Inyo and Mono Counties.

11 White Mountain district lies in Inyo and Mono Counties.

12 Randsburg district lies in Kern and San Bernardino Counties.

13 Exclusive of lode output, which is included under "Other counties and districts."

14 Output of property not classed as a "mine."

15 Dale district lies in Riverside and San Bernardino Counties.

16 Slate Range district lies in Inyo and San Bernardino Counties.

17 Includes following: Camanche district in Amador County; Butte Creek (placer) and Yankee Hill (placer) in Butte County; Bishop Creek and Slate Range in Inyo County; Silver Mountain (Antelope Valley) in Los Angeles County; Bodie and Homer (lode) in Mono County; Monterey County (Los Burros district); Napa County (Calistoga district); Greenville (Crescent Mills) (placer) in Plumas County; Lava Bed, Randsburg (placer), and Washington in San Bernardino County; Bellota (Linden) in San Joaquin County; Flat Creek (lode) and Igo (lode) in Shasta County; Jenny Lind in Stanislaus County; Big Bar (placer), Coffee Creek (lode), and Hayfork (lode) in Trinity County; Browns Valley and Yuba River in Yuba County.

18 Includes metals from tungsten concentrates from ore not included in ore and old tailings tonnage.

ALPINE COUNTY

Monitor district.—Lessees worked the Zaca mine during 1940; the principal product was gold concentrates shipped to a smelter.

AMADOR COUNTY

Camanche district.—The Gold Hill Dredging Co. operated a connected-bucket dredge with sixty-six 7¾-cubic foot buckets along the Mokelumne River during 1940.

East Belt district.—The Belama Corporation worked the Belden mine in the Volcano section of the East Belt during 1940 and treated 4,000 tons of ore in a 25-ton flotation mill; amalgamation, cyanidation, and smelting of concentrates yielded 2,044 ounces of gold and 1,130 ounces of silver. The Gwalia Gold Mining Co. and a lessee worked the Pioneer mine; gold was recovered by amalgamation and smelting of flotation concentrates. Garibaldi Bros. operated a nonfloating washing plant, to which gravel was delivered by mechanical means, on the Garibaldi mine, Pioneer Creek, one-half mile east of Volcano from January 1 to July 30 and November 10 to December 8. E. A. Kent operated two dragline dredges along Sutter Creek between Sutter Creek and Volcano; one dragline excavator had a 1¾-cubic yard bucket and the other a 2½-cubic yard bucket.

Ione district.—The Arroyo Seco Gold Dredging Co. worked a property 3 miles west of Ione throughout 1940; the company electrically powered connected-bucket dredge had eighty-six 6-cubic foot buckets. The San Andreas Gold Dredging Co. operated a dragline dredge, using a dragline excavator with a 1½-cubic yard bucket, on the Arroyo Seco ranch from January 1 to February 9. The Lancha Plana Gold Dredging Co. operated a connected-bucket dredge on Jackson Creek the entire year; the electrically powered dredge was of Yuba type, with sixty-five 4½-cubic foot buckets. The Horseshoe Dredging Co. operated a dragline dredge from May 2 until July 26. Pacific Placers Engineering Co. operated a dry-land plant on the John McCulloh property from October 14 until December 23.

Mother Lode district.—The Argonaut Mining Co., Ltd., operated the Argonaut mine throughout 1940; gold ore was treated by amalgamation and flotation, and the concentrates were shipped to a smelter. In addition to operations at the Argonaut mine, the company cyanided and floated a large tonnage of old tailings at the Plymouth mine; concentrates were shipped to a smelter. The Central Eureka Mining Co. operated the Central Eureka and Old Eureka mines; the ore was treated by amalgamation and flotation, and the sands and concentrates were cyanided. The Delta Tailings Co. continued to cyanide material derived from old tailings collected as a delta on one of the streams draining a section of the Mother Lode district. The Fremont Gover mine was closed in April after exploration and development work carried on for many months by the Fremont Gover Co. failed to yield promising results. The Black Hills Mining Co. worked the Italian mine in 1940. The Kennedy Mining & Milling Co. operated the Kennedy mine throughout the year; gold ore was treated by amalgamation and flotation, and the concentrates were smelted. The Keystone Mine Syndicate worked the Keystone mine; 86,513 tons of ore were treated in the company 300-ton amalgamation-flotation mill; gold recovery was 2,534 ounces in bullion and 8,167 ounces in 2,710 tons of concentrates shipped to a smelter. The River Pine Mining Co. operated the most productive dragline dredge in the district in 1940. The Placeritas Mining Co. operated a dragline dredge on the following properties (all within a radius of 4 miles from Plymouth): Associated Mining Co., G. W. Easton, G. Kretcher, J. Orr, Levaggi, and the W. F. Detert estate. The Rim Cam Gold Dredging Co. operated a dragline dredge on the J. Rich property 1 mile west of Drytown, the Blakeley ranch 2½ miles south of Drytown, and the Pester property on the Cosumnes River between Plymouth and Nashville. J. C. Pantle washed 265,000 cubic yards of gravel on Willow Creek with a dry-land dredge from April 1 to December 31; 1,154 ounces of gold and 139 ounces of silver were recovered. E. L. Lilly operated a dragline dredge on the Sally property from September 3 to December 31; the same equipment had worked the Wolin-Hall property from January 1 to September 2.

BUTTE COUNTY

Butte Creek district.—The Little Butte lode mine was operated during 1940.

Magalia district.—The Lemroh Mining Co. operated a dragline dredge from August 15 until the end of 1940.

Merrimac district.—Piombo Bros. & Co. operated a dragline dredge using a dragline excavator with a 1½-cubic yard bucket on French Creek throughout 1940.

Oroville district.—The Butte Operating Co. operated a dragline dredge throughout 1940. Yuba Consolidated Gold Fields (Butte Unit) operated four electric-powered connected-bucket dredges in the Oroville district during 1940; the dredge-bucket equipment per boat was as follows: Eighty-four 9-cubic foot buckets, eighty-nine 9-cubic foot buckets, eighty-seven 9-cubic foot buckets, and seventy-one 6-cubic foot buckets. William Richter & Sons operated a dragline dredge on the Douglas Jacob, Mary Harrin, V. Gamble, and John Bilkli properties. Baker and McCowan operated a dragline dredge on the Farnan ranch. The Golden Feather Dredging Co. operated a dragline dredge, using a dragline excavator with a 5-cubic yard bucket, on the Feather River opposite the town of Oroville from February 8 to December 31. Interstate Mines, Inc., moved a dragline dredge from Trinity County to the Gianella ranch, where it operated from September 11 to December 13. The Humphreys Gold Corporation operated a dry-land dredge on the L. L. Kister property intermittently from January 1 to May 15. Lord & Bishop (Lobicasa Co. after January 1, 1941) washed 66,300 cubic yards of gravel by dragline dredging between November 12 and December 31 and recovered 336 ounces of gold and 11 ounces of silver; the dragline excavator used a

1½-cubic yard bucket. The Placer Development Co. operated a dragline dredge from September 16 until the end of the year. The Sunmar Dredging Co. operated a dragline dredge in Weymans Ravine 4 miles from Oroville from January 1 until March 20; the dragline excavator used a 2-cubic yard bucket. The Gold Hill Dredging Co. operated a connected-bucket dredge with seventy-four 9-cubic foot buckets on the Wilton Kister property throughout 1940.

Yankee Hill district.—Hoefling Bros. worked the Surcease mine during 1940; the company milling plant was completely reconstructed as a 125-ton flotation-cyanidation mill; cyanidation of concentrates was not begun until 1941.

CALAVERAS COUNTY

Camanche district.—The Midas Placer Co. washed 50,000 cubic yards of gravel in a dry-land plant between April 14 and the end of 1940; 659 ounces of gold and 52 ounces of silver were recovered. The Lancha Plana Gold Dredging Co. operated its dredge No. 2 on the Mokelumne River in Calaveras County from January 1 to February 21; the dredge had eighty-four 6-cubic foot buckets.

Campo Seco district.—Glo-Bar Mines operated the Glo-Bar drift mine throughout 1940; 4,464 cubic yards of gravel yielded 321 ounces of gold and 44 ounces of silver.

Copperopolis district.—The Jumbo Consolidated Mining Co. operated the Mountain King mine in the Madam Felix section of the Copperopolis district from January 1 until June 30, 1940, when the company entered bankruptcy; a substantial quantity of ore was treated in the 250-ton amalgamation-flotation mill on the property, and the concentrates were shipped to a smelter. F. S. Tower worked the Royal mine in the Madam Felix section of the district; 14,154 tons of ore yielded amalgamation bullion containing 1,118 ounces of gold and 315 ounces of silver and 311 tons of flotation concentrates containing 721 ounces of gold and 629 ounces of silver.

East Belt district.—The St. Joseph Lead Co. worked the Sheepranch mine throughout 1940; the ore was treated in a 150-ton amalgamation-flotation mill, and the resulting concentrates were shipped to a smelter.

Jenny Lind district.—The Stagan Mining Co. operated a dragline dredge on the Hunt and Robie ranches during 1940; at the Hunt ranch 86,000 cubic yards of gravel yielded 615 ounces of gold and 37 ounces of silver, and at the Robie ranch 414,000 cubic yards of gravel yielded 2,287 ounces of gold and 145 ounces of silver. In addition, a dry-land plant on the Robie ranch washed a small quantity of gravel. The Milton Gold Dredging Enterprise operated a dragline dredge on South Gulch. W. C. Thompson operated a dragline dredge on the Calaveras River 1½ miles southwest of Jenny Lind throughout 1940.

Mother Lode district.—C. E. Gruwell worked the Big Springs mine from January 1 to September 21, 1940. The Carson Hill Gold Mining Corporation treated 385,028 tons of gold ore at the Carson Hill mine during the year and produced amalgamation bullion containing 7,061 ounces of gold and 723 ounces of silver, cyanidation bullion containing 16,655 ounces of gold and 6,223 ounces of silver, and 5 tons of gravity concentrates containing 79 ounces of gold and 407 ounces of silver; flotation replaced the table concentration used in 1939. All the ore was amalgamated and cyanided, and the flotation concentrates were reground and cyanided separately. During 1940 the company paid $72,000 in dividends, bringing its total dividend disbursements to the end of 1940 to $288,000. LeRoi Mines, Inc., operated the Easyz Bird mine from January 1 to March 15; later in the year enlargement, retimbering, and re-equipment of the mine shaft were begun. The San Andreas Gold Dredging Co. operated two dragline dredges on properties along the Mother Lode; each dragline excavator had a 1½-cubic yard bucket. Gravel was washed at the Airola-Costa, Albert Guttinger, John Guttinger, Batten, Bonnie, Bishop (Bowling Green), Calaveras Cement Co., Reed, Canepa, Byers, Fisher, Nuland, Nuner, Tanner, Bishop (Lot 29), and Solari properties. C. E. Gruwell operated a dragline dredge on the Hogate ranch 3½ miles north of Angels Camp. Gravel was hydraulicked at the Cat Camp property. The R. & M. Mining Co. operated a dragline dredge on Coyote Creek from January 1 to April 15; the dragline excavator had a 1¼-cubic yard bucket. J. H. Henry washed 17,200 cubic yards of gravel by dragline dredging on the E. A. Marsh property 4 miles southeast of Valley Springs between May 30 and July 27 and recovered 137 ounces of gold and 13 ounces of silver. The same equipment washed 45,600 cubic yards of gravel on the Genochio property on the North Fork of Calaveras River 1½ miles north of San Andreas between September 16 and the end of the year; 362 ounces of gold and 40 ounces of silver were recovered. Young & Son Co., Ltd., moved 40,000 cubic yards of gravel at the Yale and Allyn property to a stationary washing plant with tractors and carry-alls between April 9 and August 28; 420 ounces of gold and 37 ounces of silver were recovered. Lord & Bishop (now Lobicasa Co.) operated three dragline dredges on the Stockton Reservoir property on the Calaveras River 3 miles from Valley Springs; the dragline excavators used 3-, 1½-, and 1¾-cubic yard buckets, respectively. The Vallecito Mining Co., Inc., worked the Vallecito Western drift mine throughout 1940 and recovered 221 ounces of gold and 25 ounces of silver from 685 cubic yards of gravel. The Wolhall Dredging Corporation operated a dragline dredge on San Domingo Creek from July 4 to December 31; the dragline excavator had a 2-cubic yard bucket.

ELDORADO COUNTY

East Belt district.—The Cosumnes Mines, Inc., treated a substantial quantity of gold ore from a group of claims in the Grizzly Flat section of the East Belt by amalgamation and concentration in 1940. The Greenhorn Dredging Co. operated a dragline dredge on the Middle Fork of Cosumnes River near Youngs from November 3 until December 31; the dragline excavator had a 2-cubic yard bucket.

Mother Lode district.—The Alhambra-Shumway Mines, Inc., operated the Alhambra-Shumway mine throughout 1940. Although the output of the mine was substantial it was much less than that in 1939, when the company extracted one of the richest bonanzas found in California in recent years. The Briarcliffe Mines, Ltd., operated the Briarcliffe mine from January 1 to June 30; 2,904 tons of ore treated by amalgamation yielded bullion containing 38 ounces of gold and 5 ounces of silver and 79 tons of flotation concentrates containing 200 ounces of gold, 26 ounces of silver, and 487 pounds of copper; the concentrates were smelted. The Middle Fork Gold Mining Co. operated the Sliger mine throughout 1940 and treated the ore in a 160-ton amalgamation-flotation mill; during the year a new steel head frame was completed. The General Dredging Corporation operated a dragline dredge in 1940 on the South Fork of American River near the point where James Marshall discovered gold in 1848; the dragline excavator had a 1½-cubic yard bucket. The El Dorado Dredging Corporation operated a dragline dredge using a 1½-cubic yard bucket on Greenwood Creek from June 7 to August 22; on the latter date the plant was moved to Coloma Creek, where work continued until the end of the year. The Irish Creek Mining Co. moved its nonfloating washing plant to the Morgan property and operated from May 2 to October 18. McQueen & Downing operated a dragline dredge on Carson Creek from February 1 until July 8.

West Belt district.—The Mountain Copper Co., Ltd., closed its Big Canyon operation late in 1939 but produced a small quantity of gold during the clean-up of the mill in 1940. El Dorado Crystal Mine worked the El Dorado Crystal mine from January 1 to June 5, when exhaustion of known ore bodies terminated operations; 15,588 tons of ore yielded 2,393 ounces of gold and 881 ounces of silver by cyanidation. The Big Canyon Dredging Co. operated a dragline dredge for 8 months in 1940; the dragline excavator had a 3-cubic yard bucket. The dragline dredge of the Horseshoe Dredging Co. operated on the Frank Kipp property from January 26 to March 20. The Lemroh Mining Co. worked a dragline dredge from January 3 to 23.

FRESNO COUNTY

Friant district.—Griffith Co. and Bent Co., which supplied gravel for the Friant dam in 1940, recovered 443 ounces of gold and 73 ounces of silver in preparing 400,000 tons of gravel.

HUMBOLDT COUNTY

Orleans district.—Hydraulicking at the Pearch mine yielded a substantial quantity of gold in 1940.

IMPERIAL COUNTY

Cargo Muchacho district.—In 1940 the Holmes & Nicholson Mining & Milling Co. shipped a substantial quantity of gold ore from the Cargo

Muchacho group of claims to the company 80-ton cyanide mill 12 miles from the mine and 4 miles west of Winterhaven. T. L. Woodruff and J. M. Rogers worked the Queen mine from May 15 until the end of the year; 1,749 tons of ore containing 1,160 ounces of gold, 222 ounces of silver, and 9,850 pounds of copper were shipped to a smelter; 603 tons of old tailings shipped to a custom cyanide plant yielded 166 ounces of gold and 75 ounces of silver. The Sovereign Development Co. cyanided 5,521 tons of ore from the Sovereign group during 1940 and recovered 1,401 ounces of gold and 145 ounces of silver; the mill was closed October 3 owing to the decline in grade of ore, but exploration and development work continued. The company was reorganized and renamed Tumco Mines, Inc., November 16, 1940.

Mesquite district.—Vanderpool & Murphy operated the Mary Lode mine during 1940. The amalgamation of 92 tons of ore yielded 246 ounces of gold and 115 ounces of silver; in addition, 121 tons of ore containing 144 ounces of gold and 423 ounces of silver were shipped to a smelter.

INYO COUNTY

Bishop Creek district.—The United States Vanadium Corporation produced a copper concentrate containing a substantial quantity of gold as a byproduct of ore treated primarily for tungsten in 1940.

Chloride Cliff district.—J. C. Anderson subleased the Big Bell mine to K. M. Woods January 18, 1940; 4,800 tons of ore treated in a 30-ton amalgamation-concentration plant at the mine yielded amalgamation bullion containing 1,087 ounces of gold and 170 ounces of silver and 13 tons of concentrates containing 52 ounces of gold, 23 ounces of silver, and 930 pounds of lead.

Resting Springs district.—The Shoshone Mines, Inc., reopened the Columbia No. 2 on February 10 and continued operations to the end of 1940; lead ore containing substantial quantities of the precious metals was shipped to a smelter.

Sherman district.—The Argus Mining Co. ceased operation of the Orondo mine April 20, 1940; a successor—the Orondo Mining Co.—reopened the property September 28 and worked until the end of the year. Each company treated a small quantity of ore by cyanidation. Burton Bros., Inc., continued operations at the Ruth mine, where a very porous ore was cyanide-leached after crushing.

Union district.—A number of lessees shipped a substantial quantity of ore, averaging over an ounce of gold to the ton, from the Reward or Brown Monster mine to custom cyanide mills in 1940.

Wild Rose district.—The Del Norte Mining Co. and lessees operated the Del Norte-Skidoo group of mines in the Skidoo section of the Wild Rose district in 1940. The principal operator (the Del Norte Mining Co.) built a 30-ton cyanide plant and began milling May 15; 5,468 tons of ore cyanided yielded 2,587 ounces of gold and 2,599 ounces of silver.

KERN COUNTY

Cove district.—Kern Mines, Inc., operated the Big Blue and Lady Belle groups throughout 1940; 41,598 tons of ore yielded amalgamation bullion containing 2,948 ounces of gold and 1,239 ounces of silver and 694 tons of flotation concentrates containing 3,095 ounces of gold, 7,151 ounces of silver, 355 pounds of copper, and 18,581 pounds of lead; the concentrates were shipped to a smelter.

Mojave district.—Lessees shipped gold ore from the Bob Tail mine to a custom cyanide mill in 1940. The Cactus Mines Co. operated the Cactus Queen mine in the Middle Butte section of the Mojave district throughout the year; gold-silver ore was treated in the company 125-ton cyanidation-flotation mill, and the resulting concentrates were shipped to a smelter. In 1940, for the third year, this property was the State's leading silver producer. M. Albertoli shipped 2,856 tons of ore from the Desert Queen mine to a custom cyanide mill; 541 ounces of gold and 77 ounces of silver were recovered. Lessees worked the Four Jacks mine and shipped 1,097 tons of ore to custom cyanide plants; 295 ounces of gold and 3,748 ounces of silver were recovered. The Golden Queen Mining Co. operated the Golden Queen mine the entire year; in addition to treating a large tonnage of company ore in its 425-ton cyanide mill it did a substantial custom-mill business. The Lodestar Mining Co. shipped 65,119 tons of ore to the Golden Queen cyanide mill; 11,663 ounces of gold and 179,018 ounces of silver were recovered. A number of lessees and sublessees shipped 3,886 tons of ore from the Standard mine to custom cyanide plants during 1940; 1,450 ounces of gold and 15,240 ounces of silver were recovered. Burton Bros., Inc., operated the Tropico mine both on company account and through lessees. This company operated a cyanide plant which, in addition to treating the Tropico ore, treated custom material from more than 300 shippers. As a pioneer in California custom milling east of the Sierra Nevada Mountains, Burton Bros., Inc., has been an important factor in the development of mineral resources within a radius of many miles. Owing to good roads and cheap truck transportation, ore has been sent to this mill from mines over 100 miles away. Lessees on the Yellow Dog mine shipped 424 tons of ore to custom cyanide plants; 382 ounces of gold and 398 ounces of silver were extracted. Lessees on the Yellow Rover mine shipped 593 tons of ore to custom plants; 381 ounces of gold and 998 ounces of silver were recovered by cyanidation.

Randsburg district.—Wegman, Movold & Wegman operated the G. B. and Boston No. 2 claims during 1940; 1,255 tons of ore, part of which was treated by amalgamation and part shipped to a custom cyanide plant, yielded 346 ounces of gold and 8 ounces of silver. The King Solomon Mines Lease worked the King Solomon mine and treated a substantial quantity of ore by amalgamation and cyanide leaching of sands. The operators of the Lucky Boy mine treated 329 tons of ore in the Big Butte Mining Co. mill and recovered 379 ounces of gold and 94 ounces of silver. Lessees shipped 1,098 tons of ore from the Wade property to custom cyanide plants in 1940, where 797 ounces of gold and 4 ounces of silver were recovered. Lessees operated the White mine and shipped 1,029 tons of ore to custom cyanide plants; 345 ounces of gold and 36 ounces of silver were recovered. The Anglo American Mining Corporation, Ltd.—largest operator in the Randsburg district—resumed cyanidation of old tailings at the Yellow Aster mine April 1 after a labor strike had suspended operations for several months; the open pit, which produced a larger tonnage of ore than any other mine in the State in 1939, was not reopened. According to the company printed annual report for the year ended December 31, 1940, 363,715 tons of accumulated tailings were treated.

LOS ANGELES COUNTY

Cedar district.—The Governor Mine Co., operator of the Governor mine, was the principal producer in the Cedar district in 1940.

MARIPOSA COUNTY

East Belt district.—The Bondurant Mining & Milling Co. worked the Bondurant mine during 1940. The San Juan Ramsey Co. operated the Ferguson mine under lease agreement with the Original Mining & Milling Co. during part of 1940. Amalgamation of 3,673 tons of ore from the Nutmeg mine yielded bullion containing 511 ounces of gold and 126 ounces of silver. Schroeder, Odgers & Schroeder operated the Schroeder mine in the Colorado section of the East Belt; 111 tons of ore yielded 590 ounces of gold and 73 ounces of silver.

Hunter Valley district.—Mount Gaines Mining Co. worked the Mount Gaines mine during 1940. The Barker Corporation moved its dragline dredge to Eldorado Creek 1 mile from Hornitos. The Trebor Corporation operated a dragline dredge on the Chase ranch from March 16 to the end of the year; the dragline excavator had a 2-cubic yard bucket.

Mother Lode district.—The Granite King mine was operated during 1940. The Boston California Mining Co. worked the Malvina mine. Pacific Mining Co. worked the Pine Tree and Josephine mines throughout the year and treated 59,249 tons of ore by amalgamation and flotation; the amalgamation bullion contained 1,400 ounces of gold and 285 ounces of silver, and the flotation concentrates shipped to a smelter contained 7,582 ounces of gold, 1,788 ounces of silver, and 4,781 pounds of copper.

MERCED COUNTY

Snelling district.—The Snelling Gold Dredging Co. operated two connected-bucket dredges on the Merced River between Snelling and Merced Falls throughout 1940—one with sixty-six and the other with seventy-two 7-cubic foot buckets. The Merced Dredging Co. operated a connected-bucket dredge with sixty 10-cubic foot buckets one-half mile southwest of Snelling. Four miles east of Snelling, Yuba Consolidated Gold Fields (Merced Unit) operated a connected-bucket dredge with seventy-two 9-cubic foot buckets. P. H. Bottoms operated a dragline dredge from January 1 to November 1; the dragline excavator had a 2-cubic yard bucket. The San Joaquin Mining Co. operated a connected-bucket dredge with sixty-four 10-cubic foot buckets 3 miles west of Snelling in 1940.

MONO COUNTY

Blind Springs district.—The Mineral Reduction Co. continued to operate its custom cyanidation-flotation mill throughout 1940; 94 shippers sent the plant over 7,000 tons of ore during the year. A marked increase in production from prospects and small mines in Mono County has resulted from the service offered by this custom plant. Silver ore mined at the Comanche mine was treated at this plant.

Bodie district.—The Roseklip Mines Co. cyanided dump ore from the Standard mine in a 500-ton plant during 1940.

Chidago district.—R. G. Jones shipped a substantial quantity of gold ore from the Gold Crown mine to the Mineral Reduction Co. cyanidation-flotation plant during 1940.

Homer (May Lundy) district.—The Log Cabin Mines Co. operated the Log Cabin (Simpson) mine from January 1 until December 23, 1940; the ore was treated by amalgamation.

Mammoth Lakes district.—The Monte Christo Mining Co. shipped ore from the Monte Christo mine to a custom cyanide-flotation plant from May 1 until December 16, 1940; 1,640 tons of ore yielded 803 ounces of gold and 12,947 ounces of silver.

White Mountain district.—Between November 1 and 28, 1940, Molini Bros. shipped 135 tons of silver ore from the Green Monster mine to a smelter; the content of the ore was 2 ounces of gold, 9,947 ounces of silver, 818 pounds of copper, and 10,328 pounds of lead.

NAPA COUNTY

Calistoga district.—The Graham Loftus Oil Corporation floated a large quantity of gold-silver ore from the Grigsby (Palisade) mine in 1940; gold-silver concentrates were shipped to a smelter.

NEVADA COUNTY

Grass Valley-Nevada City district.—Grass Valley Bullion Mines, Inc., operated throughout 1940 and shipped its ore to the nearby Idaho Maryland Mines Corporation mill. Empire Star Mines Co., Ltd., operated the Empire, North Star, and Pennsylvania mines at Grass Valley, the Murchie mine at Nevada City, the Zeibright mine in Bear Valley, and the Pennsylvania mine at Browns Valley in Yuba County; the Grass Valley unit was the main producer, work at the Murchie mine was principally exploratory, and production at the

Zeibright mine was suspended early in the year when a storm washed out the company tailings dam. Cooley Butler operated the Golden Center mine throughout 1940. Ore from the Green Mountain mine was amalgamated in a 5-stamp mill. The Idaho Maryland Mines Corporation operated the Idaho Maryland-Brunswick group. According to the company printed annual report for the year ended December 31, 1940, 129,309 ounces of gold and about 34,000 ounces of silver were recovered from 406,707 tons of ore, compared with a recovery of 115,001 ounces of gold from 410,411 tons of ore in 1939. In 1940, 101,028 tons of ore were derived from development headings and 305,679 tons by stoping. In addition to company ore, 24,564 tons of custom ore (24,438 tons of which came from Grass Valley Bullion Mines, Inc.) and 753 tons of custom concentrates were treated. Dividends declared and paid in 1940 totaled $1,073,250.80, bringing total disbursements in dividends to $5,723,965.60. The Idaho Maryland Mines Corporation held first rank as a gold (lode) producer, despite the fact that its output came from a single operation, whereas several other companies—notably the Empire Star Mines Co., Ltd.—derived output from two or more properties widely separated in the State. The Lava Cap Gold Mining Corporation operated the Lava Cap mine throughout the year; 138,580 tons of ore were treated by amalgamation and flotation, and the resulting concentrates were shipped for smelting. Amalgamation bullion contained 5,196 ounces of gold and 33,954 ounces of silver, and 6,661 tons of flotation concentrates contained 34,373 ounces of gold, 288,508 ounces of silver, 43,330 pounds of copper, and 836 pounds of lead. During the year additions were made to the company 400-ton amalgamation-flotation plant to provide for daily cyaniding of 25 tons of concentrates, 20 tons of middlings, and 350 tons of flotation tailings. Lintecum & Garden cyanided 5,000 tons of the Old North Star old tailings on the MacDonald ranch and recovered bullion containing 324 ounces of gold and 148 ounces of silver. The Dakin Co. operated a dragline dredge at Champion Flat along Deer Creek from January 1 to March 1, 1940; the dragline excavator had a 1½-cubic yard bucket. The Pilot Dredging Co. operated intermittently a dragline dredge on the Coleburn property. Kaufield & McKinley operated a nonfloating washing plant on the Parker ranch from June 27 until September 13. The Wyandotte Dredging Co. operated a dragline dredge using a 2½-cubic yard bucket on the Perrin and Pingree ranches from October 18 until December 31; 87,000 cubic yards of gravel yielded 771 ounces of gold and 109 ounces of silver. William Richter & Sons operated a dragline dredge at Scotts Flat from January 1 to October 13.

Washington district.—The Arctic mine was operated by the Utter Mining Co., which leased the property to the Kemmerer Exploration Co. September 1, 1940; the 50-ton flotation mill at the property was started October 12. The Bradley Mining Co. worked the Spanish mine; 989 tons of ore were treated by cyanidation and flotation, and the resulting 58 tons of concentrates were shipped to a smelter; the cyanide bullion contained 51 ounces of gold and 422 ounces of silver, and the concentrates contained 194 ounces of gold, 2,107 ounces of silver, 3,904 pounds of copper, 4,626 pounds of lead, and 9,387 pounds of zinc. The company removed equipment and abandoned all underground workings, except for a small portion known as the Spanish Pit. Several operators worked the Trood mine by drifting and with surface mechanical equipment.

You Bet district.—The Wyandotte Dredging Co., the San Carlos Gold Dredging Co., and the Pilot Dredging Co. operated dragline dredges on the Alpha Stores property during 1940. The Greenhorn Dredging Co. operated a dragline dredge at Quaker Hill from January 1 until December 31; the dragline excavator had a 2-cubic yard bucket. The Calaveras Gold Dredging Co. operated a dragline dredge at Steep Hollow from April 8 to August 20.

ORANGE COUNTY

Santa Rosa district.—The Blue Light Silver Mines, Inc., worked the Silverado or Blue Light mine in Silverado Canyon throughout 1940; 1,296 tons of ore treated in the company 50-ton flotation mill yielded 215 tons of concentrates containing 41 ounces of gold, 15,169 ounces of silver, 2,900 pounds of copper, 38,715 pounds of lead, and 77,195 pounds of zinc.

PLACER COUNTY

Dutch Flat district.—The Canyon Mines Corporation worked the Rawhide mine in 1940. The Lost Camp Mining Co. hydraulicked a substantial quantity of gravel at the Lost Camp mine.

Foresthill district.—The Volcano Mining Co., Ltd., and lessees worked the Volcano drift mine 3 miles east of Foresthill in 1940.

Iowa Hill district.—El Oro Dredging Co. operated a dragline dredge on Indian Canyon from February 4 until September 19, 1940, and a second dredge in Shirttail Canyon from August 6 until October 21.

Lincoln district.—Pantle Bros. operated a dry-land placer machine equipped with four Ainlay bowls on the Ahart and Ferreva and Kaneko ranches during 1940; 179,800 cubic yards of gravel yielded 632 ounces of gold and 111 ounces of silver; the gravel was delivered with a 1-cubic yard dragline excavator. The Innis Dredging Co. operated a dragline dredge on Dry Creek from January 1 to June 1. H. J. Aalders & W. W. Prather operated a dragline dredge using a 1½-cubic yard bucket on the Gladding ranch 4½ miles north of Lincoln from January 1 to July 15. The Midland Co., Inc., moved its dragline dredge from the Lincoln district to the North Fork of Salmon River in Siskiyou County during 1940; the dragline excavator had a 1¼-cubic yard bucket. The Jasper-Stacy Co. (Recalp Co.) worked out its ground in Auburn Ravine 2 miles east of Lincoln in May; a dragline excavator with a 2-cubic yard bucket was used. C. N. Chittenden operated a nonfloating washing plant on the Rizzi ranch from January 1 to July 20 and moved it to the Mulligan ranch August 1, where operations were continued until the end of 1940; 222 ounces of gold and 45 ounces of silver were recovered from 75,000 cubic yards of gravel and 132 ounces of gold and 31 ounces of silver from 26,000 cubic yards of gravel at the respective properties.

Ophir district.—The Alabama California Gold Mines Co. operated the Alabama mine throughout 1940; the ore was treated by amalgamation and flotation, and the concentrates were shipped to a smelter. Duncan Hill Consolidated Mines worked the Duncan Hill mine, and the Ophir Nevada Mining & Milling Co. operated the Eclipse mine during 1940. Highway Forty Mines, Inc., operated the Highway Forty mine; 1,050 tons of ore yielded amalgamation bullion containing 514 ounces of gold and 202 ounces of silver and 23 tons of concentrates containing 64 ounces of gold, 952 ounces of silver, 604 pounds of copper, and 1,628 pounds of lead. Oro Fino Consolidated Mines worked the Oro Fino mine; 22,549 tons of ore were treated by amalgamation and flotation, from which 3,917 ounces of gold and 149 ounces of silver were recovered as amalgamation bullion, and 794 ounces of gold and 3,377 ounces of silver were derived from the cyanidation of 416 tons of concentrates at the Idaho Maryland Mines Corporation plant. The Panob Gold Dredging Co. operated two dry-land outfits on the Forsyth & Lewis and G. E. Stoll properties during 1940. Kaufield & McKinley operated a nonfloating washing plant using a mechanical excavator on the Love ranch from February 20 until June 28. Hallstrom & Lindblad operated a nonfloating washing plant to which gravel was delivered by a dragline excavator with a 1¼-cubic yard bucket; 124,000 cubic yards of gravel yielded 355 ounces of gold and 9 ounces of silver at the Baker ranch 6 miles east of Roseville, and 165,000 cubic yards of gravel yielded 471 ounces of gold and 30 ounces of silver at the Placer Realty Corporation property in Miners Ravine. The Antelope dredge was taken over by the Roseville Gold Dredging Co. and moved to Strap Ravine 6 miles east of Roseville, where operations were begun January 23 and continued until the end of 1940; the electrically powered connected-bucket dredge had seventy-two 3-cubic foot buckets.

PLUMAS COUNTY

Genesee district.—The Walker mine of the Walker Mining Co. (affiliate of the Anaconda Copper Mining Co.) has been the outstanding mine in Plumas County for many years and was the State's principal copper producer in 1940. According to the company printed annual report for the year ended December 31, 1940, 437,450 tons of ore were milled and 20,881 tons of concentrates produced; shipments consisted of 21,010 tons of concentrates, lime scale, and precipitates, with a net recoverable content of 10,524,345 pounds of copper, 14,176 ounces of gold, and 237,891 ounces of silver.

Greenville (Crescent Mills) district.—A substantial quantity of gold ore from the Cherokee mine was treated by cyanidation and flotation in 1940. The Indian Valley Mining Co., Inc., operated the Standart mine; the gold ore was treated by amalgamation and flotation.

Johnsville district.—Several operators worked the Jamison mine during 1940. Portola Corporation reopened the Plumas Eureka mine and rebuilt the mill on the property.

Lights Canyon district.—Innis Dredging Co. moved its dragline dredge from Nevada County to Lights Creek and resumed operations August 4, 1940; the dragline excavator had a 2-cubic yard bucket.

Quincy district.—The Imperial mine was the principal producer of lode gold in the Quincy district in 1940. Baker and McCowan moved a dragline dredge from Butte County to Meadow Valley, where operations continued through August to December; the dragline excavator had a 1½-cubic yard bucket.

Rich Bar district.—The Virgilia Mining Corporation operated the Ohio Point mine during 1940; the ore was treated by flotation, and the concentrates were shipped to a smelter.

RIVERSIDE COUNTY

Dale district.—Bird & McLeod operated the Golden Rod 1, 2, and 3 claims in the Pinto Basin section of the Dale district throughout 1940; 193 tons of ore and 144 tons of old tailings yielded amalgamation bullion containing 8 ounces of gold and 3 ounces of silver and cyanidation bullion containing 321 ounces of gold and 43 ounces of silver. The amalgamation of 86 tons of ore from the Standard mine yielded 18 ounces of gold; the cyanidation of 152 tons of ore yielded 476 ounces of gold. The Mission Mining Corporation, Ltd., worked the Water Well No. 1 mine throughout the year. The more productive section of the Dale district extended into San Bernardino County.

Eagle Mountain district.—Thirty percent of the lead produced in California in 1940 came from ore from the Black Eagle mine operated by the Imperial Smelting & Refining Co.; the ore was shipped to a smelter.

SACRAMENTO COUNTY

Cosumnes River district.—The Cosumnes Gold Dredging Co. operated a connected-bucket dredge with sixty-three 12-cubic foot buckets 7 miles southwest of Sloughhouse during 1940. The Lancha Plana Gold Dredging Co. operated its connected-bucket dredge at Sailors Bar, American River, from April 20 until December 31; the dredge had eighty-four 6-cubic foot buckets. The Humphreys Gold Corporation operated a dragline dredge, using a dragline excavator with a 2½-cubic yard bucket, on the Fassett-Parker-Hanlon property on Cosumnes River from January 1 to December 5; the equipment was moved to the Hutchison property, where operations continued. The Hutchison property was also worked by the Hoosier Gulch Placers from January 5 to October 31; the company used a dragline dredge equipped with a dragline excavator with a 2½-cubic yard bucket. F. O. Bohnett used a nonfloating washing plant on the Hutchison property from July 5 to December 22. Hoosier Gulch Placers operated a dragline dredge on Katesville Gulch and on the Logtown property; the dragline excavator had a 2-cubic yard bucket.

Folsom district.—The Capital Dredging Co. operated two connected-bucket dredges on its property 5 miles south of Folsom throughout 1940; one dredge had 88 18-cubic foot buckets and the other 100 18-cubic foot buckets. McQueen & Downing operated a dragline dredge on Deer Creek from September 10 until December 17. The General Dredging Corporation worked at its placer operation on the American River from January 1 to May 23 and from July 5 to the end of the year; the dragline excavator had a 4-cubic yard bucket. H. W. McKinley operated a nonfloating washing plant on the Hoxsie property from April 15 to September 12. The Carson Creek Dredging Co. washed gravel on the Martin Quinn estate from September 11 until the end of the year; the dragline excavator used a 1¾-cubic yard bucket. The Natomas Co. fleet of seven dredges at Natoma produced more placer gold than any other operation in the State in 1940. The number and size of buckets per dredge were: No. 1, 62 16-cubic foot buckets; No. 4, 67 15-cubic foot buckets; No. 5, 105 12-cubic foot buckets; No. 6, 106 11-cubic foot buckets; No. 7, 98 9-cubic foot buckets; No. 8, 105 12-cubic foot buckets; and No. 10, 83 15-cubic foot buckets.

SAN BERNARDINO COUNTY

Black Hawk district.—The Santa Fe (Arlington) mine produced a substantial tonnage of gold ore during 1940. The Ramsey Mining Co. worked the Wheeler group in March, April, and May; 500 tons of ore treated by cyanidation and table concentration yielded bullion containing 167 ounces of gold and 73 ounces of silver and 10 tons of concentrates containing 168 ounces of gold and 66 ounces of silver; the concentrates were shipped to a smelter.

Buckeye district.—Gold ore was shipped to a smelter from the Bagdad Chase property during 1940.

Dale district.—The Camco Mining Co. and a lessee produced a substantial quantity of gold ore at the Carlyle mine in 1940. Gold Crown Mining Co., Ltd., worked the Gold Crown mine; in addition to treating company ore, the mill handled a large quantity of custom material in its 50-ton all-slime cyanide plant. L. A. Wilson shipped 494 tons of ore from the Gold Stone group to custom cyanide plants; the recovery was 658 ounces of gold.

Randsburg district.—F. W. Royer operated the Kelly mine largely through lessees during 1940. A custom cyanide plant was put into operation January 1 and treated over 8,000 tons of ore from approximately 100 shippers (in addition to the Kelly ore) by the end of the year.

Solo district.—Lessees shipped 452 tons of ore from the Telegraph mine to custom cyanide plants in 1940; 931 ounces of gold and 793 ounces of silver were recovered.

Vanderbilt (Hart) district.—W. W. Hartman operated the Valley View mine throughout 1940.

SAN JOAQUIN COUNTY

Bellota (Linden) district.—The San Gruco Co. and C. E. Gruwell operated dragline dredges on the McGurk property in 1940; each operator used a dragline excavator with a 1½-cubic yard bucket. A. G. Watkins & Sons continued operations of a dragline dredge in the Linden area.

Camanche district.—The connected-bucket dredges of the California Gold Dredging Co. and the Gold Hill Dredging Co., operating on the Mokelumne and Calaveras Rivers, crossed the county line into San Joaquin County for short periods in 1940.

SHASTA COUNTY

Flat Creek (Iron Mountain) district.—The Mountain Copper Co., Ltd., largest mineral producer in Shasta County, worked the Iron Mountain mine throughout 1940. Most of the ore was mined by the open-cut method and was cyanided in a 720-ton sand-leaching and countercurrent-slime plant; for the first time in a number of years underground methods of mining were used, and 10 percent of the ore was produced by top-slicing. Another unusual event for the company was a substantial shipment of copper ore to a smelter.

French Gulch district.—The Willow Creek Mines, Inc., which reopened the Greenhorn mine in 1939, operated throughout 1940 and treated its ore in a 350-ton sand-leaching and slime-countercurrent decantation-cyanide plant. The Niagara Summit Mining Co. amalgamated 600 tons of ore from the Montezuma, Spring, and Summit claims of the Niagara Summit mine and recovered 243 ounces of gold and 69 ounces of silver. A. P. Robillard worked the Philadelphia and Roosevelt claims. The J. H. Scott Co. worked the Washington mine during 1940. The French Gulch Dredging Co. installed a connected-bucket dredge with seventy-six 4½-cubic foot buckets on Clear Creek near French Gulch and began operations September 2.

Igo district.—R. S. Olson operated a dragline dredge from January 1 to March 10, 1940, on China Gulch and from June 18 to December 5 on Daly Gulch. The Clear Creek Dredging Co. operated a dragline dredge, using a 1½-cubic yard bucket, on Clear Creek. J. P. Brennan operated a dragline dredge on Tadpole Creek from January 1 until October 7, then moved the equipment to Champion Gulch and continued operations until the end of the year; the dragline excavator used a 1¼-cubic yard bucket. Crow Creek Dredging Co. operated a dragline along Crow Creek intermittently between May 16 and the end of the year; the dragline excavator used a 1¼-cubic yard bucket. San Gruco Co. moved its dragline dredge, equipped with a dragline excavator with a 1½-cubic yard bucket, to property of the Happy Valley Land and Water Co. and operated from November 1 until the end of 1940. Thurman Gold Dredging Co. installed a connected-bucket dredge with seventy-two 9-cubic foot buckets on Clear Creek and began operations December 1. The Pioneer Dredging Co. operated a dragline dredge, equipped with a dragline excavator using a 3-cubic yard bucket, in Happy Valley from January 1 to August 21.

Old Diggings district.—Walker Mines, Consolidated, operated the Walker mine throughout 1940 and treated 15,285 tons of ore in the company 100-ton cyanide plant; cyanide bullion contained 939 ounces of gold and 670 ounces of silver, and 1 ton of gravity concentrates contained 42 ounces of gold and 97 ounces of silver.

Redding district.—The Blue Gravel mine owned by the City of Redding was lease-operated throughout 1940. Columbia Construction Co., Inc., recovered a substantial quantity of gold in preparing 1,781,466 tons of gravel to be used in the construction of Shasta Dam.

SIERRA COUNTY

Alleghany district.—Dickey Exploration Co. operated the Oriental mine throughout 1940. Original Sixteen to One Mine, Inc., largest gold producer in Sierra County, continued operation of its Original Sixteen to One mine. Allied Mines, Inc., worked the Plumbago mine from January 1 to August 8, 1940.

Pike (*Slate Range*) *district.*—The owner and a lessee produced 1,024 tons of ore at the Bowman mine in 1940; amalgamation bullion contained 229 ounces of gold and 39 ounces of silver.

Poker Flat (*Table Rock*) *district.*—The Loftus Blue Lead Mining Co. hydraulicked 60,000 cubic yards of gravel at the Loftus Blue Lead mine and recovered 352 ounces of gold and 25 ounces of silver.

Port Wine district.—The Poverty Hill mine, worked by A. J. Oyster, was the largest hydraulic operation in the State in 1940.

Sierra City district.—R. D. Compton operated the Colombo mine from January 1 to December 6, 1940.

SISKIYOU COUNTY

Callahan district.—Oils Incorporated of California operated the Oro Grande (McKeen) mine in 1940. During 5 months of operation at the 75-ton flotation plant 3,560 tons of ore were treated, and 63 tons of concentrates containing 524 ounces of gold, 310 ounces of silver, and 76 pounds of copper were shipped to a smelter. The Etna Gold Dredging Co. operated a connected-bucket dredge with eighty 3-cubic foot buckets on Wildcat Creek 2 miles north of Callahan; 800,000 cubic yards of gravel yielded 4,299 ounces of gold and 642 ounces of silver. Okoro Mines, Inc., operated a dry-land dredge intermittently from January to June and washed 45,000 cubic yards of gravel, from which 218 ounces of gold and 31 ounces of silver were recovered. Yuba Consolidated Gold Fields (Siskiyou Unit) was the leading gold producer in Siskiyou County in 1940; the company operated a Yuba-type connected-bucket dredge with seventy-two 9-cubic foot buckets.

Greenhorn district.—The Cal Oro Dredging Co. operated a connected-bucket dredge on the Lange property from January 28 to September 22, 1940. The Yreka Gold Dredging Co. completed its operation 2 miles north of Yreka during 1940 and moved its connected-bucket dredge to Seiad Valley.

Humbug district.—Von der Hellen & Webber operated a dragline dredge, using a dragline excavator with a 2-cubic yard bucket, throughout 1940.

Klamath River district.—Merriman Mining Merger operated the Buzzard Hill mine in 1940. The Happy Camp Dredging Co. operated a dragline dredge on the Allen property from May 1 to July 31; the dredge was moved to the Grant Smith property and operated there from September 1 to November 30. William von der Hellen Mines (renamed May 1 William von der Hellen Mining Co.) operated a dragline dredge, with a dragline excavator having a 2½-cubic yard bucket, throughout 1940. Larsen Bros. & Harms Bros. operated a dragline dredge on the Klamath River from February 25 until the end of 1940; the dragline excavator had a 5-cubic yard bucket. This company also operated a dragline dredge, using a dragline excavator with a 2-cubic yard bucket, on Horse Creek throughout the year. The Yreka Gold Dredging Co., which operated near Yreka during the early part of the year, resumed operations in Seiad Valley September 15; the dredge had sixty-seven 6-cubic foot buckets.

Liberty district.—The King Solomon Mines Co. discontinued operations at the King Solomon mine early in 1940; all mining and milling machinery was sold. Operators of the Joubert mine recovered 354 ounces of gold and 55 ounces of silver by hydraulicking.

Salmon River district.—P. D. Sacchi, E. L. Spellenberg, and F. Kubli operated a dragline dredge, using a dragline excavator with a 1½-cubic yard bucket, at Forks of Salmon intermittently during 1940; 365 ounces of gold and 53 ounces of silver were recovered.

Scott River district.—The Quartz Hill mine was worked in 1940. The Oro Trinity Gold Dredging Co. operated a dragline dredge on Kangaroo property; the dragline excavator had a 1½-cubic yard bucket.

STANISLAUS COUNTY

Jenny Lind district.—The California Gold Dredging Co. operated a connected-bucket dredge south of the Calaveras River and spent most of the year on the Stanislaus side of the county line.

Knights Ferry district.—The C & E Dredging Co. operated a dragline dredge, with a dragline excavator having a 1½-cubic yard bucket, on Littlejohn Creek 2 miles northwest of Knights Ferry intermittently between September 20 and December 17; the same equipment was used in dredging on the adjoining Jack Welsh ranch. Placer Properties Co. operated a dragline dredge on the Stanislaus River 9 miles east of Oakdale throughout 1940; a 6½- and a 7½-cubic yard bucket were tried on a 5-cubic yard dragline excavator at various times during the year; the washing plant used a shaking screen in place of a trommel.

La Grange district.—The La Grange Gold Dredging Co. dredge No. 4 operated on the Tuolumne River throughout 1940; the dredge had sixty-two 10-cubic foot buckets. The Tuolumne Gold Dredging Corporation operated a connected-bucket dredge with one hundred 12-cubic foot buckets from February 22 until the end of the year.

TRINITY COUNTY

Hayfork district.—The Cinco Mineros Co. operated a dragline dredge, using a dragline excavator with a 1½-cubic yard bucket, near Hayfork throughout 1940.

Junction City district.—G. H. Bergin operated the Canyon Placers by hydraulicking in 1940. The Junction City Mining Co. operated an electrically powered connected-bucket dredge, with seventy-six 10-cubic foot buckets, on Trinity River near Junction City continuously throughout the year. La Grange Placer Mines, Ltd., hydraulicked gravel on Oregon Gulch from March 1 to July 1 and from December 23 to the end of the year. The Weaver Dredging Co. operated a dragline dredge on Oregon Gulch from February 2 to June 1; the dragline excavator used a 2-cubic yard bucket. The Red Hill mine was worked by hydraulicking, dragline dredging, and small-scale hand methods during the year.

Lewiston district.—The Lincoln Gold Dredging Co. worked the A. E. Lunden and Adrian ranches and the Lowden & Thomas, Phillips, Fancelli, and Van Matre properties during 1940. C. R. and T. D. Harris operated the Trinity (Mary Smith) dredge on Trinity River from January 1 to November 15, when the gravel deposit was exhausted; the dredge was of flume type and had forty-two 11-cubic foot link-connected buckets.

Salyer district.—The Swanson Mining Corporation hydraulicked a small yardage of very high grade gravel between February 9 and May 24, 1940.

Trinity Center district.—The property of the Carrville Gold Co. on Trinity River between Trinity Center and Carrville was operated by the company's agent (Yuba Consolidated Gold Fields) throughout 1940; the property was equipped with a connected-bucket dredge with seventy-five 12-cubic foot buckets.

Weaverville district.—Arbuckle Bros. carried on hydraulic operations at the Arbuckle mine during 3 months of 1940. B. H. K. Mines operated a dragline dredge, equipped with a dragline excavator using a 1½-cubic yard bucket, on Little John Creek from July 1 to the end of the year; 184,000 cubic yards of gravel washed yielded 789 ounces of gold and 40 ounces of silver. The Dawn Mining Co. operated the Dawn hydraulic mine. The Viking Dredging Co. operated throughout 1940 a dragline dredge, equipped with a dragline excavator with a 2-cubic yard bucket, on Filibuster Flat, Shanahan Bar, and Hidden Channel near the confluence of Redding Creek and Trinity River. The Weaver Dredging Co. operated a dredge, using a dragline excavator with a 1-cubic yard bucket, on East Weaver Creek from January 1 to June 12, when the equipment was shipped to Montana. The company operated a second dragline dredge, equipped with a dragline excavator with a 2½-cubic yard bucket, on the La Grange property from October 8 until the end of the year. Interstate Mines, Inc., operated a dragline dredge on the Lowden ranch from January 4 to July 14. The Oro Trinity Dredging Co. operated a Diesel-powered dragline dredge, equipped with a dragline excavator using a 1½-cubic yard bucket, near Weaverville from January 1 to June 18; the equipment then was moved to the Scott River district, Siskiyou County, where operations were resumed August 10.

TUOLUMNE COUNTY

East Belt district.—The Densmore mine was worked during 1940, and lessees operated the Hidden Treasure mine. La Guria Gold Mining Co. worked the La Guria mine the entire year; the cyanide-leaching plant was replaced by a 50-ton flotation mill, and equipment to cyanide the concentrates was added later. After a short trial the company decided to ship the concentrates to a smelter. The Ryan Mining Co. worked the Ryan mine throughout the year; 1,700 tons of ore yielded amalgamation bullion containing 991 ounces of gold and 114 ounces of silver and table concentrates containing 20 ounces of gold and 30 ounces of silver; the concentrates were shipped to a smelter. R. H. Hallock crushed 375 tons of ore from the Sleepy Hollow mine in the Saw Mill Flat section of the East Belt; 373 ounces of gold and 15 ounces of silver were recovered. J. A. McMahon recovered 386 ounces of gold and 22 ounces of silver from 2 tons of pocket ore taken from the Stockton mine. L. R. Harris operated a dragline dredge on the Jackass property from April 20 to May 22.

Mother Lode district.—Allied Mines, Inc., worked the Heslep, App, Dutch, and Sweeney mines during 1940. Miller & Clemson operated the Eagle-Shawmut mine and treated 72,000 tons of ore by amalgamation and flotation; amalgamation bullion contained 1,623 ounces of gold and 471 ounces of silver, and 2,150 tons of concentrates contained 4,186 ounces of gold, 1,550 ounces of silver, 5,547 pounds of copper, and 85 pounds of lead. Lord & Bishop (now Lobicasa Co.) worked the Jumper mine from August 22 until the end of 1940; 2,585 tons of ore yielded amalgamation bullion containing 388 ounces of gold and 64 ounces of silver. The Barker Corporation operated a dragline dredge on Tuolumne River near Jacksonville from January 1 until November 18, when the equipment was moved to Hornitos, Mariposa County. A. E. Kent began operations with dredge No. 1 on Six Bit Gulch near Chinese Camp December 13; the dragline excavator had a 1¾-cubic yard bucket. The same company operated dredge No. 2 on Sanguinetti Ridge near Chinese Camp from June 29 until the end of the year; the dragline excavator had a 2½-cubic yard bucket. E. Z. Bowan operated a nonfloating washing plant on the La Bienvenita mine. Mullin & Co. washed 55,700 cubic yards of gravel by dragline dredging on Sullivan Creek and recovered 419 ounces of gold and 41 ounces of silver.

YUBA COUNTY

Bear River district.—The Empire Star Mines Co., Ltd., continued operations at its Pennsylvania mine in 1940.

Smartville district.—The Parks Bar Co. operated a Diesel-powered dragline dredge, equipped with a dragline excavator with a 1½-cubic yard bucket, in Big Ravine from May 1 until October 31, 1940; the recovery from 95,000 cubic yards of gravel was 429 ounces of gold and 20 ounces of silver. The Sunmar Dredging Co. operated a dragline dredge on Mammoth Mining Co. ground; the dragline excavator had a 2-cubic yard bucket. The Arundel Corporation produced a substantial quantity of gold in preparing gravel for concrete aggregate. Williams Bar Dredging Co. operated throughout 1940 a connected-bucket dredge with eighty-four 6-cubic foot buckets on the Yuba River 4 miles northwest of Smartville. A large number of snipers camping along the Yuba River worked gravel by small-scale hand methods.

Strawberry Valley district.—The R. & M. Mining Co. operated a dragline dredge on the Corley and Princess Pines properties in 1940.

Yuba River district.—Yuba Consolidated Gold Fields operated a fleet of six dredges at its property in the Yuba River Basin near Hammonton. All the dredges were equipped with 18-cubic foot buckets and electric power; two of them had 87 buckets each, two had 100 buckets each, one had 126 buckets, and one had 135 buckets.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE CENTRAL STATES

(MINE REPORT)

By A. J. Martin

SUMMARY OUTLINE

Mine production of zinc in the Central States in 1940 was the highest in quantity since 1929 and that of lead the highest since 1930; the output of copper, which had decreased annually from 1937 to 1939, inclusive, rose slightly in 1940. The principal factor contributing to the moderate increase over 1939 in output of lead and zinc was the advance in metal prices to a level that permitted utilization of the leaner portions of ore bodies in old mines, but one newly developed zinc-lead-fluorspar mine in southern Illinois made substantial production of zinc and lead. The output of recoverable zinc in the Tri-State region (Kansas, Oklahoma, and southwestern Missouri) increased 4 percent over 1939, but that of lead decreased 20 percent; however, lead production in southeastern Missouri—chief lead-producing district—increased 11 percent. The rise in metal prices had the usual effect of stimulating activity at small lead and zinc mines. The total number of producing mines, large and small, in the Central States increased from 251 in 1939 to 416 in 1940. The copper ore produced in 1940 came from Michigan mines, but some copper was recovered in treating residues from the smelting of lead concentrates from southeastern Missouri. The silver output was that recovered as a byproduct from lead, copper, and zinc-lead ores. The gold came from a placer prospect.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1936–40

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1936	$35.00	$0.7745	$0.092	$0.046	$0.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4].646+	.098	.046	.048
1939	35.00	[5].678+	.104	.047	.052
1940	35.00	[6].711+	.113	.050	.063

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+ ($20.671835) per fine ounce.
[2] 1936–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–40: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787. [6] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in the Central States, 1936–40, in terms of recovered metals

Year	Mines producing	Ore sold or treated (short tons)	Gold		Silver	
			Fine ounces	Value	Fine ounces	Value
1936	179	21,530,800			165,500	$128,180
1937	283	26,516,112	51.44	$1,800	206,041	159,374
1938	229	19,037,105			386,210	249,671
1939	251	22,972,151	[1] 4.00	140	315,953	214,465
1940	416	25,532,085	[1] 5.00	175	353,737	251,546

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Short tons	Value	Short tons	Value	
1936	96,350,019	$8,864,202	148,536	$13,665,312	235,447	$23,544,700	$46,202,394
1937	95,466,000	11,551,386	204,885	24,176,430	244,045	31,725,850	67,614,840
1938	93,486,000	9,161,628	158,873	14,616,316	198,721	19,077,216	43,104,831
1939	87,970,000	9,148,880	198,481	18,657,214	231,716	24,098,464	52,119,163
1940	91,766,000	10,369,558	207,587	20,758,700	244,976	30,866,976	62,246,955

[1] From placer prospecting.

Gold.—The 5 fine ounces of gold reported produced in the Central States in 1940 came from small placer prospecting in Vigo County, Ind.

Silver.—Production of silver in the Central States in 1940 totaled 353,737 fine ounces. The output of Illinois (4,766 ounces) came from galena concentrates recovered in milling zinc-lead ore and fluorspar, that of Missouri (260,314 ounces) from the refining of lead bullion, and that of Michigan (88,657 ounces) from copper ore. Mines in the other Central States yielded no recoverable silver in 1940.

Copper.—The copper output of the Central States in 1940 came from copper ore from Michigan and lead ore from Missouri; no copper ore was shipped from Missouri during the year, and the copper reported was derived from the treatment of residues from lead smelting. The output of refined copper in Michigan increased from 87,970,000 pounds in 1939 to 90,396,000 in 1940 and the average recovery per ton of rock from 19.1 to 20.4 pounds.

Lead.—The lead recovered from shipments of lead ore and concentrates in the Central States increased from 198,481 tons in 1939 to 207,587 in 1940, owing mainly to increased production from southeastern Missouri. Shipments from the Tri-State region decreased—those of Kansas from 13,697 tons in 1939 to 11,927 in 1940, southwestern Missouri from 2,759 to 2,144 tons, and Oklahoma from 27,720 to 21,240 tons. The combined output from other Central States (Arkansas, Illinois, Kentucky, and Wisconsin) was 2,368 tons, an increase of 1,585 tons over 1939.

Zinc.—The recoverable zinc in ore and concentrates shipped from mines in the Central States in 1940 was 244,976 tons; 232,437 tons (95 percent) of the total came from the Tri-State region. Oklahoma contributed 70 percent of the Tri-State output and Kansas 25 percent compared with 63 and 31 percent, respectively, in 1939. Stocks of zinc concentrates totaled 2,764 tons at the end of 1940 compared with 12,012 tons (revised figure) in 1939. The recoverable zinc in shipments from Missouri mines decreased from 15,096 to 12,703 tons; in 1939 the entire output came from southwestern Missouri, but in 1940 central and southeastern Missouri yielded 233 tons. The Wisconsin output (5,770 tons) was 2 percent under 1939, but Illinois production jumped from 334 to 4,818 tons.

MINE PRODUCTION BY STATES AND REGIONS

Mine production of gold, silver, copper, lead, and zinc in the Central States in 1940, by States, in terms of recovered metals

State	Mines producing	Ore (short tons)	Gold		Silver	
			Fine ounces	Value	Fine ounces	Value
Arkansas	27	(1)				
Illinois	6	[2] 41,940			4,766	$3,389
Indiana	(3)		5	$175		
Kansas	34	3,153,800				
Kentucky	13	(1)				
Michigan	6	4,438,219			88,657	63,045
Missouri	89	6,457,400			260,314	185,112
Oklahoma	100	11,250,400				
Wisconsin	141	190,326				
	416	25,532,085	5	175	353,737	251,546
Total, 1939	251	22,972,151	4	140	315,953	214,465

State	Copper		Lead		Zinc		Total value
	Pounds	Value	Short tons	Value	Short tons	Value	
Arkansas			55	$5,500	440	$55,440	$60,940
Illinois			1,508	150,800	4,818	607,068	761,257
Indiana							175
Kansas			11,927	1,192,700	57,032	7,186,032	8,378,732
Kentucky			360	36,000	1,278	161,028	197,028
Michigan	90,396,000	$10,214,748					10,277,793
Missouri	1,370,000	154,810	172,052	17,205,200	12,703	1,600,578	19,145,700
Oklahoma			21,240	2,124,000	162,935	20,529,810	22,653,810
Wisconsin			445	44,500	5,770	727,020	771,520
	91,766,000	10,369,558	207,587	20,758,700	244,976	30,866,976	62,246,955
Total 1939	87,970,000	9,148,880	198,481	18,657,214	231,716	24,098,464	52,119,163

1 Figures not available for small quantity of ore treated in Arkansas or Kentucky.
2 Excludes lead-bearing material mined along with fluorspar, from which some lead was recovered as a byproduct of the mining and milling of fluorspar.
3 Gold produced in Indiana was from small placer prospecting.

The report of this series for 1930 (chapter of Mineral Resources of the United States, 1930, pt. I) gives the areas included in the seven lead- and zinc-producing regions of the Central States. Mineral Resources, 1914, contains brief reviews of the history of lead and zinc mining in the Central States, the yearly production of each State from 1907 to 1914, inclusive, and historical notes and estimates of the total production of lead and zinc in each State before 1907. Subsequent records year by year are found in Mineral Resources and Minerals Yearbook.

Of a total of 428,971 tons of blende concentrates produced in 1940 in the Tri-State region, 74,506 tons—1,575 tons more than 1939—were derived from old tailings.

Quantity and tenor of ores.—The quantity and tenor of ores and old tailings treated in Kansas, Michigan, Missouri, Oklahoma, and Wisconsin from 1938 to 1940 are shown in the table that follows. Comparable figures for Kentucky and Illinois cannot be given because the lead and zinc concentrates shipped from some of the mines 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 was mined annually from 1918 to 1940, and the tenor of most of the ore treated (generally by small mills or hand jigs) was not determined by the operators.

Mine production of lead and zinc in the Central States in 1940, by regions

Region	Lead[1]		Zinc[2]		Total value
	Short tons	Value	Short tons	Value	
Concentrates:					
Joplin or Tri-State	46,212	$2,724,795	429,778	$18,062,867	$20,787,662
Southeastern Missouri [3]	232,871	14,269,600	815	20,000	14,289,600
Upper Mississippi Valley [4]	631	35,460	10,887	447,890	483,350
Kentucky-southern Illinois	3,326	132,373	[5] 11,837	376,902	509,275
Northern Arkansas	5	345	[6] 1,565	30,879	31,224
	283,045	17,162,573	454,882	18,938,538	36,101,111
Total, 1939	269,691	15,793,344	426,522	14,628,408	30,421,752
Recoverable metal:					
Joplin or Tri-State	35,311	3,531,100	232,437	29,287,062	32,818,162
Southeastern Missouri [7]	169,908	16,990,800	233	29,358	17,020,158
Upper Mississippi Valley [4]	453	45,300	5,776	727,776	773,076
Kentucky-southern Illinois	[8] 1,860	186,000	6,090	767,340	953,340
Northern Arkansas	[9] 55	5,500	440	55,440	60,940
	207,587	20,758,700	244,976	30,866,976	51,625,676
Total, 1939	198,481	18,657,214	231,716	24,098,464	42,755,678

[1] Includes galena and small quantity of lead carbonate concentrates.
[2] Includes sphalerite and small quantity of zinc carbonate and zinc silicate concentrates.
[3] Includes 20 tons of lead concentrates and 315 tons of zinc concentrates from central Missouri.
[4] Region includes Iowa, northern Illinois, and Wisconsin; no production in Iowa in 1939 or 1940.
[5] Includes 152 tons of zinc-lead concentrates averaging 50 percent zinc and 7.24 percent lead.
[6] Includes 812 tons of zinc-lead carbonate ores and concentrates.
[7] Includes 15 tons of lead and 127 tons of zinc from central Missouri.
[8] Includes 10 tons contained in zinc-lead concentrates.
[9] Includes 51 tons contained in zinc-lead carbonate ores and concentrates.

Quantity and tenor of copper, lead, and zinc ores, old tailings, etc., produced in some [1] Central States, 1938–40, by States

State	1938		1939		1940	
	Ore, etc.	Metal content [2]	Ore, etc.	Metal content [2]	Ore, etc.	Metal content [2]
	Short tons	*Percent*	*Short tons*	*Percent*	*Short tons*	*Percent*
Kansas	3,751,300	2.58	3,701,300	2.45	3,153,800	2.40
Michigan	3,757,705	1.24	4,603,751	.96	4,438,219	1.02
Missouri	4,148,000	3.28	5,650,800	3.12	6,457,400	2.94
Oklahoma	7,321,400	1.71	8,802,900	2.00	11,250,400	1.80
Wisconsin	58,700	4.46	213,400	3.26	190,326	3.61
	19,037,105	----------	22,972,151	----------	25,490,145	----------

[1] Figures not available for small quantity of ore treated in Arkansas; Kentucky and Illinois excluded because part of the metal output (lead and zinc) was a byproduct of fluorspar mining, and the quantity of metal-bearing material hoisted could not be determined.
[2] The percentages represent metal content of the ore insofar as it is recovered in the concentrates. In Michigan the metal so recovered is copper; in other Central States the metals are lead and zinc combined, relative proportions of which are shown in third table of this chapter and in tables of tenor of ore given in sections devoted to the respective States.

MINING AND METALLURGIC INDUSTRY

The ability of the mining industry, through improvements in mining methods and metallurgy, to mine and treat ores and tailings of such low average metal content as those of the Central States is an important contribution to prolongation of the productive life of the mining districts. Most of the ore is concentrated by the companies producing it, but that mined by some of the large producing companies in the Tri-State and southern Wisconsin districts is sent to central mills, which also afford an outlet for crude ore produced by individuals and partnerships working small mines or gouging in large mines abandoned by former operators. Gravity concentration continues to be an important factor in the treatment of the ores, although flotation is used in nearly all the large mills to supplement the gravity method or as the principal method of treatment. The concentrates generally have an established market. In 1940 copper concentrates from Michigan were smelted at plants at Hubbell and Houghton, Mich.; lead concentrates from southeastern Missouri were sent to smelters at Herculaneum, Mo., and Alton, Ill.; and lead concentrates from the Tri-State district went to smelters at Galena, Kans., and Alton, Ill. Zinc concentrates from the Tri-State district moved to smelters or pigment plants at Bartlesville, Blackwell, and Henryetta, Okla.; Coffeyville, Kans.; Fort Smith and Van Buren, Ark.; Danville, East St. Louis, Hillsboro, and La Salle, Ill.; Donora and Langeloth, Pa.; and Meadowbrook and Moundsville, W. Va. The lead and zinc concentrates from Wisconsin, southern Illinois, and other scattered districts in the Central States were shipped to the plants that treated the concentrates from southeastern Missouri and the Tri-State district.

REVIEW BY STATES

ARKANSAS

Mines in Arkansas yielded 440 tons of recoverable zinc in 1940 compared with 123 tons in 1939 and an annual average of 159 tons during the 5 years ended with 1938. The output of lead in 1940 was 55 tons. The zinc and most of the lead recovered in 1940 were contained in 812 tons of zinc-lead concentrates and lump ore averaging 28.57 percent zinc and 7.02 percent lead, and 753 tons of zinc concentrates averaging 34 percent zinc; all were carbonates or silicates and were sold to the Ozark Smelting & Mining Co. at Coffeyville, Kans. Galena ore shipped during the year amounted to only 5 tons. The principal shipper was the Manda Industrial Corporation at Harrison, which purchased the ore and concentrates in small lots from individuals and partnerships working mines and prospects in Boone, Lawrence, Marion, Newton, and Searcy Counties. The ore from most of the mines was hand-jigged, cobbed, or concentrated in small mills before shipment. The producing mines included the Boggs, Coon Hollow, Gloria, Jackpot, and Minnie Lee in the Zinc district; the King Jack near Smithfield; the Edith-Yellow Rose, Mineral Point, and Silver Hollow near Rush; and the Bonanza, Brewer, Chimney Rock, Confederate (mine and mill), and Ponca in Newton County. A custom mill with a capacity of 50 tons of ore daily was built late in the year on the McIntosh property in the Rush district, was operated about 30 days, and treated 1,000 tons of ore.

ILLINOIS

Northern Illinois.—All the lead and zinc mines of northern Illinois are in Jo Daviess County, the extreme northwestern county of the State. No production was reported from any of them from 1931 to

1939, inclusive. In 1940 the output was only 8 tons of recoverable lead and 6 tons of zinc contained in 10 tons of lead concentrates washed from old tailings and 60 tons of material, mostly from a clean-up at the old Blewett mine in the Galena district, shipped to the Vinegar Hill Zinc Co. flotation mill at Cuba City, Wis.

Southern Illinois.—The output of lead and zinc from southern Illinois in 1940 was the largest in any year since statistics of actual mine production in Illinois were first collected in 1907. From 1906 through 1939 shipments of silver-bearing galena concentrates, mostly byproduct of fluorspar mining and milling, totaled 20,763 tons—an average of 611 tons annually; shipments of zinc concentrates during the same period (except for a small undetermined quantity in 1906) totaled only 3,013 tons—produced in 1923, 1924, 1925, and 1939. In 1940 the output of lead concentrates totaled 2,813 tons averaging 56.13 percent lead and 3.4 ounces of silver to the ton, and that of zinc concentrates was 8,517 tons averaging 62.78 percent zinc. Production (in terms of recovered metals) amounted to 1,500 tons of lead, 4,766 ounces of silver, and 4,812 tons of zinc in 1940 compared with 308 tons of lead, 675 ounces of silver, and 334 tons of zinc in 1939. The large increase was due to expanded operations by the Mahoning Mining Co., which in 1938 and 1939 developed a body of fluorspar and zinc-lead ore near Cave in Rock, Hardin County, and constructed a 200-ton all-flotation plant that was run throughout 1940. Other shippers of lead concentrates from Rosiclare included Hillside Fluor Spar Mines and the Illinois Fluor Spar Co.

INDIANA

Placer prospecting in Vigo County yielded 5 fine ounces of gold in 1940.

KANSAS

The recoverable metal in concentrates from Kansas mines shipped in 1940 totaled 11,927 tons of lead and 57,032 tons of zinc compared with 13,697 and 68,971 tons, respectively, in 1939. The output of zinc concentrates from tailing mills decreased 35 percent in quantity and that from mine ore 14 percent. About 639,900 tons of Kansas crude ore from 12 mines were concentrated at Oklahoma mills. In all, about 34 mines and 20 mills were operated in Kansas in 1940 compared with 30 mines and 23 mills in 1939. Prices of concentrates and other general details of mining in the Tri-State region, which includes the Kansas lead- and zinc-mining area, are given in the pages of this chapter devoted to southwestern Missouri.

Mines and mills near Baxter Springs yielded 3,714 tons of lead concentrates and 18,739 tons of zinc concentrates. The largest producer was the St. Louis Smelting & Refining Co., which operated its Ballard (No. 8) mill continuously on ore from the Ballard, Bailey, Clark, English "O", and Shanks mines. The Bilharz Mining Co. operated its mill on ore from the Brewster mine in Oklahoma. The Sunflower mine and mill were operated part of the year by the Sunflower Mining Co. and from October 12 to December 31 by the Madison Mining Co. Ore from the Robob mine was shipped to the Central mill at Cardin, Okla. The Wade custom mill treated mostly ore from Oklahoma mines. Mines and mills in the Blue Mound-Treece area shipped 11,663 tons of galena and 80,924 tons of blende.

The Vinegar Hill Zinc Co. operated its Barr mine and mill early in the year but sold them in April to the Jane E. Mining Co. which, after a short period of operation, sold the property to the Eagle-Picher Mining & Smelting Co.; the mine then became part of the Eagle-Picher Westside group and the mill (since called Westside) treated ore from this group during the rest of the year. The Eagle-Picher Webber mine and mill were operated continuously. The Federal Mining & Smelting Co. ran its Muncie mill on ore from the Tar Creek and Semple mines; most of the ore from the Federal Jarrett mine was treated in the company Gordon central mill in Oklahoma. Kansas Explorations, Inc., continued operations at its Jarrett lease and mill northeast of the Federal Jarrett. The Oklahoma Interstate Mining Co. worked the Cherokee mine, sending the ore to the company Woodchuck mill at Cardin, Okla. Ore from the Robinson mine was treated in the Beck mill at Picher, Okla., and that from the Black Eagle, Big John, Chubb, Wilbur, and Mid-Continent Lead & Zinc Co. leases (Bendelari, Grace B, and Wright) was shipped to the Central mill at Cardin, Okla. The Lula Bell Mining Co. operated its

Mine shipments of lead and zinc in Kansas, 1936–40

Year	Mines producing	Lead concentrates		Zinc concentrates		Metal content [1]			
						Lead		Zinc	
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1936	60	14, 789	$765, 746	149, 095	$5, 473, 457	11, 409	$1, 049, 628	79, 017	$7, 901, 700
1937	42	20, 559	1, 454, 507	151, 646	6, 476, 064	16, 008	1, 888, 944	80, 300	10, 439, 000
1938	31	19, 909	1, 023, 851	133, 546	4, 132. 248	15, 239	1, 401, 988	73, 024	7, 010, 304
1939	30	17, 845	1, 010, 106	126, 235	4, 300, 365	13, 697	1, 287, 518	68, 971	7, 172, 984
1940	34	15, 424	907, 296	105, 070	4, 420, 360	11, 927	1, 192, 700	57, 032	7, 186, 032

[1] In calculating metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the value of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and old tailings milled and concentrates produced in Kansas, 1939–40

	1939		1940	
	Crude ore	Old tailings	Crude ore	Old tailings
Total ore and old tailings milled ... short tons	1, 764, 300	1, 937, 000	1, 843, 800	1, 310. 000
Total concentrates shipped:				
Galena ... do	17 583	262	15. 290	134
Sphalerite ... do	108, 423	17, 812	93, 537	11, 533
Ratio of concentrates to ore, etc.:				
Lead ... percent	0. 98	0. 01	0. 83	0. 01
Zinc ... do	6. 27	. 92	4. 98	. 88
Metal content of ore, etc.: [1]				
Lead ... do	. 78	. 01	. 66	. 01
Zinc ... do	3. 75	. 56	3. 01	. 53
Average lead content of galena concentrates ... do	78. 5	66. 4	78. 99	70. 0
Average zinc content of sphalerite concentrates ... do	60. 7	60. 6	60. 36	59. 91
Average value per ton:				
Galena concentrates	$56. 67	$52. 05	$58. 82	$59. 00
Sphalerite concentrates	34. 39	32. 11	42. 56	38. 13

[1] Figures represent metal content of the crude ore (or "dirt") only insofar as it is recovered in the concentrates; data on tailing losses not available.

Opperman lease and mill from August to December. The New Blue Mound Mining Co. and the J. P. Dines Mining Co. also operated mine mills. The principal producers from old tailings were the Captain Milling Co., C. Y. Semple, J. L. Smith Chat Co., and Youngman Milling Co.

Production from the Kansas part of the Waco district in 1940 was 47 tons of galena concentrates and 5,407 tons of blende. The St. Louis Smelting & Refining Co. operated its 800-ton mill and No. 9 mine from January to May, and the R. H. & G. Mining Co. ran its mill on ore and old tailings from the Barnsdall No. 3, Acme, and Butte-Kansas properties in Kansas and the Barnsdall No. 2 and other properties on the Missouri side of the Waco district. No output for 1940 was reported from the Lawton or Crestline camps, and scrapping only was done at Galena.

KENTUCKY

The Kentucky output of lead and zinc in 1940 came from Caldwell, Crittenden, and Livingston Counties in the western or fluorspar region of the State. Shipments comprised 2,716 tons of zinc sulfide concentrates averaging 42.84 percent zinc, 152 tons of zinc-lead sulfide concentrates averaging 50 percent zinc and 7.24 percent lead, 452 tons of zinc carbonate averaging 40 percent zinc, and 513 tons of lead sulfide averaging 69.59 percent lead. The recoverable metal content of the combined concentrates was 360 tons of lead and 1,278 tons of zinc compared with 87 and 909 tons, respectively, in 1939.

The Eagle Fluor Spar Co. of Salem, Livingston County, which operated its "Hutson" mine and 100-ton gravity-concentration mill most of the year, was the principal shipper of zinc concentrates. Avery H. Reed of Marion, Crittenden County, shipped 348 tons of 40-percent zinc carbonate concentrates from ore mined on land owned by the K–K–Mining Co. and treated by log washing. The National Fluorspar Co. and the Kentucky Fluor Spar Co. shipped byproduct lead concentrates, part of which were recovered in the milling of fluorspar purchased from other producers; and the United States Coal & Coke Co. Fluorspar Division shipped byproduct zinc-lead and lead concentrates. From Princeton, Caldwell County, C. F. Lester shipped 2 cars of zinc sulfide concentrates produced in 1939. The zinc concentrates produced in Kentucky in 1940 were shipped to the Ozark Smelting & Mining Co. plant at Coffeyville, Kans., and the lead concentrates to the American Smelting & Refining Co. Federal smelter at Alton, Ill.

MICHIGAN

Production of copper in Michigan was 90,396,000 pounds in 1940, a 3-percent increase over 1939. The output in both years came from mines of the Calumet and Hecla Consolidated Copper Co. (including Peninsula group), Copper Range Co. (Globe and Champion), Isle Royal Copper Co., and Quincy Mining Co. There was little variation in rates of operation by individual companies in 1940 and 1939. The total copper-bearing material milled or treated in 1940 amounted to 4,438,219 tons, comprising 1,827,119 tons of crude ore and 2,611,100 tons of old tailings or sands.

Output of silver in Michigan (all from copper ore) decreased from 101,878 fine ounces in 1939 to 88,657 in 1940.

Mine production of gold, silver, and copper in Michigan, 1936–40 [1]

Year	Gold (fine ounces)	Silver (fine ounces)	Copper [2]			Concentrate ("mineral") [3]		Ore ("rock") (short tons) [4]
			Pounds	Yield				
				Pounds per ton of ore ("rock")	Percent	Pounds	Yield (percent copper)	
1936			95,968,019	29.8	1.49	141,166,376	68.0	3,225,600
1937	51.44	25,454	94,928,000	22.6	1.13	148,172,000	64.1	[5] 4,197,881
1938		93,634	93,486,000	24.9	1.24	144,964,890	64.5	3,757,705
1939		101,878	87,970,000	19.1	.96	136,771,339	64.3	4,603,751
1940		88,657	90,396,000	20.4	1.02	138,451,495	65.3	4,438,219

1 Figures based upon actual recovery of copper from "mineral" smelted and estimated recovery from "mineral" not smelted during year.
2 Includes copper from sands.
3 Includes "mineral" from sands.
4 Includes sands.
5 Excludes 600 tons of siliceous ore.

Value of silver and copper produced in Michigan mines, 1936–40

Year	Silver	Copper		Total	Year	Silver	Copper		Total
		Total	Per ton of ore ("rock")				Total	Per ton of ore ("rock")	
1936		$8,829,058	$2.74	$8,829,058	1939	$69,154	$9,148,880	$1.99	$9,218,034
1937	$19,689	11,486,288	2.74	11,505,977	1940	63,045	10,214,748	2.30	10,277,793
1938	60,531	9,161,628	2.44	9,222,159					

The following data are abstracted from reports of the companies to their stockholders:

In 1940 the mines of the Calumet and Hecla Consolidated Copper Co. produced 20,728,000 pounds of copper at an average cost sold of 9.02 cents a pound; in addition, the reclamation plants at Lake Linden and Hubbell produced 29,682,000 pounds of copper at an average cost sold of 5.64 cents a pound. These figures do not include depreciation and depletion. The average selling price for the year was 11.82 cents a pound.

At the Ahmeek mill 731,403 tons of Kearsarge amygdaloid rock from the Ahmeek mine and 92,300 tons from the Peninsula Copper Co. group were stamped. At Lake Linden the Hecla mill and sand wheels were scrapped. Both the Lake Linden and the Tamarack reclamation plants operated throughout the year under normal conditions. Of the 1940 recovery at these plants 8,646,000 pounds were from table treatment, 17,251,000 pounds from leaching, and 3,785,000 pounds from flotation. The smelter received 43,396 tons of concentrates and mass and smelted 43,890 tons. From the material smelted 55,835,544 pounds of refined copper were produced. Copper oxide shipped to customers amounted to 2,738 tons containing 4,169,004 pounds of copper. Besides development work done in the course of mining operations, the company continued geological studies concerning the problem of exploring the district (with special reference to Calumet and Hecla lands) and did 36,336 feet of diamond drilling, largely on the surface in Houghton and Keweenaw Counties. In addition to providing geological information of value, these holes encountered many copper showings, a few of which are encouraging enough to justify further investigation.

Operations at the Calumet and Hecla reclamation plants at Lake Linden and Hubbell in 1940 and for the entire period of their operation

	1940	Since beginning
Quantity treated short tons	2,398,000	36,070,000
Assay headings percent	0.721	0.661
Assay tailings do	.098	.123
Refined copper produced pounds	29,682,000	387,025,000
Refined copper produced per ton treated do	12.38	10.73

The Copper Range Co. in 1940 produced 18,889,160 pounds of copper compared with 18,109,409 pounds in 1939. Champion and Globe ore treated totaled 315,480 tons with an average yield of 57.715 pounds to the ton compared with 330,605 tons in 1939 with an average yield of 54.011 pounds to the ton. The tailings recovery plant ran for about 6 months in 1940, and 661,727 pounds of refined copper were recovered from the operation. Reserve areas at the Champion mine were held to about 75 percent of the estimate as of January 1, 1940. Diminishing prospective areas are partly responsible for the loss in reserves, but the principal contributing factor was the loss of time on development work caused by an accident in No. 4 shaft in August. Development and production at the Globe were also affected by the accident, as the openings in the Globe mine are reached from the 9th and 18th levels of the Champion.. The Globe mine produced 1,164,687 pounds of copper compared with 1,075,582 pounds in 1939. Because of the spotty and broken condition of the vein, exploration has been difficult and slow, but showings encountered recently are more promising. Old mine workings of the White Pine mine were unwatered to the second level, and laboratory and mill tests were made on ore from the Nos. 1 and 2 sandstone beds and the parting shale. Results thus far have been encouraging. During 1940 the smelter continued to handle custom shipments in addition to the mineral produced by the company. The amount smelted totaled 28,633 tons or approximately 7 percent more than in 1939. Operations of the company for 5 years are shown in the following table:

Copper produced by the Champion mine of the Copper Range Co., 1936–40

Year	Rock stamped	Copper produced	Yield per ton	Cost per pound [1]	Price received
	Short tons	*Pounds*	*Pounds*	*Cents*	*Cents*
1936	320,815	17,486,019	54.51	8.87	9.59
1937	[2] 306,075	16,131,277	[3] 51.59	11.45	12.375
1938 [4]	[5] 333,190	18,066,891	[3] 54.06	9.50	9.80
1939 [4]	[6] 330,605	18,109,409	[3] 54.01	10.12	10.81
1940 [4]	[7] 315,480	18,889,160	[3] 57.72	(8)	(8)

[1] Excludes depreciation and depletion.
[2] Excludes 133,594 tons of tailings treated.
[3] Yield from ore only.
[4] Includes Globe mine.
[5] Excludes small unstated quantity of tailings treated.
[6] Excludes 85,842 tons of tailings treated.
[7] Excludes 213,100 tons of tailings treated.
[8] Not given in company report.

MISSOURI

The total value of the recovered silver, copper, lead, and zinc shipped from Missouri mines in 1940 was $19,145,700, which compares with silver, lead, and zinc valued at $16,405,251 in 1939 when the mines of the State yielded no recoverable copper. The silver output in 1940 (260,314 fine ounces valued at $185,112) and the copper (1,370,000 pounds valued at $154,810) were byproducts recovered in smelting and refining lead concentrates from southeastern Missouri. These two metals occur in such small quantity to the ton of concentrates that no value is attached to them in the sale of the concentrates. The lead came largely from the disseminated-lead district centering around Flat River and Bonne Terre in St. Francois County in southeastern Missouri; the zinc came mostly from southwestern Missouri, which is part of the Tri-State or Joplin region extending into Kansas and Oklahoma. The central district of Missouri has produced lead and zinc intermittently, but it was inactive from 1928 to 1939 and yielded only 15 tons of recoverable lead and 127 tons of zinc in 1940.

Mine production of lead and zinc in southeastern and central Missouri, 1936–40

Year	Lead concentrates (galena)		Zinc concentrates (sphalerite)		Metal content [1]			
					Lead		Zinc	
	Short tons	Value [2]	Short tons	Value	Short tons	Value	Short tons	Value
1936	145,575	$7,278,750	112	$2,016	108,422	$9,974,824	44	$4,400
1937	209,937	14,360,271	24	720	153,205	18,078,190	11	1,430
1938	163,500	9,040,593			118,870	10,936,040		
1939	210,526	12,339,360			153,522	14,431,068		
1940	232,871	14,269,600	[3] 815	20,000	169,908	16,990,800	233	29,358

[1] In calculating metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.
[2] Values given are to a certain extent arbitrary, as part of the lead concentrates are smelted by the producer.
[3] Includes 500 tons of zinc carbonate ore containing 106 tons of recoverable zinc.

Tenor of lead ore and concentrates in southeastern Missouri disseminated-lead district, 1936–40

	1936	1937	1938	1939	1940
Total lead ore .... short tons	3,418,800	5,012,631	3,668,400	5,127,000	5,837,400
Galena concentrates in ore .... percent	4.26	4.18	4.45	4.11	3.99
Zinc content of ore .... do	(1)	(1)	(1)	(1)	(1)
Average lead content of galena concentrates .... do	76.0	74.5	74.8	74.4	74.45
Average value per ton of galena concentrates	$50.00	$68.42	$55.29	$58.61	$61.28
Average zinc content of sphalerite concentrates .... percent	45.0	51.6			
Average value per ton of sphalerite concentrates	$18.00	$30.00			

[1] Figures not available.

Shipments of lead concentrates from Missouri mines in 1940 totaled 235,746 tons with a recovered lead content of 172,052 tons compared with 214,200 and 156,281 tons, respectively, in 1939. Shipments of zinc concentrates totaled 24,539 tons with a recovered zinc content of 12,703 tons compared with 27,741 and 15,096 tons, respectively, in 1939.

Mine production of lead and zinc in southwestern Missouri, 1936–40

Year	Lead concentrates				Zinc concentrates				Metal content [1]			
	Galena		Carbonate		Sphalerite		Silicate		Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1936	2,340	$113,912	294	$10,497	34,068	$1,085,455	621	$10,762	2,006	$184,552	18,665	$1,866,500
1937	5,587	368,231	173	8,160	37,715	1,611,158	1,690	43,411	4,426	522,268	20,589	2,676,570
1938	4,130	209,758	104	3,100	18,474	560,089	1,022	17,931	3,157	290,444	10,226	981,696
1939	3,674	199,885	-------	-------	27,741	944,587	949	16,757	2,759	259,346	15,096	1,569,984
1940	2,818	158,556	57	2,446	22,917	959,356	807	10,965	2,144	214,400	12,470	1,571,220

[1] In calculating metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and old tailings treated and concentrates produced in southwestern Missouri, 1936–40

	1936	1937	1938	1939	1940
Total ore and old tailings treated ....short tons..	[1] 871,200	[2] 980,100	[3] 479,600	[4] 523,800	[5] 614,500
Total concentrates in ore:					
Lead ....percent..	0.27	1.02	0.88	0.70	0.58
Zinc ....do....	3.95	5.82	4.07	5.48	4.59
Metal content of ore: [6]					
Lead ....do....	.20	.78	.67	.54	.44
Zinc ....do....	2.40	3.47	3.00	3.20	2.68
Average lead content of galena concentrates...do....	77.0	79.0	77.0	76.6	76.4
Average lead content of lead carbonate concentrates percent..	63.0	63.0	50.0	----------	59.7
Average zinc content of sphalerite concentrates.do....	61.1	60.7	58.5	58.9	59.5
Average zinc content of silicates and carbonates.do....	40.1	40.5	44.4	45.0	27.5
Average value per ton:					
Galena concentrates	$50.53	$66.00	$50.79	$54.41	$56.27
Lead carbonate concentrates	35.70	47.16	31.14	----------	42.91
Sphalerite concentrates	32.20	43.30	30.26	34.05	41.86
Zinc silicates and carbonates	17.33	25.69	17.54	17.66	13.59

[1] Includes 408,700 tons of old tailings and slimes yielding 5 tons of galena concentrates and about 6,200 tons of 59.8-percent sphalerite concentrates.
[2] Includes 422,000 tons of old tailings yielding 40 tons of galena concentrates and 6,932 tons of 57.9-percent sphalerite concentrates.
[3] Includes 126,600 tons of old tailings and slimes yielding 1,420 tons of 55.8-percent sphalerite concentrates.
[4] No tailings treated in 1939.
[5] Includes 117,000 tons of old tailings yielding 795 tons of 59.5-percent sphalerite concentrates.
[6] Figures represent metal content of the crude ore (or "dirt") only insofar as it is recovered in the concentrates; data on tailing losses not available.

Southeastern and central Missouri.—Lead production in southeastern Missouri in 1940 was the highest since 1930; the increase over 1939 was 11 percent. In St. Francois County the St. Joseph Lead Co. operated four mills—the Bonne Terre, with a daily capacity of 2,500 tons; Desloge, 3,450 tons; Federal, 10,000 tons; and Leadwood, 4,500 tons. All the mills used gravity concentration and flotation. In Madison County the Mine La Motte mine and 1,000-ton mill were operated steadily. The Ozark Lead Co. continued mining on the Fleming tract near Fredericktown; its crude ore was treated in the Clark & Hallock mill, which is of the Joplin type, using jigs and flotation machines. At Annapolis, Iron County, the Basic Metals Mining Corporation operated its mine and 500-ton mill intermittently before closing them in November. Of the lead concentrates (232,851 tons) made in 1940 in southeastern Missouri 108,518 tons were flotation concentrates, compared with 94,488 tons in 1939. About 500 tons of zinc carbonate ore and a little galena from the vicinity of St. Clair, Franklin County, were shipped to smelters. Local buyers shipped 223 tons of galena recovered in shallow workings (including barite mines) in Crawford, Jefferson, St. Francois, and Washington Counties.

In central Missouri the Wemhaner Mining Corporation produced 315 tons of zinc sulfide concentrates and 20 tons of lead concentrates from ore removed during stripping on the Rannells land in Moniteau County northeast of Versailles. The ore, which is in a general confused mass of coal, selvage, flint, and lime, was treated in a 100-ton (per 8 hours) gravity-concentration mill erected in 1940.

Southwestern Missouri.—The method of marketing the mine output in the Tri-State or Joplin lead and zinc region (southwestern Missouri, Kansas, and Oklahoma) differs from that employed in other parts of the country where miners receive pay for ore upon the basis of the assay content of metal at a certain price per unit f. o. b. smelter and freight charges are deducted from the smelter settlement if not paid in advance or guaranteed by the shipper. In the Tri-State region compensation is paid per ton of concentrates f. o. b. mine bins. In effect, however, this is equivalent to paying for the metal contained, inasmuch as the price per ton is based upon a sliding scale determined by the assay content. The standard for zinc sulfide concentrates is 60 percent zinc and for lead sulfide 80 percent lead. No base prices have been quoted in recent years for zinc silicate and lead carbonate concentrates, as the output has been scattered and small.

The total value given in this report for all concentrates produced in the Tri-State region is based upon actual receipts by the sellers and not upon quoted prices. In 1940, as in 1939, the quoted price was that paid for medium quantities or carlots; small lots brought less. The quoted weekly prices a ton for Tri-State zinc blende concentrates at Joplin in 1940 were as follows: From the week ended January 6 to that ended January 20, inclusive, $37.50; January 27 to February 24, $35.50; March 2 to May 18, $37.50; May 25 to June 1, $39; June 8 to August 10, $41; August 17 to September 21, $42.50; and September 28 to December 28, $48. The $48 price was still being quoted on May 1, 1941. The quoted prices for galena concentrates changed 16 times in 1940, ranging downward from the opening price of $64.54 a ton for the week ended January 6 to $53.74 (a low for the year) for the week ended August 10, then upward to $68.86 (highest price of the year) for the week ended November 9. The quotation dropped on November 30 to $66.70 and on December 7 to $64.54, which held until the end of December. The price paid for the zinc silicate shipped in 1940 averaged only $13.59 a ton, as much of the tonnage sold was low-grade concentrates.

Total zinc concentrate shipments from the Tri-State region increased from 413,139 tons valued at $14,199,263 in 1939 to 429,778 tons valued at $18,062,867 in 1940, and lead concentrate shipments decreased from 57,941 tons valued at $3,399,068 to 46,212 tons valued at $2,724,795. The Tri-State Zinc & Lead Ore Producers Association reported that stocks at mines in the Tri-State region as of December 28, 1940, totaled 2,764 tons of zinc concentrates and 186 tons of lead concentrates compared with 12,012 (revised figure) and 491 tons, respectively, on the same date in 1939. Flotation concentrates comprised

52 percent of the total blende and 14 percent of the galena in 1940. The galena from jigs and tables averaged 80.07 percent lead and that from the flotation machines only 65.02 percent; most of the flotation zinc concentrates, however, were higher in grade than the gravity zinc concentrates.

Production of recoverable zinc in southwestern Missouri decreased from 15,096 tons in 1939 to 12,470 in 1940 and lead from 2,759 to 2,144 tons. However, there was an increase in the number of active small mines, and the total number of producing mines rose from about 43 in 1939 to 80 in 1940 and the number of mills (including those operated intermittently) from 13 to 17. Mines near Oronogo, Joplin, Waco, and Stark City yielded the bulk of the ore treated. Operations were continued at the old Oronogo Circle open pit, from which the ore was removed by power shovels and trucks. At the end of 1940 the pit was 140 feet deep. The mining was done by the Oronogo Mutual Mining Co., and the crude ore was milled at the American mill. This mill (capacity, 900 tons daily) also treated ore from the Red Dog, Sucker Flat, D. C. & E., and Wingfield mines. Part of the ore from the D. C. & E. and Wingfield and that from other mines at Oronogo operated by the Hickam Mining Co. and Fenix & Son were shipped to the Central mill at Cardin, Okla. The F and M Mining Co. operated its 200-ton mill and LaTosca lease steadily. The Playter custom mill at Waco received crude ore from mines at Waco, Neck City, Webb City, Cave Springs, and Belleville. Ore from the Boulder Lead & Zinc Co. property and from several small mines near Joplin was treated in the Burton mill. The High Grade Mining Co. constructed a mill at Chitwood, but it was destroyed by fire after a short period of operation. The Eagle-Picher Mining & Smelting Co. continued to ship ore from Stark City to its Central mill at Cardin, Okla., and constructed a new 45-ton (an hour) mill at the Navy Bean mine near Wentworth and began operating it late in December. Other producers of lead or zinc concentrates in 1940 included Luther Eakens (custom mill), the Happy Hollow Mining Co., Hays & Manning Mining Co., Independent Gravel Co., and Jayenel Metals Corporation in Jasper County; Midwestern Mining & Sand Co., Pilant & Ogle, Spurgeon Mining Co., and Success Mining Co. (tailing mill) in Newton County; and Chapman & Doane, Mary Arnold Mining Co., and J. C. Shepherd in Ozark County.

OKLAHOMA

The method of marketing concentrates, prices quoted for them in 1940, and other general details of mining in the Tri-State region—which includes northeastern Oklahoma—are given in the preceding pages on southwestern Missouri. The combined value of the zinc and lead concentrates shipped from Oklahoma mines was $14,328,683, a 29-percent increase over 1939. Part of the higher value in 1940 was due to the advance in metal prices and part to the 17-percent increase in tonnage of zinc concentrates shipped; the tonnage of lead concentrates shipped decreased 23 percent.

Mine shipments of lead and zinc in Oklahoma, 1936–40

Year	Lead concentrates (galena)		Zinc concentrates (sphalerite)		Metal content [1]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1936	34,833	$1,735,732	244,740	$7,628,448	25,427	$2,339,284	129,175	$12,917,500
1937	39,446	2,729,690	255,839	10,428,354	29,840	3,521,120	135,696	17,640,480
1938	27,608	1,446,058	208,484	6,390,422	21,004	1,932,368	112,924	10,840,704
1939	36,422	2,189,077	258,214	8,937,554	27,720	2,605,680	140,379	14,599,416
1940	27,913	1,656,497	300,984	12,672,186	21,240	2,124,000	162,935	20,529,810

[1] In calculating metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore, old tailings, and slimes milled and concentrates produced in Oklahoma, 1939–40

	1939		1940	
	Crude ore	Old tailings and slimes	Crude ore	Old tailings and slimes
Total ore, etc., milled short tons	3,465,900	5,337,000	4,195,400	7,055,000
Total concentrates shipped:				
Galena do	35,820	602	27,328	585
Sphalerite do	203,095	55,119	238,806	62,178
Ratio of concentrates to ore, etc.:				
Lead percent	0.80	0.01	0.65	.01
Zinc do	5.97	1.03	5.55	.88
Metal content of ore, etc.: [1]				
Lead do	.62	.01	.51	.004
Zinc do	3.64	.60	3.35	.53
Average lead content of galena concentrates do	78.1	51.7	78.3	48.2
Average zinc content of sphalerite concentrates percent	61.1	59.5	60.3	59.6
Average value per ton:				
Galena concentrates	$60.52	$35.10	$59.75	$40.64
Sphalerite concentrates	34.96	33.33	42.40	40.95

[1] Figures represent metal content of the crude ore (or "dirt") only insofar as it is recovered in the concentrates; data on tailing losses not available.

Mine production of lead and zinc concentrates in Oklahoma, 1891–1940, by districts

District	Lead concentrates (mainly galena)		Zinc concentrates			
			Sphalerite		Zinc silicate and carbonate	
	Short tons	Value	Short tons	Value	Short tons	Value
Davis	----------	----------	558	$27,399	899	$24,592
Miami [1]	1,304,916	$105,615,842	7,640,681	298,964,809	164	2,692
Peoria	2,639	127,163	220	8,289	3,120	79,649
	1,307,555	105,743,005	7,641,459	299,000,497	4,183	106,933

[1] Includes Quapaw and Sunnyside.

During 1940 mine and mill operating schedules in Oklahoma were generally maintained at a steady rate except for interruptions in January caused by extremely cold weather. About 100 mines were producing during the year, and 31 mills were in operation at the end of the year. The advent of centralized milling enables groups of miners with little capital to work small mines or to mine ore left in old workings of large mines that can no longer support a mill. At least 65 operators, large and small, did not mill their crude ore but shipped it to custom or to central mills.

About 2,859,600 tons more old tailings than crude ore were treated in Oklahoma in 1940, and the tailings yielded 21 percent of the total zinc concentrates.

The Eagle-Picher Mining & Smelting Co. continued to be the largest producer of both lead and zinc in Oklahoma and in the Tri-State region. The company Central mill near Cardin has a capacity of more than 10,000 tons daily and treats company and custom ore. It is equipped with a cone plant using a heavy-density fluid-separation process of gravity concentration which discharges a large part of the mill feed at coarse size as a finished tailing, thereby reducing the quantity to be handled by the jigs and flotation machines. The total ore treated was 2,795,963 tons in 1940 compared with 1,881,079 in 1939. The improvements made in 1940 included a new sampling plant. Company-operated mines in Oklahoma shipping to the mill were the Blue Goose Nos. 1 and 3; Crystal No. 1, Central, and Velie; Grace Walker Nos. 1 and 2; John Beaver Nos. 1 and 2; Hum-bah-wat-tah Nos. 1 2, and 3; La Salle; Ohimo; See Sah; South Side Nos. 1 and 2; Stanley; Swift; and Wesah Greenback. The company sank a new shaft on the Blue Goose lease to the 325-foot level. Its Bird Dog central mill operated at less than capacity, mostly on ore from the Pelican mine.

The Federal Mining & Smelting Co. operated its Gordon central mill on ore from the Gordon, Lucky Bill, Lucky Syndicate, and Quapaw-Davenport mines in Oklahoma and the Jarrett mine in Kansas; in addition, the company sent ore from the Huttig-Beck mine to the Beck mill. The Beck Mining Co., operator of the Beck mill, also treated company ore from the Dobson and Sequoyah mines and other custom ore, mostly from the Andrews Mining & Milling Co. (Dobson and Texas), Harris Mining Co. (Robinson), L. & H. Mining Co., and Twin Mounds Mining Co. The United Zinc Smelting Corporation operated its Royal mill, treating mostly company ore but also custom ore largely from the Smoky Hill Mining Co., B. & H. Mining Co., and Indian Head Mining Co. The St. Louis Smelting & Refining Co. ran its No. 4 mill on ore from the Imbeau mine. Other producers of concentrates from mine mills included the Bilharz Mining Co., operating the Brewster mine in Oklahoma and Bilharz mill in Kansas; Davis Big Chief Mining Co., Kropp mine; Evans Wallower Zinc, Inc., No. 4 and No. 7 mines; Guaranty Mining & Royalty Co.; Hudson Lead & Zinc Co., Goodeagle; Kansas Explorations, Inc., Ritz; Lavrion Mining Co.; Lawyers Lead & Zinc Co., mine dirt and tailings; Mission Mining & Royalty Co.; Oklahoma Interstate Mining Co., Townsite and Woodchuck; Romo Mining Co., Mission; and Skelton Lead & Zinc Co., mine ore and tailings. The Rialto Mining Corporation completed the mill for its No. 3 mine late in the year. In April the Scott mine east of Hockerville was acquired by the Jane E. Mining Co. which operated it the rest of the year, treating the ore in the mill on the property until October 5 and then sending it to the Central mill.

Companies operating tailing mills comprised the Atlas Milling Co., Big Chief Tailing Co., Britt Mining Co., Captain Milling Co. (also treated tailings from Kansas), Cardin Mining & Milling Co. (Nos. 2 and 3), Cortez King Brand Mining Co., Rialto Mining Corporation, Semple Mining Co., Tri-State Zinc, Inc. (Sooner and Ottawa), and Western Mining & Milling Co.

No activity was reported in the Peoria district in either 1939 or 1940, and no output was made from the Davis district, Murray County, from 1918 to 1940, inclusive.

WISCONSIN

The lead- and zinc-mining area of Wisconsin is in Grant, Iowa, and Lafayette Counties in the southwestern part of the State. In 1940, 445 tons of recoverable lead and 5,770 tons of zinc were produced compared with 388 and 5,904 tons, respectively, in 1939. In recent years the Vinegar Hill Zinc Co. has been the principal producer in the State; in 1940 the company continued operations at the Winskill-Petersen mine until August, when the mine was closed owing to exhaustion of the ore body. After August the company mined ore from the Mullen No. 2, reopened in September. Ore from these two mines was treated in the Winskill mill near Shullsburg, yielding low-grade rougher zinc-iron-lead concentrates that were sent to the company all-flotation central plant near Cuba City and re-treated. The central plant also treated mine dirt and concentrates purchased from companies, individuals, and small partnerships mining (and in some instances operating mills) in the Benton, Cuba City, Dodgeville, Hazel Green, Highland, Leadmine, Linden, New Diggings, Platteville, Shullsburg, and other scattered districts. The quantity of purchased material treated was 19,984 tons from 191 operators in 1940 compared with 10,243 tons from 75 operators in 1939. The larger shippers to the central plant in 1940 included the Bootjack Mining Co. at Tennyson, Cherrey & Welsh at Shullsburg, the Dodgeville Mining Co. and

Mine production of lead and zinc in Wisconsin, 1936–40

Year	Lead concentrates		Zinc concentrates (sphalerite)		Metal content [1]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1936	1,277	$61,198	38,276	$400,899	904	$83,168	8,126	$812,600
1937	1,590	109,468	37,060	444,531	1,091	128,738	6,938	901,940
1938	493	21,050	[2] 3,895	[2] 121,180	320	29,440	2,073	199,008
1939	567	29,327	[3] 10,169	[3] 355,915	388	36,472	5,904	614,016
1940	621	34,852	[4] 10,875	[4] 447,396	445	44,500	5,770	727,020

[1] In calculating metal content of the ores from assays allowance has been made for roasting and smelting losses of both lead and zinc. In comparing the values of ores and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

[2] The zinc concentrates shipped in 1938 were a flotation product or raw concentrates roasted at Cuba City, Wis. No raw concentrates were shipped in 1938; about 13,000 tons were produced.

[3] Virtually all the raw concentrates in 1939 were milled at the Winskill-Petersen mill and re-treated at the flotation plant of the Vinegar Hill Zinc Co., yielding 10,169 tons of 60-percent zinc concentrates. No raw concentrates were shipped in 1939; about 32,360 tons were produced.

[4] Most of the ore mined in Wisconsin in 1940 was first treated in gravity-concentration mills producing bulk concentrates (averaging about 20 percent zinc, 19.5 percent iron, and 0.9 percent lead), which were re-treated by flotation. A considerable quantity of crude ore was floated direct. The finished flotation concentrates averaged 58.94 percent zinc.

the Four S. & B. Mining Co. at Dodgeville, the Farrey Mining Co. and the Meloy & Baker Mining Co. at Benton, the Oak Ridge Mining Co. at Leadmine, and Shaak & Minter at Highland.

All the zinc concentrates shipped to smelters from Wisconsin in 1940 (10,875 tons averaging 58.94 percent zinc) were a finished product of the Vinegar Hill Zinc Co. flotation mill. The iron sulfide concentrates made in the mill were roasted in a flash-roasting furnace to produce sulfuric acid. Of the 621 tons of lead concentrates shipped, 347 tons were a flotation product.

Tenor of lead and zinc ore and concentrates produced in Wisconsin, 1936–40

	1936	1937	1938	1939	1940
Total ore ... short tons	284,800	285,000	58,700	213,400	190,326
Total concentrates in ore:					
Lead ... percent	0.45	0.56	0.84	0.26	0.33
Zinc ... do	13.44	13.00	[1] 22.15	[2] 15.15	[3] 5.71
Metal content of ore: [4]					
Lead ... do	.32	.29	.55	.19	.24
Zinc ... do	3.61	3.12	3.91	3.07	3.37
Average lead content of galena concentrates ... do	72.2	70.1	67.0	70.0	73.1
Average zinc content of sphalerite concentrates percent	27.0	24.0	18.5	20.2	[3] 58.94
Average value per ton:					
Galena concentrates	$48.08	$68.85	$42.70	$51.72	$56.12
Sphalerite concentrates	10.47	11.99	[5] 31.11	[6] 35.00	[6] 41.14

[1] The zinc concentrates shipped in 1938 (3,895 tons) were a flotation product or raw concentrates roasted at Cuba City, Wis. No raw concentrates were shipped in 1938; about 13,000 tons, averaging 18.5 percent zinc, were produced.

[2] All sphalerite shipped in 1939 (10,169 tons) was a flotation product. No raw concentrates were shipped in 1939; 32,360 tons, averaging 20.2 percent zinc, were produced.

[3] Percentage represents finished flotation concentrates. Most of the ore mined in Wisconsin in 1940 was first treated in gravity-concentration mills producing bulk concentrates (averaging about 20 percent zinc, 19.5 percent iron, and 0.9 percent lead), which were re-treated by flotation. A considerable quantity of crude ore was floated direct.

[4] Percentages represent metal content of the ore insofar as it is recovered in the concentrates.

[5] Value is that of roasted or flotation concentrates shipped. No value can be assigned for zinc concentrates prior to roasting or re-treatment by flotation.

[6] Value is that of flotation concentrates shipped, which averaged 60 percent zinc in 1939 and 58.94 percent in 1940.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN COLORADO

(MINE REPORT)

By CHAS. W. HENDERSON AND A. J. MARTIN

SUMMARY OUTLINE

The Colorado output of gold, silver, copper, lead, and zinc in 1940 was valued (in terms of recovered metals) at $24,293,665—an increase of 9 percent over 1939 and the highest value in any year since 1918 (see fig. 1). Although some of the gain in value in 1940 resulted from moderate advances in prices of silver and the base metals, the larger part was due to increases in the quantity of silver, lead, and zinc produced; gold output was approximately the same as in 1939, and copper decreased (8 percent) in quantity but varied little in total value in the 2 years. Virtually all the large mines that were active in 1939 continued producing throughout 1940, and the tonnage of low-grade material from mine dumps and old tailing piles sold or treated increased. The number of small producing mines, prospects, and dumps (each of which is counted in this report as a producing mine if the material sold yielded any recoverable metal) was less than in 1939. Placer mines contributed only 5 percent of the State output of gold in 1940 and 6 percent in 1939.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1936–40

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1936	$35.00	$0.7745	$0.092	$0.046	$0.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052
1940	35.00	[6] .711+	.113	.050	.063

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] 1936–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–40: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producer.
[4] $0.64646464.
[5] $0.67878787.
[6] $0.71111111.

Annual figures for the 5 years ended with 1940 and total production from 1858 to 1940 are given in the table that follows. Colorado has produced more silver in the past than any other State and ranks second in total recorded output of gold.

Mine production of gold, silver, copper, lead, and zinc in Colorado, 1936–40, and total, 1858–1940, in terms of recovered metals

Year	Mines producing		Ore sold or treated (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1936	714	601	2,151,849	366,607	$12,831,245	5,902,776	$4,571,700
1937	655	490	2,068,619	368,905	12,911,675	6,260,693	4,842,646
1938	669	592	1,996,095	367,468	12,861,380	7,932,095	5,127,819
1939	758	583	1,914,593	366,852	12,839,820	8,496,488	5,767,313
1940	691	439	2,157,765	367,336	12,856,760	9,710,709	6,905,393
1858–1940			[1]	37,916,726	820,962,374	710,648,867	553,288,858

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1936	17,730,000	$1,631,160	14,534,000	$668,564	2,344,000	$117,200	$19,819,869
1937	21,868,000	2,646,028	19,572,000	1,154,748	8,494,000	552,110	22,107,207
1938	28,342,000	2,777,516	18,910,000	869,860	9,106,000	437,088	22,073,663
1939	26,430,000	2,748,720	16,444,000	772,868	3,660,000	190,320	22,319,041
1940	24,304,000	2,746,352	22,952,000	1,147,600	10,120,000	637,560	24,293,665
1858–1940	[2] 237,546	62,906,671	[2] 2,364,317	223,262,277	[2] 1,135,292	159,228,396	1,819,648,576

[1] Figures not available.
[2] Short tons.

Gold and silver produced at placer mines in Colorado, 1936–40, in fine ounces, in terms of recovered metals

Year	Sluicing and hydraulic		Drift mining		Dredges						Total	
					Dry-land [1]		Dragline floating		Floating bucket			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1936	2,307.74	573	1,990.14	403	7,754.79	1,365			1,528.33	364	13,581.00	2,705
1937	1,948.21	401	2,020.13	411	6,212.24	1,033	2,780.35	286	1,910.07	434	14,871.00	2,565
1938	2,285.00	433	1,362.00	279	10,201.00	2,020	3,166.00	279	1,027.00	239	18,041.00	3,250
1939	2,535.00	498	15.00	1	10,631.00	2,436	1,950.00	178	4,688.00	1,012	19,819.00	4,125
1940	1,822.00	360			10,203.00	2,210			4,975.00	1,068	17,000.00	3,638

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

Gold.—In total value gold was the leading metal produced in Colorado from 1858 to 1940, but in annual value it was surpassed by silver from 1874 to 1896 and by molybdenum from 1937 to 1940. The principal gold-producing districts in 1940, in order, were: Cripple Creek, Teller County; Red Cliff, Eagle County; Mosquito, Park County; Upper San Miguel, San Miguel County; Empire and Idaho Springs, Clear Creek County; Gold Hill, Boulder County; Animas, San Juan County; Summitville, Rio Grande County; and Sneffels, Ouray County. The largest gold-producing properties, in order, were the United Gold Mines and Cresson at Cripple Creek, "Eagle

Mine" group in the Red Cliff district, Smuggler-Union at Telluride, London in the Mosquito district, Shenandoah-Dives in the Animas district, Minnesota Mines at Empire, Summitville Consolidated Mines (Inc.) group in Rio Grande County, Camp Bird at Ouray, and the Stratton-Cripple Creek M. & D. Co. group at Cripple Creek. Important gains in gold production were made in Eagle, Boulder, and Clear Creek Counties; the largest decreases were in Teller, Park, and San Miguel Counties. Dry and siliceous ores yielded 82 percent of the total gold; copper ore 8 percent; zinc-lead, lead, and lead-copper ores 5 percent; and placers 5 percent.

Silver.—Silver production in Colorado has increased annually since 1932, when the output (1,860,408 ounces) was the lowest in 59 years; the output in 1940 (9,710,709 ounces—in terms of recovered metal) was the highest since 1907. Eagle County contributed 70 percent of the total in 1940, Mineral County 9 percent, San Miguel County

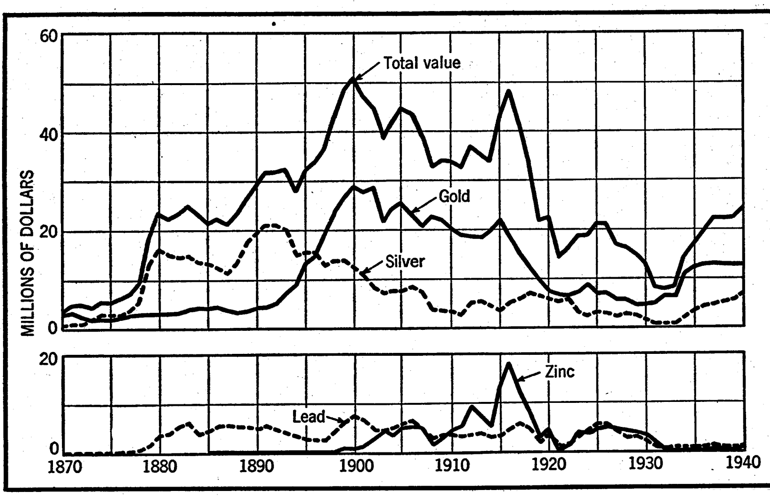

FIGURE 1.—Value of mine production of gold, silver, lead, and zinc and total value of gold, silver, copper, lead, and zinc in Colorado, 1870–1940. The value of copper has been less than $2,000,000 annually, except in a few years.

5 percent, San Juan County 4 percent, and other counties (chiefly Pitkin, Ouray, Dolores, and Clear Creek) 12 percent. The principal silver-producing properties were: "Eagle Mine" group, Eagle County; Amethyst-Commodore-Last Chance-New York and others, Mineral County; Smuggler-Union group, San Miguel County; and Shenandoah-Dives-Mayflower group, San Juan County. Copper ore yielded 70 percent of the total silver; dry and siliceous ores 19 percent; and other types of ore, together with a very small quantity of silver from placer mines, 11 percent.

Copper.—The mine output of recoverable copper in Colorado decreased 8 percent in 1940 from 1939. Eagle County produced 87 percent of the State total; the remainder came chiefly from Dolores, San Juan, Ouray, and Clear Creek Counties. The only sizable copper producer in the State was the Empire Zinc Division ("Eagle Mine") of the New Jersey Zinc Co. at Gilman, Eagle County, which shipped copper-iron-silver-gold-lead ore direct to the copper smelter at Garfield, Utah.

Lead.—Although the total recorded production of recoverable lead in Colorado from 1858 through 1940 was nearly 10 times that of copper, the annual recovered output from 1932 to 1940 was less than that of copper; the average over the 9 years was 13,477,100 pounds for lead and 17,965,200 pounds for copper. Of the 22,952,000 pounds of lead recovered in 1940 (highest production since 1930), 32 percent was contained in concentrates made from dry and siliceous gold, gold-silver, and silver ores, mostly from San Miguel, Clear Creek, Mineral, Park, and Ouray Counties; 43 percent was contained in concentrates from zinc-lead ore, mostly from San Juan and Dolores Counties; and the remainder was recovered principally from copper and lead ores shipped from Eagle and Lake Counties direct to smelters.

Zinc.—Of the 10,120,000 pounds of zinc (highest production since 1931) recovered from Colorado ores in 1940, Dolores County contributed 52 percent, San Juan 29 percent, Park 7 percent, and Summit 5 percent; Lake, Pitkin, Gunnison, Ouray, Saguache, San Miguel, and Hinsdale Counties together contributed 7 percent. The principal producers of zinc were the Rico Argentine Mining Co. at Rico, Dolores County, and the Shenandoah-Dives Mining Co. at Silverton, San Juan County.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1940, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Adams	-------	7	259	$9,065	41	$29
Arapahoe	-------	5	5	175	-------	-------
Boulder	124	-------	33,621	1,176,735	40,102	28,517
Chaffee	10	17	1,005	35,175	3,240	2,304
Clear Creek	94	12	38,282	1,339,870	162,322	115,429
Conejos	1	-------	5	175	83	59
Costilla	1	1	12	420	1	1
Custer	11	-------	152	5,320	3,607	2,565
Dolores	4	-------	469	16,415	163,724	116,426
Douglas	-------	14	21	735	-------	-------
Eagle	7	7	31,173	1,091,055	6,766,726	4,811,894
Elbert	-------	5	27	945	-------	-------
Garfield	1	-------	308	10,780	142	101
Gilpin	76	130	9,216	322,560	48,105	34,208
Grand	2	3	4	140	2,298	1,634
Gunnison	17	3	2,426	84,910	14,099	10,026
Hinsdale	6	-------	19	665	3,846	2,735
Jackson	-------	1	9	315	-------	-------
Jefferson	1	47	240	8,400	1,180	839
Lake	56	12	10,150	355,250	81,263	57,787
La Plata	6	-------	714	24,990	2,423	1,723
Larimer	2	-------	11	385	11	8
Mesa	1	-------	-------	-------	45	32
Mineral	8	-------	893	31,255	866,402	616,108
Moffat	-------	5	10	350	-------	-------
Montezuma	2	-------	1,607	56,245	945	672
Montrose	2	17	110	3,850	505	359
Ouray	19	-------	11,565	404,775	249,930	177,728
Park	34	80	38,412	1,344,420	49,320	35,072
Pitkin	5	-------	7	245	266,625	189,600
Rio Grande	1	-------	12,637	442,295	37,215	26,464
Saguache	13	-------	30	1,050	27,059	19,242
San Juan	33	-------	16,098	563,430	362,662	257,893
San Miguel	15	6	27,343	957,005	469,014	333,521
Summit	40	67	1,564	54,740	57,946	41,206
Teller	99	-------	128,932	4,512,620	29,828	21,211
	691	439	367,336	12,856,760	9,710,709	6,905,393
Total, 1939	758	583	366,852	12,839,820	8,496,488	5,767,313

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1940, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Adams							$9,094
Arapahoe							175
Boulder	162,000	$18,306	167,000	$8,350			1,231,908
Chaffee	900	102	160,000	8,000			45,581
Clear Creek	198,000	22,374	1,351,000	67,550			1,545,223
Conejos							234
Costilla							421
Custer	2,000	226	52,000	2,600			10,711
Dolores	965,000	109,045	3,855,000	192,750	5,214,000	$328,482	763,118
Douglas							735
Eagle	21,105,000	2,384,865	2,828,000	141,400			8,429,214
Elbert							945
Garfield	100	11					10,892
Gilpin	157,000	17,741	231,000	11,550			386,059
Grand			3,000	150			1,924
Gunnison	1,800	203	151,000	7,550	87,000	5,481	108,170
Hinsdale	3,600	407	81,000	4,050	9,000	567	8,424
Jackson							315
Jefferson	114,000	12,882					22,121
Lake	26,000	2,938	1,605,000	80,250	343,000	21,609	517,834
La Plata			1,000	50			26,763
Larimer							393
Mesa	3,400	384					416
Mineral	10,200	1,153	1,299,000	64,950			713,466
Moffat							350
Montezuma							56,917
Montrose	19,000	2,147					6,356
Ouray	405,000	45,765	798,000	39,900	67,000	4,221	672,389
Park	85,000	9,605	922,000	46,100	711,000	44,793	1,479,990
Pitkin	2,000	226	585,000	29,250	168,000	10,584	229,905
Rio Grande	130,000	14,690					483,449
Saguache	62,000	7,006	345,000	17,250	26,000	1,638	46,186
San Juan	739,000	83,507	5,378,000	268,900	2,971,000	187,173	1,360,903
San Miguel	104,000	11,752	2,889,000	144,450	14,000	882	1,447,610
Summit	9,000	1,017	251,000	12,550	510,000	32,130	141,643
Teller							4,533,831
	24,304,000	2,746,352	22,952,000	1,147,600	10,120,000	637,560	24,293,665
Total, 1939	26,430,000	2,748,720	16,444,000	772,868	3,660,000	190,320	22,319,041

Gold and silver produced at lode mines in Colorado in 1940, by counties, in terms of recovered metals

County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
Boulder	94,500	33,621	40,102
Chaffee	570	138	3,112
Clear Creek	221,182	38,134	162,284
Conejos	29	5	83
Costilla	44	4	-
Custer	1,530	152	3,607
Dolores	43,535	469	163,724
Eagle	333,933	31,169	6,766,726
Garfield	213	308	142
Gilpin	32,139	6,127	47,565
Grand	34	2	2,298
Gunnison	12,198	2,416	14,092
Hinsdale	986	19	3,846
Jefferson	1,764	93	1,149
Lake	68,325	8,400	80,706
La Plata	167	714	2,423
Larimer	6	11	11
Mesa	19	-	45
Mineral	41,113	893	866,402
Montezuma	3,066	1,607	945
Montrose	207	2	467
Ouray	46,283	11,565	249,930
Park	132,060	28,942	47,385
Pitkin	37,485	7	266,625
Rio Grande	39,026	12,637	37,215
Saguache	1,528	30	27,059
San Juan	231,630	16,098	362,662
San Miguel	235,509	27,338	469,014
Summit	6,130	503	57,624
Teller	572,554	128,932	29,828
Total	2,157,765	350,336	9,707,071
Total, 1939	1,914,593	347,033	8,492,363

Gold and silver produced at placer mines in Colorado in 1940, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Drift mining		Dredges: Dry-land[1]		Dredges: Dragline floating		Dredges: Floating bucket		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Adams	259	41	-	-	-	-	-	-	-	-	259	41
Arapahoe	5	-	-	-	-	-	-	-	-	-	5	-
Chaffee	46	6	-	-	821	122	-	-	-	-	867	128
Clear Creek	15	3	-	-	133	35	-	-	-	-	148	38
Costilla	8	1	-	-	-	-	-	-	-	-	8	1
Douglas	21	-	-	-	-	-	-	-	-	-	21	-
Eagle	4	-	-	-	-	-	-	-	-	-	4	-
Elbert	6	-	-	-	21	-	-	-	-	-	27	-
Gilpin	427	79	-	-	2,662	461	-	-	-	-	3,089	540
Grand	2	-	-	-	-	-	-	-	-	-	2	-
Gunnison	10	7	-	-	-	-	-	-	-	-	10	7
Jackson	9	-	-	-	-	-	-	-	-	-	9	-
Jefferson	147	31	-	-	-	-	-	-	-	-	147	31
Lake	99	24	-	-	1,651	533	-	-	-	-	1,750	557
Moffat	10	-	-	-	-	-	-	-	-	-	10	-
Montrose	108	38	-	-	-	-	-	-	-	-	108	38
Park	428	75	-	-	4,067	792	-	-	4,975	1,068	9,470	1,935
San Miguel	5	-	-	-	-	-	-	-	-	-	5	-
Summit	213	55	-	-	848	267	-	-	-	-	1,061	322
Total	1,822	360	-	-	10,203	2,210	-	-	4,975	1,068	17,000	3,638
Total, 1939	2,535	498	15	1	10,631	2,436	1,950	178	4,688	1,012	19,819	4,125

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

MINING INDUSTRY

Significant features of the mining industry of Colorado in 1940 were the maintenance of steady operations in all the principal producing mining districts and a material increase in the output of ore from Clear Creek, Dolores, Lake (mostly from dumps), Ouray, San Juan, and San Miguel Counties. The most ambitious projects under way were the 32,000-foot Carlton drainage tunnel at Cripple Creek, which was advanced 19,326 feet during 1940 to a total length of 26,634 feet, and the 10,000-cubic yard (per day) steel connected-bucket dredge of the South Platte Dredging Co. in Park County, for which the hull and part of the superstructure were completed before the end of the year.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Colorado in 1940, with content in terms of recovered metals

Source	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	1,367,102	292,830	736,298	1,059,775	4,912,272	
Dry and siliceous gold-silver ore	75,472	7,196	252,554	145,635	1,204,779	
Dry and siliceous silver ore	86,163	1,020	918,320	43,673	1,691,921	
	1,528,737	301,046	1,907,172	1,249,083	7,808,972	
Copper ore	334,312	30,331	6,765,877	21,254,198	2,822,832	
Lead ore	10,199	1,854	291,905	12,780	2,095,766	
Lead-copper ore	1,037	45	16,630	56,469	295,734	
Zinc ore	27					6,519
Zinc-lead ore	283,453	17,060	725,487	1,731,470	9,928,696	10,113,481
	629,028	49,290	7,799,899	23,054,917	15,143,028	10,120,000
Total, lode mines	2,157,765	350,336	9,707,071	24,304,000	22,952,000	10,120,000
Total, placers		17,000	3,638			
	2,157,765	367,336	9,710,709	24,304,000	22,952,000	10,120,000
Total, 1939	1,914,593	366,852	8,496,488	26,430,000	16,444,000	3,660,000

METALLURGIC INDUSTRY

Ore treated in 1940 by all mills in Colorado handling ores of gold, silver, copper, lead, and zinc totaled 1,773,566 tons, of which 1,126,881 tons were treated in company mills at mines and dumps; 550,521 tons by the Golden Cycle custom roast-amalgamation-cyanidation-flotation mill at Colorado Springs; and 96,164 tons by custom flotation mills in or near the mining districts (some of which also treated company ore included above), comprising the following: Clear Creek-Gilpin, Clear Creek Consolidated, Commonwealth, Dumont (burned in July), Gustafson, Hoosac, Ruth, Silver Spruce, and Watrous (Silver Leaf) in Clear Creek County; Creede Mills (Emperius) in Mineral County; Banner American in Ouray County; Record in Park County; Shenandoah-Dives in San Juan County; Smuggler-Union in San Miguel County; and Cameron in Teller County. All these custom mills except the Shenandoah-Dives and Banner American treated gold, gold-silver, or silver ores, with minor content of lead and copper. Zinc-lead ore (2,907 tons) containing gold and silver and some copper from Dolores, Gunnison, Hinsdale, Lake, Ouray, Saguache, San Juan, San Miguel, and Summit Counties was shipped to custom mills at Bauer, Midvale, and Tooele, Utah. The samplers at Boulder and Idaho Springs were idle throughout 1940.

Direct-smelting ores comprised 18 percent of the State total output of ore in 1940. The Arkansas Valley lead bullion-leady copper matte smelter at Leadville purchased most of the gold, silver, and gold-silver-lead-copper ores and concentrates shipped to smelters during the year. Ore and concentrates were shipped to smelters in other States as follows: Zinc-lead sulfide and zinc-lead carbonate ores from Lake County to Coffeyville, Kans.; zinc concentrates from Dolores, Ouray, Park, Pitkin, and San Juan Counties to Amarillo, Tex.; and copper-iron-silver-gold ore from Eagle County, copper-silver and copper-silver-gold ores from Garfield, Jefferson, Mesa, and Montrose Counties, and gold-silver-lead-copper ores and concentrates from the San Juan region to Utah smelters.

The quantity of gravel handled in 1940 by 1 floating connected-bucket dredge and 27 dry-land dredges was approximately 2,340,000 cubic yards averaging 22.8 cents to the yard. Specific data on yardage handled at small-scale placer operations are not obtainable because of lack of knowledge by the operators of the quantity of gravel sluiced.

Mine production of metals in Colorado in 1940, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore and concentrates amalgamated [1]	940,866	74,705	17,803			
Ore, old tailings, concentrates, sands, and slimes cyanided [2]	[3] 658,744	122,030	49,706			
Concentrates smelted	79,624	108,533	2,333,341	3,001,103	17,312,806	9,838,578
Ore smelted	381,292	45,068	7,306,221	21,302,897	5,639,194	281,422
Placer [1]		17,000	3,638			
		367,336	9,710,709	24,304,000	22,952,000	10,120,000
Total, 1939		366,852	8,496,488	26,430,000	16,444,000	3,660,000

[1] Quicksilver purchased (which is close to quantity used) by amalgamation mills was 3,664 pounds. Placer mines used approximately 600 pounds.
[2] Cyanide (in terms of 96- to 98-percent NaCN) used was 854,159 pounds.
[3] Comprises 364,157 tons of sands and slimes from ore and iron concentrates first roasted and amalgamated, 186,309 tons of tailings from ore first floated, 38,365 tons of tailings from ore first treated by jigging, and 69,913 tons of combined flotation concentrates, crude ore, and old tailings cyanided direct.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Colorado in 1940, by counties, in terms of recovered metals

County	Ore treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal					
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Boulder	87,855	24,528	5,355	3,754	5,593	25,819	106,000	154,099	----------
Clear Creek	176,668	19,286	4,351	6,253	12,101	71,962	104,332	788,864	----------
Conejos	29	5	83	----------	----------	----------	----------	----------	----------
Costilla	44	4	----------	----------	----------	----------	----------	----------	----------
Custer	1,400	151	1,153	----------	----------	----------	----------	----------	----------
Gilpin	20,559	1,906	596	1,440	1,905	7,951	36,033	17,904	----------
Gunnison	8,563	1,275	828	132	267	5,200	----------	7,982	----------
Lake	48,782	1,421	670	2,038	2,131	16,486	20,297	199,194	----------
Montezuma	3,000	1,355	295	----------	----------	----------	----------	----------	----------
Ouray	38,177	6,121	1,528	3,794	4,889	118,856	376,489	432,815	----------
Park	34,243	1,052	319	1,618	5,470	16,524	6,952	134,817	----------
Rio Grande	39,026	8,394	17,829	661	4,243	19,386	130,000	----------	----------
San Miguel	223,256	9,544	8,971	17,527	16,721	376,163	69,838	2,552,397	----------
Summit	3,039	77	13	----------	----------	----------	----------	----------	----------
Teller	541,100	121,616	25,518	13	19	23	----------	----------	----------
	1,225,741	196,735	67,509	37,230	53,339	658,370	849,941	4,288,072	----------
Total, 1939	1,054,840	207,908	105,865	34,435	48,191	573,549	774,100	4,222,035	9,000

Mine production of metals from concentrating mills in Colorado in 1940, by counties, in terms of recovered metals

County	Ore treated (short tons)	Concentrates smelted and recovered metal					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Boulder	4,919	185	638	986	5,279	2,119	----------
Clear Creek	44,198	4,455	5,992	76,277	88,935	529,752	----------
Dolores	43,474	11,168	468	162,763	958,162	3,854,093	5,214,000
Gilpin	10,855	2,426	1,421	33,422	89,913	174,047	----------
Gunnison	3,345	381	800	4,565	500	106,224	87,000
Hinsdale	954	86	16	2,963	3,271	77,768	9,000
Jefferson	1,764	503	93	1,149	114,000	----------	----------
Lake	409	155	30	1,518	1,931	39,442	61,578
Mineral	37,622	2,028	805	595,557	10,200	960,674	----------
Ouray	7,178	598	56	107,686	23,932	336,079	67,000
Park	97,176	5,376	20,850	25,619	73,595	738,336	711,000
Pitkin	22,000	851	----------	183,598	2,000	420,441	168,000
Saguache	187	49	3	2,345	3,246	20,404	26,000
San Juan	231,373	10,577	15,689	355,645	735,284	5,343,649	2,971,000
San Miguel	12,133	1,404	989	81,429	33,467	327,322	14,000
Summit	1,691	644	47	35,162	7,447	94,384	510,000
Teller	31,454	1,508	7,297	4,287	----------	----------	----------
	550,732	42,394	55,194	1,674,971	2,151,162	13,024,734	9,838,578
Total, 1939	458,443	27,954	54,409	1,116,920	1,385,430	6,348,400	3,170,000

Gross metal content of concentrates produced from ores mined in Colorado in 1940, by classes of concentrates smelted

Class of concentrates	Concentrates produced (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (wet assay) (pounds)	Lead (wet assay) (pounds)	Zinc (pounds)
Dry gold	15,662	29,577	134,147	501,703	650,923	129,875
Dry gold-silver	397	627	21,265	2,766	19,377	12,728
Copper	2,722	1,210	58,006	920,510	74,936	67,540
Lead	41,648	63,223	1,654,889	595,833	14,094,214	4,246,597
Lead-copper	8,926	13,578	426,760	1,277,538	4,329,055	1,814,580
Zinc	10,269	473	55,158	284,519	464,200	10,897,656
Total	79,624	108,688	2,350,225	3,582,869	19,632,705	17,168,976
1939	62,389	102,647	1,697,137	2,592,418	11,899,251	8,788,455

Mine production of metals from Colorado concentrates shipped to smelters in 1940, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Boulder	3,939	6,231	26,805	111,279	156,218	----------
Clear Creek	10,708	18,093	148,239	193,267	1,318,616	----------
Dolores	11,168	468	162,763	958,162	3,854,093	5,214,000
Gilpin	3,866	3,326	41,373	125,946	191,951	----------
Gunnison	513	1,067	9,765	500	114,206	87,000
Hinsdale	86	16	2,963	3,271	77,768	9,000
Jefferson	503	93	1,149	114,000	----------	----------
Lake	2,193	2,161	18,004	22,228	238,636	61,578
Mineral	2,028	805	595,557	10,200	960,674	----------
Ouray	4,392	4,945	226,542	400,421	768,894	67,000
Park	6,994	26,320	42,143	80,547	873,153	711,000
Pitkin	851	----------	183,598	2,000	420,441	168,000
Rio Grande	661	4,243	19,386	130,000	----------	----------
Saguache	49	3	2,345	3,246	20,404	26,000
San Juan	10,577	15,689	355,645	735,284	5,343,649	2,971,000
San Miguel	18,931	17,710	457,592	103,305	2,879,719	14,000
Summit	644	47	35,162	7,447	94,384	510,000
Teller	1,521	7,316	4,310	----------	----------	----------
Total	79,624	108,533	2,333,341	3,001,103	17,312,806	9,838,578
1939	62,389	102,600	1,690,469	2,159,530	10,570,435	3,179,000

BY CLASSES OF CONCENTRATES SMELTED

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	15,662	29,576	134,147	400,615	584,351	----------
Dry gold-silver	397	627	21,265	2,260	16,785	----------
Copper	2,722	1,210	58,006	884,703	48,808	----------
Lead	41,648	63,220	1,654,886	461,469	12,736,292	----------
Lead-copper	8,926	13,578	426,760	1,023,051	3,892,778	----------
Zinc	10,269	322	38,277	229,005	33,792	9,838,578
	79,624	108,533	2,333,341	3,001,103	17,312,806	9,838,578

Gross metal content of Colorado crude ore shipped to smelters in 1940, by classes of ore

Class of ore	Ore		Gross metal content				
	Short tons	Percent of total	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	16,889	4.43	12,496	39,562	105,733	180,526	28,274
Dry and siliceous gold-silver	1,738	.46	371	19,102	3,151	33,350	5,653
Dry and siliceous silver	18,308	4.80	69	177,984	5,852	278,888	3,195
Copper	332,548	87.22	30,238	6,764,728	21,842,933	4,987,695	5,000,000
Lead	10,042	2.63	1,849	288,215	16,115	2,277,044	59,812
Lead-copper	1,037	.27	45	16,630	70,724	328,828	3,713
Zinc-lead	730	.19				50,380	351,282
	381,292	100.00	45,068	7,306,221	22,044,508	8,136,711	5,451,929
Total, 1939	401,310	100.00	36,525	6,696,029	25,086,062	8,589,467	5,795,388

Mine production of metals from Colorado crude ore shipped to smelters in 1940, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Boulder	1,726	2,862	7,942	50,721	10,782	
Chaffee	570	138	3,112	900	160,000	
Clear Creek	316	755	9,694	4,733	32,384	
Custer	130	1	2,454	2,000	52,000	
Dolores	61	1	961	6,838	907	
Eagle	333,933	31,169	6,766,726	21,105,000	2,828,000	
Garfield	213	308	142	100		
Gilpin	725	895	5,596	31,054	39,049	
Grand	34	2	2,298		3,000	
Gunnison	290	74	3,499	1,300	36,794	
Hinsdale	32	3	883	329	3,232	
Lake	19,134	4,818	62,032	3,772	1,366,364	281,422
La Plata	167	714	2,423		1,000	
Larimer	6	11	11			
Mesa	19		45	3,400		
Mineral	3,491	88	270,845		338,326	
Montezuma	66	252	650			
Montrose	207	2	467	19,000		
Ouray	928	499	21,860	4,579	29,106	
Park	641	1,570	4,923	4,453	48,847	
Pitkin	15,485	7	83,027		164,559	
Saguache	1,341	27	24,714	58,754	324,596	
San Juan	257	409	7,017	3,716	34,351	
San Miguel	120	84	2,451	695	9,281	
Summit	1,400	379	22,449	1,553	156,616	
	381,292	45,068	7,306,221	21,302,897	5,639,194	281,422
Total, 1939	401,310	36,525	6,696,029	24,270,470	5,873,565	481,000

BY CLASSES OF ORE

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	16,889	12,496	39,562	87,046	161,153	
Dry and siliceous gold-silver	1,738	371	19,102	2,459	29,899	
Dry and siliceous silver	18,308	69	177,984	4,416	250,671	
Copper	332,548	30,238	6,764,728	21,140,198	2,822,832	
Lead	10,042	1,849	288,215	12,309	2,043,343	
Lead-copper	1,037	45	16,630	56,469	295,734	
Total to copper and lead plants	380,562	45,068	7,306,221	21,302,897	5,603,632	
Zinc-lead	730				35,562	281,422
	381,292	45,068	7,306,221	21,302,897	5,639,194	281,422

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1940, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Adams County		7			259	259		41	41				$9,094
Arapahoe County		5			5	5							175
Boulder County:													
Central	20		19,553	7,169		7,169	1,097		1,097		2,100		251,800
Gold Hill	42		53,880	15,346		15,346	28,748		28,748	106,000	154,400		577,251
Grand Island	8		839	272		272	744		744		1,800		10,139
Magnolia	15		2,801	1,423		1,423	1,042		1,042		1,100		50,601
Sugar Loaf	22		12,259	6,076		6,076	3,476		3,476		400		215,152
Ward	17		5,168	3,335		3,335	4,995		4,995	56,000	7,200		126,965
Chaffee County:													
Chalk Creek	2		118	74		74	817		817	600	21,000		4,289
Granite [1]	4	17	26	54	867	921	170	128	298	300			32,481
Monarch	4		426	10		10	2,125		2,125		139,000		8,811
Clear Creek County:													
Alice	7		1,267	560		560	97		97	400	400		19,734
Argentine	6		7,358	155		155	13,171		13,171	4,200	57,000		18,116
Cascade and Ute Creek	1		23	1		1	62		62		400		99
Dailey and Atlantic	1		1				7		7		600		35
Empire	8		79,109	16,693		16,693	2,714		2,714	1,400	400		586,363
Geneva Creek	2		1,803	50		50	772		772	300	500		2,358
Griffith	8		4,781	29		29	16,816		16,816	400	56,400		15,838
Idaho Springs	42	12	97,507	15,301	148	15,449	112,306	38	112,344	183,200	933,900		688,001
Montana	8		1,658	113		113	4,988		4,988	1,400	73,800		11,350
Trail Creek	11		27,675	5,232		5,232	11,351		11,351	6,700	227,600		203,329
Conejos County	1		29	5		5	83		83				234
Costilla County:													
Grayback		1			8	8		1	1				281
Plomo	1		44	4		4							140
Custer County:													
Hardscrabble	10		1,520	152		152	3,600		3,600	2,000	50,400		10,626
Ilse	1		10				7		7		1,600		85
Dolores County:													
Lone Cone	1		4,800	194		194	9,734		9,734				13,712
Pioneer (Rico)	3		38,735	275		275	153,990		153,990	965,000	3,855,000	5,214,000	749,406
Douglas County: Newlin Gulch		14			21	21							735
Eagle County:													
Burns-McCoy		7			4	4							140
Holy Cross	1		22	21		21	294		294	1,600	4,200		1,335
Red Cliff	6		333,911	31,148		31,148	6,766,432		6,766,432	21,103,400	2,823,800		8,427,739

Elbert County		5			27	27							945
Garfield County: Rifle Creek	1		213	308		308	142		142	100			10,892
Gilpin County:													
Southern	60	119	27,755	5,696	2,991	8,687	47,025	533	47,558	151,800	230,800		366,557
Northern	16	11	4,384	431	98	529	540	7	547	5,200	200		19,502
Grand County	2	3	34	2	2	4	2,298		2,298		3,000		1,924
Gunnison County:													
Elk Mountain	2	1	1		4	4	128	4	132		100		239
Gold Brick	6		11,530	2,324		2,324	9,225		9,225	400	49,700		90,430
Goose Creek	1		21	1		1	4		4	400			83
Green Mountain	3		123	45		45	66		66		3,100		1,777
Rock Creek	1		32	6		6	1,412		1,412		200		1,224
Taylor Park (Tin Cup)	3	2	477	40	6	46	2,897	3	2,900	100	94,300	87,000	13,879
Tomichi	1		14				360		360	900	3,600		538
Hinsdale County:													
Galena	4		943	8		8	3,019		3,019	3,600	79,200	1,000	6,857
Lake	2		43	11		11	827		827		1,800	8,000	1,567
Jackson County		1			9	9							315
Jefferson County	1	47	1,764	93	147	240	1,149	31	1,180	114,000			22,121
Lake County:													
California (Leadville)	50	8	67,484	8,115	93	8,208	72,796	24	72,820	25,200	1,588,400	343,000	442,940
Other districts [2]	6	4	841	285	1,657	1,942	7,910	533	8,443	800	16,600		74,894
La Plata County: California	6		167	714		714	2,423		2,423		1,000		26,763
Larimer County:													
Manhattan	1		1	5		5	1		1				176
Masonville	1		5	6		6	10		10				217
Mesa County: Sinbad	1		19				45		45	3,400			416
Mineral County: Creede	8		41,113	893		893	866,402		866,402	10,200	1,299,000		713,466
Moffat County:													
Fourmile (Timberlake)		5			10	10							350
Montezuma County	2		3,066	1,607		1,607	945		945				56,917
Montrose County:													
La Sal	2	4	207	2	49	51	467	21	488	19,000			4,279
Naturita		13			59	59		17	17				2,077
Ouray County:													
Red Mountain	7		626	60		60	6,210		6,210	2,800	38,000	10,000	9,362
Sneffels	6		37,936	10,956		10,956	120,905		120,905	376,000	434,400		533,645
Uncompahgre	6		7,721	549		549	122,815		122,815	26,200	325,600	57,000	129,382
Park County:													
Alma Placers		18			2,013	2,013		426	426				70,758
Beaver Creek		4			5,459	5,459		1,170	1,170				191,897
Buckskin	11	9	6,342	1,112	15	1,127	6,594	3	6,597	26,400	75,000	711,000	95,662
Consolidated Montgomery	7		7,352	1,093		1,093	7,972		7,972	3,700	400		44,362
Fairplay		36			1,165	1,165		246	246				40,950
Hall Valley	1		3				21		21		1,200		75
Horseshoe	1		23				114		114		2,000		181
Mosquito	13	1	118,331	26,731	4	26,735	32,680		32,680	54,900	843,400		1,007,338
Tarryall	1	12	9	6	814	820	4	90	94				28,767

[1] Granite district lies in both Chaffee and Lake Counties.
[2] Includes Box Creek, Granite, Lackawanna Gulch, St. Kevin, Tennessee Pass, and Twin Lakes districts.

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1940, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Pitkin County:													
Independence	1		2	7		7	11		11				$253
Roaring Fork	4		37,483				266,614		266,614	2,000	585,000	168,000	229,652
Rio Grande County:													
Summitville	1		39,026	12,637		12,637	37,215		37,215	130,000			483,449
Saguache County: Kerber Creek	13		1,528	30		30	27,059		27,059	62,000	345,000	26,000	46,186
San Juan County:													
Animas	17		224,668	15,034		15,034	301,895		301,895	703,400	4,942,800	2,787,000	1,243,076
Eureka	13		5,358	917		917	42,369		42,369	17,000	154,600	93,100	77,740
Ice Lake Basin	3		1,604	147		147	18,398		18,398	18,600	280,600	90,900	40,087
San Miguel County:													
Iron Springs	6		12,199	1,076		1,076	82,731		82,731	34,100	333,600	14,000	117,906
Lower San Miguel		6			5	5							175
Mount Wilson	2		5	21		21	17		17				747
Upper San Miguel	7		223,305	26,241		26,241	386,266		386,266	69,900	2,555,400		1,328,782
Summit County:													
Breckenridge	19	67	3,842	307	1,061	1,368	12,472	322	12,794	400	60,800	23,000	61,512
Montezuma	8		915	11		11	12,524		12,524	4,700	123,800		16,012
Ten Mile	9		440	124		124	1,838		1,838		18,500		6,572
Wilkinson and Green Mountain	4		933	61		61	30,790		30,790	3,900	47,900	487,000	57,547
Teller County: Cripple Creek	99		572,554	128,932		128,932	29,828		29,828				4,533,831
Total Colorado	691	439	2,157,765	350,336	17,000	367,336	9,707,071	3,638	9,710,709	24,304,000	22,952,000	10,120,000	24,293,665

ADAMS COUNTY

Most of the output of gold and silver from Adams County in 1940 was recovered as a byproduct from the gravel-washing plant of the Brannan Sand & Gravel Co. on Clear Creek north of Denver.

ARAPAHOE COUNTY

Sluicing on Little Dry Creek south of Denver recovered a little gold in 1940.

BOULDER COUNTY

Central (Jamestown) district.—The Wano mine continued in 1940 to be the principal producer of gold in the Central district; it was operated throughout the year by the owner and several sets of lessees, who shipped the ore to the Golden Cycle mill at Colorado Springs. Lessees at the Smuggler mine shipped to the Golden Cycle mill 7,801 tons of stope fill and sorted dump ore containing 1,866.47 ounces of gold. Associated Metal Mines, Inc., operated the John Jay mine throughout 1940; part of the ore was treated in the 40-ton flotation mill at the mine, and part was shipped to the Golden Cycle mill.

Gold Hill district.—In 1940, as in 1939, Slide Mines, Inc., was the leading producer of gold, silver, copper, and lead in the Gold Hill district and in Boulder County. The company operated continuously its Slide-Klondyke group of mines and 70-ton gravity- and flotation-concentration mill. The gold concentrates caught on burlap tables between the classifier and Wilfley tables were amalgamated, and the rest were shipped to the Leadville smelter. Most of the ore from the other producing mines and dumps in the district was shipped to the Golden Cycle mill.

Grand Island district.—No mill was operated in the Grand Island district in 1940, and the ore produced was shipped to the Golden Cycle mill, the Ruth custom mill at Idaho Springs (Clear Creek County), and the Leadville smelter. Producing mines included the Amy Paul, Eagle Bird, Enterprise-Mogul, First National, New York, Shirley, and St. Louis.

Magnolia district.—The principal producers in the Magnolia district in 1940 were the Cash-Rebecca, Keystone, Hereafter, Senator Hill, Ben C. Lowell, India, and Poorman mines.

Sugar Loaf district.—Nearly all the ore produced from mines and dumps in the Sugar Loaf district in 1940 was shipped to the Golden Cycle mill. The Poorman group, worked steadily by lessees, was again the largest producer of gold in the district; it was followed by the Alpine Horn, Nancy, Empress, Tambourine, Wood Mountain, Grand Republic, Livingston, Gladys, Herold, and Logan. The 75-ton flotation mill built in 1939 at the Logan mine was idle throughout 1940.

Ward district.—The Boston and Utica mines were operated throughout 1940 under lease by the Ward United Mines Co. and yielded the greater part of the output of gold and copper and a large part of the silver from the Ward district during the year. The ore, which was shipped to the Leadville smelter, averaged 1.84 ounces of gold and 2.23 ounces of silver to the ton and 2.15 percent copper. Kissell & Co. treated ore from the B & M mine and dump by flotation in a leased mill near Ward; the concentrates produced, containing gold, silver, copper, and a little lead, were shipped to the Leadville smelter.

Gold ore from the Golden Queen mine and gold-silver-copper-lead ore from the Columbia were shipped to the Golden Cycle mill and the Leadville smelter.

CHAFFEE COUNTY

Chalk Creek district (Romley, St. Elmo).—Lessees continued to work the Mary Murphy mine on a small scale in 1940 and shipped 114 tons of gold-silver-lead-copper-[zinc] ore to the Leadville smelter.

Granite district (see also Lake County).—Lode mines in the Chaffee County part of the Granite district yielded only small quantities of ore in 1940; those producing comprised the Buckhorn, Deer, and Marion Belle claims and the Granite Tunnel group. The Raeanna Mining Co. worked placer ground on Cache Creek with a dragline, caterpillar bulldozer, and washing plant from May 15 to July 3. In November the company gave up its lease on the property. During the summer Len Savage operated his placer in Lost Canyon, using a power shovel and screening-sluicing plant. Wolfe and Hesser operated their ¾-cubic yard power shovel and screening and sluicing plant in Lost Canyon from July 20 to August 2 and handled 20,994 cubic yards of gravel from which 570 fine ounces of gold and 82 fine ounces of silver were recovered. The Deep Lead, Independent, Franklin, Georgia Bar, and other placers on the Arkansas River near Granite were worked on a small scale with sluices, and drift mining was done at the Channel and North Star placers.

Monarch district.—The output of ore from the Monarch district in 1940 comprised 402 tons of lead-silver-gold ore (of which 333 tons came from the Hawkeye mine and 69 tons from the Lilly group) and 24 tons of lead-silver ore (21 tons from the Monarch lime quarry and 3 tons from the Mary J. claim); the ore was shipped to the Leadville smelter.

CLEAR CREEK COUNTY

Alice district (Yankee, Lincoln).—A lessee worked the Gold King mine during most of 1940 and shipped the ore produced to the Golden Cycle mill at Colorado Springs. The owner operated the San Juan mine from September 1 to November 15 and amalgamated 40 tons of ore in the 10-ton mill on the property; he recovered bullion containing 26.81 fine ounces of gold and 10 fine ounces of silver.

Argentine district.—The 50-ton flotation mill at the Santiago mine was operated several months in 1940 and treated about 4,750 tons of ore from the dump and 150 tons from the mine; the concentrates produced, containing gold, silver, copper, and lead, were shipped to the Leadville smelter.

Cascade and Ute Creek district (Idaho Springs).—A lessee at the Cecil claim shipped 23 tons of gold-silver-lead ore to the Ruth custom mill at Idaho Springs in 1940.

Dailey and Atlantic district (Empire).—One ton of lead-silver ore was shipped from the Grand Clear Creek mine in 1940.

Empire district.—In 1940 Minnesota Mines, Inc., operated continuously its consolidated group of claims in the area north of Empire; since 1935 this company has been the largest producer of gold in Clear Creek County. The ore is treated in the 250-ton mill at the mine by concentration on mats in launders and by flotation followed by cyanidation of the flotation concentrates. After cyanidation the flotation concentrates, containing chiefly iron sulfide, are sold to the General Chemical Co. of Denver for the manufacture of sulfuric acid; the mat concentrates, containing mostly free gold, are amalgamated. The Conqueror Operating Co. worked the Conqueror group throughout 1940; the ore was trucked to the Clear Creek-Gilpin mill at Idaho Springs for concentration, and the concentrates (containing gold as the only commercial metal) were shipped to the Leadville smelter. The Tenth Legion-Gold Dirt-Sprankel-Empress Tunnel group was under development during most of the year by the Indiana Empire Gold Mining Trust, which treated some ore in the 100-ton flotation- and table-concentration mill on the property.

Geneva Creek district.—The small cyanide mill built in 1939 on the Sill property was operated part of 1940; the gold-silver bullion produced was sold to the Denver Mint.

Griffith (Georgetown-Silver Plume) district.—Lessees worked the Clara B lode in the Commonwealth Tunnel group for a period in 1940 and produced silver-lead ore, which was concentrated in the Commonwealth mill. The mill also treated custom silver-lead ore from dumps near Silver Plume. Fargo Mines Operators drove 100 feet of drifts on the Fargo property and shipped about 1 ton of copper-silver ore. A lessee operated the Watrous mill from July to November on material containing silver and lead from dumps in the vicinity of the mill. Gold-silver-lead ore from the St. George mine was shipped to the Ruth mill at Idaho Springs.

Idaho Springs district.—The Alma-Lincoln Mining Co., a consistent producer since 1933, operated the Lincoln-South Lincoln-Elliott Barber group continuously in 1940 and treated 36,404 tons of ore by mat concentration and flotation in the company mill. The Dixie mine on Ute Creek, operated by LeRoy Giles & Co., continued to be a substantial producer of gold; the ore was treated in the Ruth custom mill at Idaho Springs. The East Dixie mine, which had been under development by the Ute Creek Syndicate, began producing in 1940; part of the ore was trucked to the Silver Spruce mill for treatment and part to the Ruth mill. The Silver Spruce mill is situated just east of Idaho Springs; it was built in the latter part of 1939 by the Silver Spruce Gold Mining Co., which had acquired leases on a number of mines in the Idaho Springs district. The ore treated in the mill in 1940 totaled 15,530 tons, comprising 14,230 tons of company ore (mostly from the Lord Byron mine) and 1,300 tons of custom ore from six mines in Clear Creek County and one mine in Gilpin County. The Clear Creek Corporation (merged with the Newton Development Corporation April 27, 1940) operated the Mattie group throughout the year and produced 16,630 tons of gold-silver ore containing some lead, copper, and zinc; the ore was trucked 8 miles to the Clear Creek Consolidated mill at Dumont and treated by flotation and gravity concentration. Gold Mines Consolidated, Inc., treated 1,965 tons of gold-silver-lead-copper ore from the Dona Juanita group in the Gustafson mill; the mill also treated 415 tons of custom ore from other mines. Ore from the Metropolitan and several other mines was treated in the Hoosac mill. The Clear Creek-Gilpin mill adjacent to the sampler at Idaho Springs treated custom ore in addition to ore from the Conqueror mine (Empire district); the sampler was not run during the year. The Specie Mining Co. operated the Specie Payment and Diamond Joe groups after April 3, 1940, and produced more than 8,000 tons of ore, most of which was milled in the Gold Ridge mill (Gilpin County). Colorado Silver Mines, Inc., pulled stopes from the Bald Eagle mine during January and part of February and treated the ore in the company mill near Blackhawk.

Montana district (*Lawson, Dumont*).—The Dumont mill was run as a custom plant from January 1940 until early in July, when it was destroyed by fire. The Red Elephant group was operated from January to July 31 and yielded silver-lead ore, part of which was shipped to the Leadville smelter and part to local custom mills.

Trail Creek district.—Lamartine Mines, Inc., operated the Lamartine-Falcon group of mines continuously in 1940 and was the second-largest producer of gold in Clear Creek County. The ore (25,855 tons) was treated in the company mill by flotation supplemented by jigs in the ball mill-classifier circuit to extract free gold for amalgamation. Bullion sold to the Denver Mint contained 1,908 fine ounces of gold and 503 fine ounces of silver, and concentrates shipped to the Leadville smelter contained 2,794 ounces of gold, 9,075 ounces of silver, 220,910 pounds of lead, and some zinc and copper. A lessee at the Phoenix mine had 977 tons of ore treated in the Dumont mill and shipped the concentrates to the Leadville smelter.

CONEJOS COUNTY

Platoro district (*Ute*).—A lessee did development work at the Forest King mine in 1940 and shipped some ore to the Golden Cycle mill for testing.

COSTILLA COUNTY

Grayback district.—Sluicing in Grayback Gulch on the property of the Drum Estate recovered placer gold in 1940.

Plomo district.—The Rito Seco Gold Mines Co. shipped 44 tons of gold ore from the Rito Seco property to the Golden Cycle mill in 1940.

CUSTER COUNTY

Hardscrabble district (*Westcliffe, Silver Cliff*).—Shore, Kettle, Henning & Stroehlke operated its 10-ton cyanide plant at Silver Cliff from May 1 to November 20, 1940, on tailings hauled from the Nemaha claim; gold-silver precipitates produced were shipped to the Midvale (Utah) refinery.

Ilse district.—A lessee on the dump at the Terrible mine shipped material containing lead and silver to the Leadville smelter in 1940.

DOLORES COUNTY

Lone Cone district (*Dunton*).—Modern Gold Mines, Inc., operated the Emma and Smuggler-Almont mines under lease from August 27, 1940, to the end of the year.

Pioneer district (*Rico*).—The Rico Argentine Mining Co. operated its group of mines and 135-ton selective-flotation mill continuously in 1940 at an average rate of 104 tons of ore daily. The products of the mill were copper-iron-silver concentrates (carrying some lead and zinc and a little gold) shipped to the Garfield (Utah) smelter; lead-silver concentrates (containing some zinc and copper and a little gold) shipped to the Leadville smelter; and zinc concentrates (carrying also silver, lead, copper, and a little gold) shipped to the Amarillo (Tex.) smelter.

DOUGLAS COUNTY

Individuals sluicing on Dry Creek and Newlin, Russellville, and other gulches near Parker and Franktown in 1940 recovered small lots of gold dust, some of which were sold to dealers in Denver and some to the Denver Mint.

EAGLE COUNTY

Burns-McCoy district.—Hand sluicing and experimental testing with a dragline and sluices on placer ground on the Colorado River recovered a little placer gold in 1940.

Holy Cross district.—Thos. E. and Donald B. Knight worked their Glengarry mine from May 15 to November 1, 1940, and shipped 22 tons of lead-copper-gold-silver ore to the Leadville smelter.

Red Cliff district (Battle Mountain).—In 1940 the Red Cliff or Battle Mountain district again contributed the bulk of the Colorado output of silver and copper and ranked first among the districts of the State in combined value of gold, silver, copper, and lead. The New Jersey Zinc Co. Empire Zinc Division continued to ship large quantities of copper-iron-silver-gold sulfide ore from its Eagle mine at Gilman to the Garfield (Utah) smelter. The company 600-ton underground flotation mill in Eagle Canyon, used in 1930–31 to treat zinc-lead ore (large reserves of which are also developed in the mine), was idle from 1932 to 1940, inclusive; however, preparations were being made early in 1941 to reopen the mill. The Ben Butler Corporation worked the Ben Butler mine throughout 1940 and shipped gold-silver-copper ore to the Garfield (Utah) smelter.

ELBERT COUNTY

A floating "pony dredge" using 23 buckets (7 by 7 by 12 inches) was run from April 1 to October 1, 1940, on the Crail ranch on Ronk Creek near Elizabeth.

EL PASO COUNTY

GOLDEN CYCLE MILL

The Golden Cycle custom mill at Colorado Springs recovered 41 percent of the total Colorado output of gold from lode mines in 1940. It treated 550,521 tons of ore averaging 0.2905 ounce of gold to the ton, of which 485,155 tons were gold-[silver]-sulfotelluride ores from the Cripple Creek district (Teller County) and 65,366 tons comprised miscellaneous gold, gold-silver, and gold-silver-lead ores from other districts, mainly in Boulder, Clear Creek, and Gilpin Counties. Ores purchased vary in character and grade; therefore, all are not treated by the same methods. Average-grade Cripple Creek ores, comprising most of the mill feed, together with iron concentrates made from low-grade ores treated by flotation, are roasted, amalgamated,[1] and cyanided. Miscellaneous ores containing appreciable quantities of

[1] Free gold saved on lightweight canton-flannel blankets and amalgamated in iron arrastre.

base metals are treated by selective flotation. The tailings from all operations are separated into sand and slime fractions and cyanided. In 1940 the mill recovered more than 99 percent of its total gold output in the form of gold-silver bullion; the remainder was contained in clean-up material around the plant shipped to the Leadville smelter.

The 80-ton cyanide plant of the Mill Tailings Recovery Co. continued to treat tailings from the old Portland mill dump near Colorado Springs. The output from this dump is included in the figures for the Cripple Creek district (Teller County), where the material originated.

FREMONT COUNTY

A new cyanide mill built in 1940 to treat tailings from the Metallic dump 2 miles northwest of Florence was placed in operation during the year. As this dump is composed of tailings from mills that treated Cripple Creek ores, the metals recovered are included in the production of Teller County.

GARFIELD COUNTY

Rifle Creek district.—The lessee at the Gray Eagle mine 8½ miles from New Castle continued to ship gold-silver-copper sulfide ore to smelters in 1940.

GILPIN COUNTY

Southern districts (Blackhawk, Central City, Nevadaville, Russell Gulch).—Production of gold, copper, and lead in the southern districts of Gilpin County increased in 1940 over 1939, and that of silver decreased. The leading lode producers of gold, silver, lead, and copper were the Frontenac-Aduddell group and the Monmouth-Kansas group. Most of the ore from these mines was treated in concentrating mills in Gilpin and Clear Creek Counties, and the concentrates produced were sold to the Leadville smelter. The New Brunswick mine ranked third in the southern districts in lode gold output; it is equipped with a 15-ton stamp amalgamation-table concentration mill, which was operated throughout the year. Lessees on the Carr, First National-Kansas, Granite, and Mammoth West claims in the consolidated group owned by the California-Hidden Treasure Mines Co. shipped 250 tons of ore to custom plants, and the lessee on dumps on this company's property at Nevadaville treated 5,996 tons of material in the Monmouth-Kansas amalgamation-flotation mill. The lease on the dumps and mill was forfeited about April 1, 1940. A lessee at the Pittsburg-Notoway group shipped high-grade gold-copper-silver ore to the Leadville smelter. The mill on the property was remodeled during the latter part of the year and was placed in operation in February 1941. Colorado Silver Mines, Inc., treated ore from the Lotus mine and Saratoga dump in its flotation mill near Blackhawk.

The Manion Placer Co. operated its land dredge during part of 1940 on ground on North Clear Creek owned by the City of Blackhawk and part of the year 6 miles downstream on the Homesite, Pay Dirt, and Hamilton placers. The equipment comprised a 1½-cubic yard power shovel, ½-cubic yard dragline, caterpillar bulldozer, screening plant on crawlers, and separate sluicing plant on wheels. The Colorado-Nevada Mining Co. worked the Nugget placer for about 6 months, using two tractor bulldozers, a dragline, power shovel, and washing plant. At the Missions Mines Co. placer a ⅜-cubic yard dragline and sluice boxes were operated from April to December. Dunfield & James and the Pleasant Valley Placer Co. each used portable machinery for handling gravel at placers in lower Russell Gulch and North Clear Creek.

Northern districts.—Gold production in the northern districts dropped sharply in 1940 from 1939, owing to the ending in 1939 of the dragline-dredge operation by the Cooley Gravel Co. on the Pactolus placer. The only producer of more than a few ounces of placer gold in the northern districts in 1940 was the Gamble Gulch Mining Co., which operated a ½-cubic yard dragline and sluicing plant on the Perigo placer ground in Gamble Gulch during the summer. Tip Top Gold Mines, Inc., lessee on the Perigo group of lode mines, treated 2,920 tons of ore by amalgamation and flotation in the Monarch mill. Ore from the Lone Star group was shipped to the Golden Cycle mill and the Leadville smelter.

GRAND COUNTY

Shipments of ore from lode mines in Grand County in 1940 comprised 28 tons of silver-lead-gold ore from the Wolverine group about 22 miles north of Granby and 6 tons of lead-silver ore from the Ready Cash claim near Jones Pass.

GUNNISON COUNTY

Elk Mountain district.—Small lots of silver-lead ore were shipped from the Blue Streak and Painter Boy claims to the Leadville smelter in 1940.

Gold Brick district.—The Carter Mines Co. operated its mine and mill on Gold Creek continuously in 1940. The mill is equipped with amalgamation plates, jig, flotation machine, tables, and corduroy-lined launders. Ore treated during the year totaled 8,291 tons, from which were recovered bullion containing 1,217 fine ounces of gold and 792 fine ounces of silver, and concentrates containing 264 ounces of gold, 5,184 ounces of silver, and 8,772 pounds of lead. Burleson Mines, Inc., operated the Raymond group and 60-ton flotation mill from January 1 to October 4; the mill product was bulk concentrates (containing chiefly gold, silver, and lead), which were sold to the Leadville smelter.

Goose Creek district.—Roberts & Laws shipped 21 tons of gold-silver-copper ore from the Surprise claim to the Garfield (Utah) smelter in 1940.

Green Mountain district.—Small tonnages of ore were shipped in 1940 from the Lucky Strike and two other claims in or near the Green Mountain district.

Rock Creek district.—Several lots of silver-gold-lead ore from the Black Eagle claim were sold to the Leadville smelter in 1940.

Taylor Park (Tin Cup) district.—The Star mine was operated from June to October 1940 and yielded 319 tons of zinc-lead-silver ore, which was shipped to custom plants at Midvale, Utah. Some gold ore was treated in a small mill at the Red Buck-Trail Horse group, and 88 tons of smelting ore were shipped from another property in Taylor Park.

Tomichi district.—Fourteen tons of lead-copper-silver ore from the Morning Glim claim were shipped to the Leadville smelter in 1940.

HINSDALE COUNTY

Galena district.—The M. B. Burke Mining & Investment Co. operated its Ute and Ulay group and flotation mill from May 15 to August 25, 1940; the concentrates produced, containing lead, copper, silver, and a little gold, were sold to the Leadville smelter.

Lake district.—One car of zinc-lead-silver-gold ore from the George III-St. Jacobs group was shipped to the Midvale (Utah) custom concentrator in 1940, and 18 tons of lead-silver-gold ore from the Belle of the West mine were sold to the Leadville smelter.

JACKSON COUNTY

The Pure Gold placer on Independence Mountain was worked from April to September 1940 with sluices and a small placer machine.

JEFFERSON COUNTY

The old Malachite mine 3½ miles northwest of Morrison, which produced ore in the 1890's and early 1900's and again in 1931, was reopened in 1940 and operated several months during the latter part of the year. The ore, which contained copper, gold, and silver, was concentrated in custom mills at Idaho Springs and the concentrates produced were shipped to the Garfield (Utah) smelter.

LAKE COUNTY

LEADVILLE DISTRICT

Lake County (chiefly Leadville—sixth principal mining district in the United States up to the close of 1940) produced from 1859 through 1940 a total of 343,948 fine ounces of placer gold valued at $7,271,575, and 19,495,693 tons of ore from which were recovered 2,377,387 fine ounces of gold valued at $50,415,099; 235,378,421 fine ounces of silver (including a negligible quantity from placers) valued at $192,363,746; 51,004 tons of copper valued at $14,584,784; 1,018,291 tons of lead valued at $92,689,445; and 697,151 tons of zinc valued at $95,254,850—a grand total of $452,579,499. These figures do not include the bismuth, iron, manganese, and sulfuric acid produced.

Owing to the filling of four fault-blocked basins of ore deposits by water, output fell off heavily in 1931 and still more in 1932, revived somewhat in 1933 with the increased price for gold, and improved again in 1934 with fixation of the gold price at $35 an ounce and Government regulation of the silver price. In 1939 and 1940 the production was mainly in the treatment of gold-bearing dumps, with some shipments of newly mined and dump gold ore and lead-silver ore and of dump zinc-lead ore. The principal new work in the Leadville district was that by the Newmont Mining Corporation (of New York) and the Hecla Mining Co. (of Idaho) at the Resurrection mine at the end of the Yak tunnel, where water is not a problem. Ore has been developed at the Resurrection mine in sufficient quantity to furnish gold-silver-lead-zinc ore for a 300-tons-a-day concentration mill. Early in 1941 these companies acquired the Yak tunnel with its tracks, right-of-way, and certain mining property contiguous to the Yak drainage-transportation tunnel. These companies plan a drainage tunnel from the east fork of the Arkansas River, starting at

10,000 feet altitude and running southeastward across the district. This tunnel will be 350 feet lower than the Yak tunnel and about 150 feet below the Canterbury tunnel.

The H. G. N. Mining & Milling Co. operated its 300-ton flotation- and gravity-concentration mill from June 24 to December 31, 1940, and treated 44,099 tons of ore from dumps of the St. Louis, Ibex, Valley, and Fanny Rawlings mines. Before being sent to the mill the ore was crushed or screened to minus-1½-inch size. The jig concentrates were amalgamated, and the flotation and table concentrates were shipped to the Leadville smelter. The California Gulch Milling Co. operated its mill in California Gulch on ore from the Venir dump. Andy Caine & Co. erected a 45-ton gravity-concentration mill to treat low-grade ore from the Fanny Rawlings property and operated it from October 7 to the end of the year. A small tonnage of ore from the "Lilian" group was cyanided in the plant of the Leadville Cyanide Corporation. The principal shippers of ore direct to the Leadville smelter (in approximate order of tonnage) were the Breece mine and dump, Chippewa, New Monarch, Dolly B, Wolftone, Morgan dump, Ollie Reed and Tenderfoot, and Ibex. The Ibex was shut down 2 months for shaft repairs. About 300 tons of zinc-lead-silver-gold ore from the Leadville district were shipped to the Midvale (Utah) custom concentrator, and 730 tons of zinc-lead sulfide and carbonate ores, mostly from the Tucson and Moyer dumps and the F. J. Irwin operation, were shipped to the Ozark pigment plant at Coffeyville, Kans.

The Arkansas Valley lead bullion-leady copper matte custom smelter of the American Smelting & Refining Co. at Leadville was operated continuously (one furnace) in 1940. Receipts of ore and concentrates totaled 114,371 tons (all but 27 tons from Colorado mines) compared with 111,526 tons (all but 50 tons from Colorado mines) in 1939.

OTHER DISTRICTS

Less than 900 tons of ore were shipped in 1940 from mines in Lake County outside the Leadville district. Producing lode properties comprised the Mount Champion in the Lackawanna Gulch district; the Dinero and Fanchon in the St. Kevin-Sugar Loaf district; and the Gordon, Mary Jane, and White Star in the Twin Lakes district. Small lots of placer gold were recovered at the Cureton, Oregon, and other placers in the Granite district and at the Wye placer in the Tennessee Pass district. The dry-land dredge of the Mt. Elbert Mining Corporation on the Derry Ranch placers in the Box Creek district 12 miles south of Leadville was operated from April 10 to December 11.

The Climax Molybdenum Co. at Climax, 13 miles north of Leadville, operated its 12,000-ton flotation mill continuously in 1940, treating 3,833,838 tons with an average of 10,500 tons of ore daily for the year, and produced molybdenum sulfide concentrates containing 22,782,608 pounds of elemental molybdenum.

LA PLATA COUNTY

The American Smelting & Refining Co. lead bullion-leady copper matte smelter at Durango was dismantled in 1940. Sintering equipment was sent to the Amarillo (Tex.) plant, and other parts went to the Leadville smelter.

California (or La Plata) district (Hesperus, La Plata).—The metal output from the La Plata district in 1940 was contained in small tonnages of gold-silver ore shipped to smelters from the Bessie G, Delaware, Gold King, May Day, Mountain Lilly, and an unidentified property.

LARIMER COUNTY

A little gold ore was shipped to the Leadville smelter in 1940 from the Free Gold claim in the Manhattan district and the Little Mary Mason group in the Masonville district.

MESA COUNTY

Sinbad district.—One car of copper-silver ore was shipped from the Precipice claim to the Garfield (Utah) smelter in 1940.

MINERAL COUNTY

Creede district.—Silver production in the Creede district increased 45 percent in 1940 over 1939, following a 30-percent increase in 1939 over 1938 and a 42-percent increase in 1938 over 1937. The output of gold and lead recovered from the silver ore also increased in 1940. Much high-grade silver ore was shipped direct to the Leadville smelter, but the bulk of the ore from the district was concentrated in the custom flotation mill of Creede Mills, Inc., and the concentrates produced were shipped to the Leadville smelter. The mill was operated by Creede Mills, Inc., from January 1 to September 1, when it was leased to the Emperius Mining Co., which ran it the rest of the year. The Emperius Mining Co. also acquired the mining leases of Creede Mills, Inc., in the Sunnyside area.

MOFFAT COUNTY

Fourmile (or Timberlake) district.—Small lots of placer gold were recovered in 1940 by sluicing at the Gooldy, Grubstake, Old Faithful, and other placers in the Fourmile district.

MONTEZUMA COUNTY

The Red Arrow Gold Corporation operated its Red Arrow mine throughout 1940 and produced 3,039 tons of ore, of which 3,000 tons were concentrated in the company mill by jigging, blanket-tabling, and flotation and 39 tons were shipped crude to the Leadville smelter. The concentrates were amalgamated and yielded 1,354.92 fine ounces of gold and 295 fine ounces of silver in retorts sold to the Denver Mint; the ore shipped crude contained 179 ounces of gold and 585 ounces of silver.

MONTROSE COUNTY

La Sal district.—Lessees at the Cashin group and the Talbert claim shipped copper-silver ore to the Garfield (Utah) smelter in 1940. Most of the output of placer gold from the La Sal district during the year came from the Honora claim.

Naturita district.—Individuals sluicing on San Miguel River in 1940 recovered small lots of placer gold.

Paradox Valley district.—An increased output of vanadium ore was made in the Paradox Valley area in 1940. The United States Vanadium Corporation continued to operate its 260-ton roasting, leaching, and vanadium oxide precipitation plant at Uravan. A similar plant at Naturita was reopened by the Vanadium Corporation of America. Custom ore was bought by both companies. The North Continent Mines, Inc., also built a mill for the treatment of vanadium ores near Cedar (San Miguel County).

OURAY COUNTY

Red Mountain district.—The Guston, Yankee Girl, and Robinson claims in the Red Mountain group were operated under lease from January 1 to June 1, 1940, by G. A. Franz, Inc., which shipped to the Leadville smelter 412 tons of stope filling from the old Guston stopes, containing 55.5 ounces of gold, 4,479 ounces of silver, and a little lead, copper, and zinc. Some ore from the Koehler tunnel and the Micky Breen mine was shipped to the Shenandoah-Dives mill at Silverton (San Juan County).

Sneffels district.—The King Lease new 100- to 125-ton mill built in 1939 within the old Camp Bird stamp-mill building 6 miles south of Ouray was placed in operation January 1, 1940, and ran continuously throughout the year on ore from the Camp Bird mine. The ore was transported from the mine workings through the lower 11,000-foot adit to the mill bins, from which it was fed to jaw crushers and then to ball mills; the pulp from the ball mills was amalgamated on plates, and the pulp from the plates was sent to the flotation circuit where bulk gold-silver-copper-lead-[zinc] concentrates were made for shipment to smelters. The gold-silver bullion recovered was sold to the Denver Mint.

Uncompahgre district.—Lessees working the Bachelor Consolidated group in 1940 shipped some of the ore produced to the Leadville smelter but had most of it milled in the Banner American mill at Ouray, operated by G. A. Franz, Inc. Zinc-lead-silver dump ore from the Syracuse Tunnel was milled at the Shenandoah-Dives mill at Silverton. Zinc-lead ore cleaned up at the Pony Express group also was concentrated in the Banner American mill, yielding lead concentrates (shipped to the Leadville smelter) and zinc concentrates (shipped to the Amarillo (Tex.) smelter). The McCullough Lease continued to ship gold-silver-copper ore to the Leadville smelter from the American Nettie and Wanakah groups and treated 250 tons of old tailings from the Wanakah mill dump in the flotation mill on the property; the daily capacity of this mill was raised during the year from 30 to 50 tons by the installation of a new ball mill. Silver ore from the Senorita group was shipped to the Midvale (Utah) smelter, and zinc-lead ore from the Ophir group was sent to the Midvale custom concentrator.

PARK COUNTY

Alma Placers district.—The Alplaco Mining Co. was the principal producer on the Alma Placers in 1940; the company used a central slucing plant, to which gravel dug from open pits by power shovels was hauled by trucks.

Beaver Creek district.—The Timberline Dredging Co. operated its electric floating connected-bucket dredge on Beaver Creek near Fairplay from April 5 to December 25, 1940, and handled 876,760 cubic yards of gravel yielding 4,975 fine ounces of gold and 1,068 fine ounces of silver; the dredge is equipped with 84 buckets, each with a capacity of 7½ cubic feet. A lessee at the Shelton placer recovered 75 fine ounces of gold and 16 fine ounces of silver, using a 1¼-cubic yard gasoline shovel, four trucks, a bulldozer, and a screening-sluicing plant to handle the gravel. Output was made from other placers on Beaver Creek during the year.

Buckskin district.—The 2-3-4 Mines, Inc., continuing exploration and development work at the Philips group, opened some new ore in 1940 and reopened old workings containing zinc ores carrying lead, copper, gold, and silver. The company leased the Alma Betts 50-ton mill and operated it from June to the end of the year. The zinc concentrates made (containing also some gold, silver, copper, and lead) were shipped to the Amarillo (Tex.) smelter, and the lead concentrates (containing also gold, silver, copper, and zinc) were sold to the Leadville smelter.

Consolidated Montgomery district.—The Magnolia Gold Mining Co. continued operations at the Magnolia mine in 1940 and completed the rebuilding of its mill, which had burned in 1939. The mill was operated from April 1 to the end of the year and treated 6,900 tons of ore by table and flotation concentration. Small lots of ore were shipped to the Golden Cycle mill from the Kansas mine and to the Leadville smelter from other properties in the Consolidated Montgomery district.

Fairplay district.—Placer mining was continued in 1940 on the Snowstorm placer and at various places on the Platte River in the vicinity of Fairplay. A large part of the gold output was produced from gravel dug by power shovels and hauled by truck to central sluicing plants, but individuals continued to recover some gold by hand sluicing. At the close of 1940 the South Platte Dredging Co. had completed the hull and part of the superstructure of a 10,000-cubic yard (per-day) steel connected-bucket dredge, equipped with 100 buckets of 11 cubic feet capacity each, on the bench below Fairplay. Natomas Co. (of California) which owns an interest in the South Platte Dredging Co. reports that 80,000,000 cubic yards of gravel have been thoroughly tested.

Hall Valley district.—About 3 tons of lead-silver ore were shipped from the Ypsilanti claim to the Leadville smelter in 1940.

Horseshoe district.—One car of lead-silver ore was shipped in 1940 from the Hill Top group.

Mosquito district.—The London Mines & Milling Co. maintained production throughout 1940 from its consolidated group of mines on London Mountain and continued to be the principal metal producer in the Mosquito district and in Park County. The ore was transported from the mine workings through the 4,400-foot London Extension tunnel and was put through a sorting plant before being treated in the company 200-ton flotation- and gravity-concentration mill. Besides gold—the metal of chief value—the concentrates contained some silver, a little copper, and considerable lead and zinc; they were sold to the Leadville smelter. The London-Butte Gold Mines Co. operated its Butte mine and 100-ton flotation mill throughout the year. During part of the year the Record mill was operated by the Chicago Mines Co., for the fourth season, on ore from the American and South London waste dumps, and part of the year by the London Extension Mining Co. on mine and dump ore from the American mine and Huron claim and dump ore from the Champaign. Operations by W. A. Ellis, Inc., at the American mine were discontinued June 8.

Tarryall district.—The Peerless Mining Co., which from 1934 to 1939, inclusive, operated its 1¼-cubic yard gasoline shovel and portable four-bowl washing machine in Park Gulch about 7 miles southeast of Como, moved the equipment in 1940 to the Fortune placer northwest of Como and ran it from May 10 to October 7. Gage L. Odell worked the Roberts placer on Tarryall Creek 2½ miles northwest of Como from May 25 to November 3 with a 1¼-cubic yard gasoline shovel and screening and sluicing plant. A four-bowl land dredge and steam shovel were installed on the Little Mint-Storming Jordan property 10 miles east of Como and operated for 2 days. A little gold was recovered by individuals sluicing on Tarryall Creek. In 1940 Cooley Bros. took a royalty lease on the Cline bench placer and Peabody and Fortune placers and began installation in 1941 of a 3½-cubic yard dragline floating dredge. Some 9,000,000 cubic yards of gold-bearing gravel have been developed by pits and churn drilling. About 9 tons of gold ore were shipped from the Black Butterfly lode claim.

PITKIN COUNTY

Independence district.—A 2-ton lot of gold-silver-copper ore was shipped from the Mount Hope dump to the Leadville smelter in 1940.

Roaring Fork district (Aspen).—The Midnight Mining Co. operated the Midnight mine and mill continuously 6 days a week in 1940. The ore mined (7,000 tons) was treated in the company 60-ton flotation mill. The products were lead-silver concentrates, which were sold to the Leadville smelter, and zinc concentrates, which were shipped to the Amarillo (Tex.) zinc smelter. D. P. Rohlfing continued to ship to the Leadville smelter lime fluxing material carrying silver and lead from the Smuggler, Spar Consolidated, and other groups under his management. A lessee of the Hunter Creek flotation mill treated about 15,000 tons of silver- and lead-bearing material from the Mollie Gibson dump.

RIO GRANDE COUNTY

Summitville district.—Summitville Consolidated Mines, Inc., maintained production throughout 1940 from its consolidated group of mines and 125- to 150-ton mill at Summitville. Part of the ore is mined from underground workings and part from glory holes. In treatment, the ore is ground in a ball mill with cyanide solution to minus-100-mesh. A jig between the ball mill and classifier removes coarse high-grade gold-silver-pyrite concentrates, which are shipped to the Leadville smelter. The classifier overflow goes to primary thickeners to remove pregnant solution; the primary thickener underflow goes to agitators and from them to three stages of countercurrent decantation. The pregnant solution is precipitated in Merrill-Crowe units, and the precipitates are acid-treated and reduced to bullion for shipment to the Denver Mint.

SAGUACHE COUNTY

Kerber Creek district (Bonanza).—The metal output from the Kerber Creek district in 1940 was contained in lead-silver-copper-gold, lead-silver-gold, and copper-silver-gold ores shipped to smelters in Colorado and Utah and in zinc-lead-silver-copper-gold ore shipped to the Midvale (Utah) custom concentrator. The only shippers of more than 100 tons of ore during the year were the Rawley and Warwick groups; other producers included the Hornet, Jupiter, Liberty, and Minnie Lynch properties.

SAN JUAN COUNTY

Animas district.—Operations of the Shenandoah-Dives Mining Co., a large annual producer since 1928, were continued without interruption throughout 1940. The company owns and operates a consolidated group of claims on King Solomon Mountain opened by the Mayflower Tunnel and a 750-ton selective-flotation mill on Animas River near Silverton. Company and custom ore treated in 1940 totaled 221,801 tons (of which 8,910 tons were custom) and yielded 9,292 tons of combined lead, zinc, and iron (lead) concentrates, containing in all 15,303 ounces of gold, 336,066 ounces of silver, 847,340 pounds of copper (wet assay), 5,060,276 pounds of lead (wet assay), and 4,024,906 pounds of zinc; the lead and iron (lead) concentrates were shipped to the Leadville smelter, and the zinc concentrates (2,607 tons of 58.5-percent zinc content, with also gold, silver, and minor lead and copper content) to the Amarillo (Tex.) smelter. Part of the custom ore came from the Mystery, Little Fannie, and other mines in the Animas district and part from mines in other districts in San Juan and Ouray Counties. The new Pride of the West 50-ton flotation mill at Howardsville was completed and placed in operation July 21, 1940, and to the end of the year treated 7,389 tons of ore and produced 955 tons of lead concentrates averaging 0.36 ounce of gold and 18.8 ounces of silver to the ton, 50 percent lead (wet assay), 2.87 percent copper (wet assay), and 7.26 percent zinc, and 164 tons of zinc concentates averaging 0.04 ounce of gold and 5.05 ounces of silver to the ton, 2.25 percent lead (wet assay), 0.91 percent copper (wet assay), and 58.6 percent zinc. The Highland Mary mine and mill were operated from September 3 to November 25. Small tonnages of smelting ore were shipped from the Coming Wonder, Delaware, Kankakee (Crusader Lease), and other mines. From inside the Mayflower Tunnel the Shenandoah-Dives Mining Co. during the last several years had completed a 3,000-foot crosscut to the Silver Lake property of the American Smelting & Refining Co., and during 1940 several raises were made on the Stelzner vein.

Eureka district.—Most of the output of ore from the Eureka district in 1940 was sold to the Shenandoah-Dives mill. The largest shipper to the mill was Superior Metal Mines, Inc., which hauled by truck 1,703 tons of material containing chiefly gold and silver but also some zinc, lead, and copper, from the leased Mammoth and Polar Star dumps on the south slope of Engineer Mountain. The second-largest shipper was the Esmeralda Lease, with 1,637 tons of silver-gold-zinc-lead-copper ore. Other shippers included the Mountain Queen mine, Golden Fleece and San Juan Queen dumps, and Robert Bonner and Lead Carbonate mines. Gold-silver ore from the Brooklyn mine was shipped to the Leadville smelter. The Sunnyside mine and 1,000-ton selective-flotation mill at Eureka, closed June 30, 1938, remained idle throughout 1940.

Ice Lake Basin district.—The Blanco Mining Co. operated the Bandora group from May 4 to October 31, 1940, and shipped 1,579 tons of lead-silver-zinc-gold-copper ore to the Shenandoah-Dives mill. The company surrendered its lease on the property at the end of 1940.

SAN MIGUEL COUNTY

Iron Springs district (Ophir).—In 1940 Butterfly Consolidated Mines, Inc., continued working its Butterfly-Terrible-Silver Bell group of mines and treated 12,000 tons of ore in its 250-ton flotation mill. The concentrates produced (1,373 tons) contained 920 ounces of gold, 80,157 ounces of silver, 323,099 pounds of lead (wet assay), 39,173 pounds of copper (wet assay), and some zinc; they were sold to the Midvale (Utah) smelter. The mill was destroyed by fire December 6. Belisle Bros. shipped several cars of zinc-lead-gold-silver-copper ore to the Midvale (Utah) custom mill from the New Dominion mine, which was under development throughout the year. Other small producers included the Carbonero, Hattie, Sulphurette, and Yellow Jacket.

Lower San Miguel district (Sawpit, Vanadium).—Sluicing on the San Miguel River recovered a little gold in 1940.

Mount Wilson district.—Small lots of high-grade gold ore were shipped to smelters in 1940 from the Chindey and Shenandoah claims.

Upper San Miguel district (Telluride).—Veta Mines, Inc., operated its amalgamation-flotation mill at Pandora 2½ miles east of Telluride at an average rate of 486 tons daily for 365 days in 1940 compared with 375 tons in 1939. Improvements made in 1940 raised the daily capacity of the mill (formerly 500 tons) to 700 tons. The company ore treated came from the Smuggler-Union and Cimarron mines and dumps and the custom ore (119 tons) from the Gold Queen, Little Mary, Shoemaker, and Wasatch claims and a prospect. Mine development during the year comprised 4,281 feet of drifts, 1,660 feet of tunnel, 15 feet of winze, and 174 feet of diamond drilling. A crushing plant was installed at the portal of the Pennsylvania Tunnel and an aerial tramway erected from this point to the Cimarron dump. Alta Mines, Inc., operated the Alta-St. Louis group steadily throughout 1940. The mine is developed by 6 to 8 miles of tunnels and drifts, of which 500 feet of tunnel and 1,000 feet of drifts were driven during the year. The ore produced (45,988 wet tons) was treated in the company 150-ton mill by jig, flotation, and table concentration; the jig concentrates were amalgamated, and the flotation and table concentrates were shipped to the Leadville smelter.

SUMMIT COUNTY

Breckenridge district.—Ores shipped to the Leadville smelter from the Breckenridge district in 1940 comprised chiefly silver-lead ore from the Fredonia mine; gold-silver-lead ore from the Carbonate, Jumbo, Laurium (Blue Flag), Minnie B, Silver King, and Standard-Bulwer; and gold-silver ore from the Hoosier. Zinc-lead ore from the Mountain Pride and Wellington mines and zinc ore from the Sally Barber were shipped to custom concentrators in Utah. Some gold was recovered from ore amalgamated at other lode properties in the district.

The Bemrose-Bostwick, Louis D, and Ford-Bedrock placers, equipped with power shovels, trucks, and central sluicing plants, yielded most of the output of placer gold from the Breckenridge district in 1940. The Beaver Head, Long Island, Pittsburg, and other placers were worked by sluicing or hydraulicking. The Blue River Co. floating connected-bucket dredge at Breckenridge was not run in 1940.

Montezuma district.—The output of ore and concentrates from the Montezuma district in 1940 was sold to the Leadville smelter. The Bullion mine was operated by a lessee who concentrated the ore in a small gravity-concentration mill near the mine. The Marlin Mining Co. treated ore from its property in a small mill equipped with a crusher, ball mill, and tables. Direct-smelting ore was shipped from the Florado-Sts. John, Gold Arrow, Maid of Orleans, Pennsylvania, Revenue, and Tip Top mines. Silver and lead were the chief metals contained in most of the ore.

Ten Mile (Kokomo, Robinson) district.—The Wilfley Leasing Co. cleaned out and retimbered old workings in the Wilfley mine and treated in the Wilfley mill 150 tons of low-grade gold-silver-lead ore cleaned up from the Tabor incline. A six-cell flotation machine was installed in the mill, formerly equipped for gravity concentration only. The Gold Crest Mining Co. drove 600 feet of tunnel at the Gold Crest group and shipped 177 tons of gold-silver ore to the Leadville smelter. Small shipments of smelting ore were made from the Boston and other properties in the Ten Mile district.

Wilkinson and Green Mountain district.—Walter McDaniel continued producing rich zinc-silver-lead-gold-copper ore from his Big Four mine, opened on Green Mountain in 1937; he shipped part of the ore to the Combined Metals Reduction Co. at Bauer, Utah, and part to the United States Smelting, Refining & Mining Co. at Midvale, Utah. Output in 1940 was 755 tons of ore containing 633,800 pounds of zinc, 34,002 ounces of silver, 29,907 pounds of lead, 43.84 ounces of gold, and 5,247 pounds of copper. Other output from the Wilkinson district comprised gold-silver ore from the Excelsior and lead-silver-gold ore from the Chief Mountain and another property.

TELLER COUNTY

CRIPPLE CREEK DISTRICT

Cripple Creek is the leading gold-producing district in Colorado. From 1891, when gold was discovered in that area, through 1940 it has yielded a total of 18,182,819 fine ounces valued at $389,973,147, or 48 percent of the State total output of gold from 1858 to 1940, inclusive. In 1940 the district produced 128,932 ounces (35 percent of the State total), compared with 134,003 ounces (37 percent) in 1939 and 145,215 ounces (40 percent) in 1938. Output in 1939 and 1940 was reduced by the temporary suspension of operations in the lower levels of the Ajax and Cresson mines, pending completion in 1941 of the Carlton drainage tunnel. The portal of the Carlton tunnel is at an altitude of 6,893 feet above sea level, and drainage will be approximately 1,110 feet lower than the Roosevelt tunnel. Approximate additional depths to connect some of the deeper shafts are: Cresson, 700 feet; Ajax, 500 feet; Vindicator, 1,000 feet; and Portland, 200 feet. The total output of ore from mines and dumps in the district proper in 1940 was 536,504 tons, of which 485,155 tons were shipped to the Golden Cycle mill (operations reviewed under El Paso County), 31,454 tons were treated by flotation in the Cameron mill, and 19,895 tons were treated by cyanide leaching in the Kavanaugh plant. Other output credited to the Cripple Creek district in 1940 is 36,050 tons of old tailings treated in cyanide plants at the old Portland mill dump at Colorado Springs and the Metallic dump at Florence. These dumps are composed entirely of tailings from ore shipped from the Cripple Creek district many years ago. Cripple Creek ores generally contain gold as the only commercial metal, but some silver ore has been shipped from two or three veins in the district; a small quantity of silver is recovered annually in bullion and concentrates produced from the gold ores.

MINES REVIEW

Operations of the Golden Cycle Corporation, which owns and operates the Golden Cycle mill at Colorado Springs and several mines in the Cripple Creek district, are described in the following extract from the corporation's annual report to stockholders for the year ended December 31, 1940 (dated March 1, 1941):

During the year 1940, the Cripple Creek district shipped to the Golden Cycle mill at Colorado Springs a total of 485,155 tons of ore of an average value of $9.058 per ton. This is an increase in tonnage over the previous year, but a decrease in the average value. All this ore came from above the Roosevelt Tunnel level. A consiaerable part of this tonnage is also dump ore, which is naturally lower in value than mine ore. Lessees accounted for the greater part of the tonnage shipped. The leasing system as is practiced in the Cripple Creek district is the most economical way mining can be carried on, due to the character of the small and erratic nature of the ore chutes. However, it is, of course, necessary for the companies to take the lead on development work and mine all the larger and better grade bodies of ore possible.

The United Gold Mines Co. was the largest shipper from the district, with the Cresson Consolidated Gold Mining & Milling Co. a close second. These two properties accounted for 60 percent of the ore shipped from the district. The ore mining division of the Golden Cycle Corporation shipped 34,179 tons with a gross value of $377,347 or an average value of $11.04 per ton. This is a decrease over the previous year, due to the curtailment of operations on the Ajax mine.

Ajax operation.—In July 1939, it was decided to stop pumping operations on the Ajax mine due to the heavy expense, and due to the fact that as long as the corporation had commenced the driving of the Carlton Tunnel, which would drain these workings, it seemed senseless to keep on with the heavy expense of pumping, which the Carlton Tunnel would eliminate when completed. Consequently, the mine workings were flooded up to the Roosevelt Tunnel level.

Almost the entire production of the Ajax, prior to this time, came from the flooded area. Since that time production has been maintained by lessees on the upper levels, and by the company washing and sorting the ore house waste dump, which was put out prior to 1939.

The Ajax shipped 22,202 tons of ore during 1940, with a gross value of $226,628. Of this amount the company shipped 8,644 tons, with an average value of $7.90 per ton (mainly dump ore), while the lessees shipped 13,558 tons with an average value of $11.675 per ton.

The Ajax has 14 sets of lessees working through the main Ajax shaft, employing about 35 men. During the past year they have done 1,041 feet of development work, including drifting, crosscutting, raising, and winzing.

The company did 686 feet of development work in 1940. The Queen of the Hill system on the 20th level was thoroughly prospected with very little ore being discovered.

The Ajax shaft has been retimbered from the collar down 50 feet. Some surface buildings, that were a big fire hazard, have been removed and the remaining buildings have been repaired and painted. The plant is in much better shape today than it was 2 years ago.

It is quite probable that enough drainage will take place, within the next few months, to permit work to be resumed late this year on some of the levels now under water.

Index operation.—The Index mine, which was purchased in 1939, started operations early in 1940. A development campaign was at once started and is being continued in the hope of discovering ore in undeveloped territory. Four sets of lessees are also operating through this shaft and shipping some ore.

During the past year, the company shipped 962 tons with a gross value of $10,706, and the lessees shipped 2,460 tons with a gross value of $15,629. A total of 1,724 feet of drifts, crosscuts, and raises was accomplished by the company and lessees.

Anchoria Leland operation.—Operations upon the Anchoria Leland were very successful during the year. The Anchoria Leland was the only operation to show a profit for the year. Company and lessees shipped a total of 8,554 tons with an average value of $14.54 per ton. A total of 1,175 feet of drifting, crosscutting, and raising was done by the company and lessees with very successful results. The Anchoria Leland shipped a grade of ore considerably higher than the average grade of the district.

The Carlton Tunnel.—This tunnel was started in July of 1939, for the purpose of draining the mines of the district. It will be 32,000 feet in length when it reaches its objective at the Portland No. 2 shaft. All records for speed on driving a tunnel of this size have been broken. The ground through which this tunnel has been driven has been extremely hard, requiring more powder than the ordinary tunnel job, as well as causing a very large consumption of drill steel and bits. Providing no unforeseen difficulties arise or extremely large flows of water are encountered, we should reach the Portland No. 2 shaft in May 1941.

During the year 1940, the Carlton Tunnel was advanced 19,326 feet. On March 1, 1941, the heading was in 28,973 feet from the portal. 1,787 feet was driven in October 1940, which is the greatest monthly footage made to date. 78 feet was the highest footage made in one day.

The average, over-all costs, per foot of tunnel driven since its start is $32.18 per foot. This figure includes all costs, including such items as road building, equipment used, engineering, etc.

The annual report of the United Gold Mines Co., an operating and holding company for property scattered throughout the Cripple Creek district, for the year ended December 31, 1940 (dated February 15, 1941), includes a report of the mine superintendent, which gives the following details on operations at individual mines:

Production of the United Gold Mines Co. reached the highest point in the history of the company during the year 1940, a total of 159,239.44 tons with a gross value of $1,463,544.45. Of this amount over 95 percent, or 149,652.30 tons with a gross value of $1,399,449.15, was accounted for by lessees on the various properties. The following shafts were operated on company account mainly for the accommodation of split-check lessees: The Portland No. 1 and No. 2, Vindicator, Theresa, Rose Nicol, Hull City, and Last Dollar. Some company development work was done on the Theresa and Portland No. 2, but by far the greater part of all work accomplished was accounted for by lessees.

Portland Group.—A disastrous fire in January totally destroyed the Portland No. 1 ore house and stopped the production in this shaft for over 3 months. In planning to rebuild this ore house it was decided to tear down Portland No. 2 ore house, another fire hazard, and build an all-steel ore house at Portland No. 1 to handle the Portland production from both shafts. This program has been completed. All of the Portland buildings have been repaired and painted and the physical condition of the surface plants have all been much improved. Three shafts on the Portland were operated on company account for the accommodation of split-check lessees, namely, the Portland No. 1 and No. 2 and the Last Dollar. There were employed a total of 25 sets of lessees working through these shafts; 10 sets working in other small shafts, making in all, including company employees, about 125 men. The Portland made a very good production during the year despite the fire in January.

Vindicator Group.—The Vindicator and Hull City were operated on company account during the year, while the Glorietta, Anna J., Tateman, and LaBelle were operated by royalty lessees. The Vindicator Group has about 48 sets of lessees, employing in the neighborhood of 153 men, with an additional 30 employed by the company. During the past year lessees produced a considerable tonnage of medium-grade ore from the Logan Tract. Most of the work on company account was done through the Theresa Shaft.

Rose Nicol.—Early in the year the shaft was sunk 100 feet to the 11th level, where extensive development work has been carried on. At the present time, four different bodies of ore are being mined on that level. Two of them being of fairly good grade and the other two low grade. Work through the Cresson Shaft on the 1,700-foot level was suspended about the middle of the year, so that all work now being carried on by the Rose Nicol is through the Rose Nicol Shaft. As in the other properties, lessees account for a large part of the production on this property. Nine sets of lessees are employed upon the property at the present time. They accomplished 3,401 feet of development work during the year. The company accounted for 1,565 feet.

Miscellaneous properties.—Lessees operated many blocks of ground on the various properties owned by the company not included in the above groups. They accounted for a very large share of the production of the United Gold Mines Co.

Production of company ore by United Gold Mines Co. in 1940

Mine	Net tons	Gross value [1]	Company ore cash receipts	Average gross value per ton [1]
Vindicator	2, 634	$11, 488. 67	$3, 782. 28	$4. 36
Rose Nicol	4, 270	37, 055. 31	20, 221. 99	8. 68
Portland	896	7, 427. 24	3, 946. 50	8. 29
Theresa	58	189. 27	24. 51	3. 25
No. 2 Plant	1, 729	7, 934. 81	2, 819. 17	4. 59
	9, 587	64, 095. 30	30, 794. 45	6. 69

[1] Gross value in 1940 is calculated at $32.76 per fine ounce of gold content.

Production of lessee ore of United Gold Mines Co. in 1940

Group	Net tons	Gross value [1]	Royalties received	Lessees' receipts	Average gross value per ton [1]
Vindicator	34, 485	$308, 899. 24	$73, 006. 97	$100, 574. 83	$8. 96
Rose Nicol	7, 387	87, 491. 16	25, 053. 53	27, 878. 31	11. 84
Portland-Last Dollar	36, 584	383, 298. 05	92, 309. 75	133, 562. 42	10. 48
Theresa	10, 566	120, 404. 50	37, 788. 15	34, 432. 70	11. 40
Hull City	6, 753	54, 410. 99	15, 259. 44	13, 925. 12	8. 06
Deadwood group	38, 234	314, 529. 60	22, 723. 55	136, 876. 86	8. 23
Hardwood group	8, 998	72, 052. 45	4, 435. 42	27, 868. 89	8. 01
Londonderry group	3, 897	28, 792. 31	1, 786. 84	10, 998. 22	7. 39
W. P. H. group	2, 748	29, 570. 85	3, 459. 06	12, 936. 78	10. 76
	149, 652	1, 399, 449. 15	275, 822. 71	499, 054. 13	9. 35

[1] Gross value in 1940 is calculated at $32.76 per fine ounce of gold content.

Production of properties of United Gold Mines Co. before and after organization of the company (May 15, 1902) to December 31, 1940

	Net tons	Gross value
Ore mined before consolidation	26, 310	$456, 806. 19
Production under operation of United Gold Mines Co	2, 044, 519	21, 944, 826. 63
Total to Dec. 31, 1940	2, 070, 829	22, 401, 632. 82

The annual report of the Cresson Consolidated Gold Mining & Milling Co. for the 12 months ended December 31, 1940 (dated January 15, 1941), says—

The following is a summary of the development work for the 12 months ending December 31, 1940:

Development

	Feet	Feet
Drifts and crosscuts:		
Company	2, 655	
Hart group	180	
Lessees	1, 311	
		4, 146
Raises and winzes:		
Company	1, 425	
Lessees	807	
		2, 232
		6, 378

The Cresson mine shaft was kept running to full capacity for 11 months during the year. On August 15, it was necessary to close down for 30 days in order to repair part of the shaft. From the collar down to a point 110 feet below, steel and concrete was used. This part of the shaft was in very bad condition and always gave considerable trouble. In addition, 200 feet of timber sets were placed between the 4th and 6th levels. The size and condition of this shaft greatly handicap hoisting ore, besides being very costly to maintain. It is necessary to work a maintenance crew every night in order to keep the shaft in running order.

Due to the shut-down, production was slightly less than the preceding year. Split-check lessees account for more than 50 percent of the ore produced, and every effort is made to encourage leasing on all ground the company does not wish to work.

Development work was continued throughout the year by both the company and lessees. However, the main ore-bearing zone above the water level has been pretty thoroughly prospected, and it is below this level that we must look for new ore in the future. At the present time the company is mining in a large low-grade stope between the 16th and 17th levels, that was opened during the past year. 26 sets of split-check lessees are also operating through the Cresson shaft, and at the present time production is being maintained up to our hoisting capacity.

The Gold Sovereign is still under a royalty lease to Blackwood & Co., who have maintained a good production throughout the year.

A drift has been started by the Cresson Co. from the Empire shaft to drive into the Hart group in order to prospect this ground. This group is located on the north slope of Bull Hill, adjacent to some very productive territory. A large amount of work will be necessary in order to thoroughly develop this ground.

The 32,000-foot Carlton Drainage Tunnel being driven by the Golden Cycle Corporation to the Portland No. 2 shaft has been driven with record-breaking speed during the year and is now in approximately 27,500 feet. It is very possible that it will reach this shaft early this year. After the main tunnel reaches its objective at the Portland No. 2 shaft, it will undoubtedly be necessary for the Cresson Co. to drive, at its own expense, a lateral of about 4,000 feet in order to drain the Cresson ground. This will give us 1,100 feet of additional ground in depth to prospect. It will also permit the sinking of the Cresson shaft and the prospecting of ground which we have been unable to develop. This drainage program is of the utmost importance to the Cresson, as well as other mines in this district, as it will show whether the ore chutes that have been worked above the Roosevelt Tunnel persist at greater depth. Of course, to accomplish this program we must within the next few years spend more money on development than has hitherto before been spent. To a great extent the future life of the mines depends upon whether the ore does go to a greater depth or not.

The average cost per ton shipped by company and the lessees during 1940 was $3.040 on a total of 114,375 tons.

Federal taxes	$0.124
State income taxes	.022
State and county taxes	.105
Capital stock taxes	.009
Social-security taxes	.045
Unemployment compensation insurance	.072
Compensation insurance	.092
Fire insurance	.018
Salaries of officers and directors	.042
Mining operations	2.457
General expense	.054

Production of Cresson Consolidated Gold Mining & Milling Co., 1903 to December 31, 1940

Period	Dry short tons	Gross value	Freight and treatment	Net value
1903 to Dec. 31, 1939	2,848,634	$42,662,297.48	$13,841,979.97	$28,820,317.51
1940:				
Company ore	51,779	[1] 401,542.03	186,829.12	214,712.91
Lessee ore	62,596	[1] 777,334.22	286,298.69	491,035.53
1903 to Dec. 31, 1940	2,963,009	43,841,173.73	14,315,107.78	29,526,065.95

Period	Royalties received by company	Amount paid lessees	Average gross value per ton	Average net value per ton	Dividends
1903 to Dec. 31, 1939			$14.98	$10.12	$13,284,072.50
1940:					
Company ore			[1] 7.75	4.15	97,600.00
Lessee ore	$234,518.08	$256,517.45	[1] 12.42	7.84	
1903 to Dec. 31, 1940			14.80	9.96	[2] 13,381,672.50

[1] Gross value in 1940 is calculated at $32.76, $33.12, and $33.47 per fine ounce of gold content.
[2] Represents 30.52 percent of gross value and 45.32 percent of net value.

Ore shipped in 1940 from mines owned by the Stratton Cripple Creek Mining & Development Co. totaled 32,567 tons, which brought a net return of $190,669 after freight, treatment, hauling, and umpire charges had been deducted. Most of the ore was mined by lessees under the royalty system. Producing mines were the American Eagle, Block 219, Favorite, Logan, Longfellow, Orpha May, Specimen, and War Eagle on Bull Hill and Block 107 and Geneva on Globe Hill. A considerable part of the ore shipped came from dumps.

In approximate order of gold output, the Free Coinage, Empire Lee, Elkton, Acacia, Doctor Jack Pot, New Gold Dollar, Le Clair (Mary McKinney), Mary Nevin, El Paso, and Jerry Johnson properties continued to be important producers in 1940. Cameron Mines, Inc., operated the Cameron and Pinnacle groups and the Cameron flotation mill throughout the year. Company ore treated totaled 28,792 tons, which yielded 1,382 tons of concentrates containing 6,956 ounces of gold and 3,015 ounces of silver. Custom ore milled comprised 2,662 tons of dump rock from the El Paso and Tenderfoot properties. All the concentrates produced were sold to the Leadville smelter. The Kavanaugh 100-ton cyanide leaching plant was in operation about 8½ months and treated 19,895 tons of ore from the Iron Clad group, recovering 1,031 fine ounces of gold and 165 fine ounces of silver. Some of the other producing mines and dumps were the Atlanta, Atlas (Midget Bonanza King), Ben Hur, Black Belle, Buckeye, Cardinal-Great West, Delmonico, Economic Dump, Golden Swan, Hamlet Dexter, Hiawatha, Hoosier, Irving Howbert (Conundrum), Joe Dandy, Katinka-Chicken Hawk, Krug property (Amanda), Moose, Morning Star, Raaler, School Section, Smith Moffat (Victor), Strong, and Wagner (Little Ida).

GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE EASTERN STATES

(MINE REPORT)

By A. J. Martin

SUMMARY OUTLINE

The mine output of gold, silver, and copper in the Eastern States increased and that of lead decreased in both quantity and value in 1940 compared with 1939; the output of zinc, however, varied little in quantity (1-percent decrease) but rose 14 percent in value owing to the advance in average price. Prices of silver, copper, and lead also averaged higher in 1940, and the total value of the recovered output of the five metals amounted to $28,217,995, an increase of 15 percent over 1939 and of 24 percent over 1938 but a decrease of 3 percent from 1937. Zinc represented 86 percent of the total value in 1940, 1939, and 1937 and 84 percent in 1938. The mines producing zinc in 1940 (some of which yielded lead also) are in New Jersey, New York, Tennessee, and Virginia. Copper ranked next to zinc in total value; most of it came from copper mines in Tennessee and North Carolina and the Cornwall magnetite-pyrite-chalcopyrite mine in Pennsylvania. Gold mines in South Carolina, North Carolina, Georgia, Virginia, and Alabama supplied 89 percent of the total gold and 10 percent of the silver; the rest of the gold was a byproduct of iron and copper mining and the rest of the silver a byproduct of copper, zinc-lead, iron, and lead mining. All the large mines and mills that were in operation at the end of 1939 ran steadily throughout 1940, and one medium-size gold mine in North Carolina was reopened September 1 and operated to the end of the year, contributing substantially to the gold output of the Southern Appalachian region.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1936–40

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1936	$35.00	$0.7745	$0.092	$0.046	$0.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052
1940	35.00	[6] .711+	.113	.050	.063

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] 1936–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–40: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464.
[5] $0.67878787.
[6] $0.71111111.

Annual figures for the 5 years ended with 1940 are given in the table that follows. The figures for tonnage of ore sold or treated do not include magnetite ore containing pyrite and chalcopyrite, from which copper, gold, and silver were recovered as byproducts.

Mine production of gold, silver, copper, lead, and zinc in the Eastern States, 1936–40, in terms of recovered metals

Year	Mines producing		Ore sold or treated (short tons)[1]	Gold (lode and placer)[2]		Silver (lode and placer)[3]	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1936	30	47	2,984,659	10,377.10	$363,199	83,350	$64,554
1937	39	40	3,407,883	10,680.90	373,832	106,873	82,667
1938	51	26	3,159,880	19,928.00	697,480	94,945	61,380
1939	47	24	3,409,619	17,414.00	609,490	94,083	63,862
1940	40	18	3,674,815	18,456.00	645,960	102,825	73,120

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Short tons	Value	Short tons	Value	
1936	22,907,700	$2,107,508	5,996	$551,632	161,740	$17,053,710	$20,140,603
1937	24,444,000	2,957,725	5,539	653,602	189,353	24,894,159	28,961,985
1938	21,079,160	2,065,758	7,900	726,800	172,501	19,211,235	22,762,653
1939	21,295,000	2,214,680	6,284	590,696	180,955	21,100,174	24,578,902
1940	25,490,000	2,880,370	4,831	483,100	178,815	24,135,445	28,217,995

[1] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.
[2] Includes placer gold as follows: 1936, 339 ounces; 1937, 632 ounces; 1938, 667 ounces; 1939, 413 ounces; 1940, 452 ounces.
[3] Placer silver did not exceed 39 ounces in any year during the 5-year period.

Gold.—South Carolina was the leading gold-producing State among the Eastern States from 1937 to 1940, inclusive, and most of the gold came from the Haile mine in Lancaster County near Kershaw. In 1940, however, the output of gold in the State decreased 5 percent from 1939. The principal changes in output in other Eastern States in 1940 were increases of 1,448 ounces in North Carolina and 291 ounces in Georgia. The gold from Pennsylvania and Tennessee, as well as a small portion of that from North Carolina, was recovered in the refining of copper bullion. The estimated output of gold in the Southern Appalachian States from 1799 to 1940 is recorded as follows:

Mine production of gold in the Southern Appalachian States, 1799–1940

State	Period	Fine ounces	Value
Alabama	1830–1940	49,458	$1,197,690
Georgia	1830–1940	870,168	18,071,727
Maryland	(1)–1940	6,102	163,940
North Carolina	1799–1940	1,157,115	24,066,288
South Carolina	1829–1940	295,322	$6,740,360
Tennessee	1831–1940	19,811	441,015
Virginia	1828–1940	167,015	3,558,504
Total	1799–1940	2,564,991	54,239,524

[1] Year of first production not recorded.

Silver.—The quantity of silver recovered from ores mined in the Eastern States increased 9 percent in 1940 over 1939. The gain was mostly in silver derived from the copper ores of Tennessee and North Carolina, but that recovered from gold ore in South Carolina, North Carolina, and Georgia also increased. There were small decreases in silver produced from zinc-lead and iron (magnetite-pyrite-chalcopyrite) ores.

Copper.—As the three mines that produced nearly all the copper output of the Eastern States in 1940 are in different States (North Carolina, Pennsylvania, and Tennessee), it is not possible to show the production of each State without disclosing that of individual mines; the combined output of the three States is shown under Tennessee in the following table. The total for the Eastern States increased 20 percent over 1939. Tennessee, the largest producer, gained 31 percent; Pennsylvania, which ranked second, 3 percent; and North Carolina, 36 percent. Mines in Georgia, South Carolina, and North Carolina produced 26,100 pounds of copper from gold ore. Copper ore yielded, in recovered metals, about 0.0004 ounce of gold and 0.06 ounce of silver to the ton of crude ore. Copper concentrates from the magnetite-pyrite-chalcopyrite ore of the Cornwall mine in Pennsylvania contained a little recoverable gold and silver.

Lead.—The lead recovered from mines in the Eastern States in 1940 came chiefly from zinc-lead sulfide ores from the Austinville mine in Virginia and the Balmat in New York and lead carbonate ore from the Embree mine in Tennessee. Some lead was recovered from zinc-lead sulfide and carbonate ores shipped from the Imperial mine in Claiborne County, Tenn., and from zinc-lead carbonate ore taken from an old mine dump in Russell County, Va. Production of recoverable lead totaled 4,831 tons in 1940, a decrease of 1,453 tons from 1939.

Zinc.—From 1935 to 1939, inclusive, mines in the Eastern States produced from 28 to 33 percent (average 31) of the total domestic mine output of zinc; in 1940, however, owing to increased production in the Western and Central States and a small decrease in the Eastern States, the proportion dropped to 27 percent. New Jersey continued to be the largest producer of zinc in the Eastern States, and its output was exceeded in the United States only by that of Oklahoma. Zinc production was higher in New Jersey and Tennessee than in 1939 but lower in New York and Virginia. Zinc ore yielded 76 percent of the total zinc output and zinc-lead ore and copper ore together 24 percent.

MINE PRODUCTION BY STATES

Mine production of gold, silver, copper, lead, and zinc in the Eastern States in 1940, by States, in terms of recovered metals

[For historic gold figures, see p. 317]

State	Mines producing		Ore (short tons)	Gold			Silver		
				Fine ounces		Total value	Fine ounces		Total value
	Lode	Placer		Lode	Placer		Lode	Placer	
Alabama	2		900	5		$175	3		$2
Georgia	7	14	6,963	533	428	33,635	610	20	448
New Jersey	2		556,031						
New York	2		432,219				35,720		25,401
North Carolina	9	3	28,238	1,936	7	68,005	6,479	1	4,608
Pennsylvania	1		(1)	1,840		64,400	13,064		9,290
South Carolina	5	1	126,607	13,059	17	457,660	8,038	9	5,722
Tennessee	7		1,921,618	173		6,055	38,610		27,456
Virginia	5		602,239	458		16,030	271		193
	40	18	[2] 3,674,815	18,004	452	645,960	102,795	30	73,120
Total, 1939	47	24	[2] 3,409,619	17,001	413	609,490	94,048	35	63,862

State	Copper		Lead		Zinc		Total value
	Pounds	Value	Short tons	Value	Short tons	Value	
Alabama							$177
Georgia	25,200	$2,848					36,931
New Jersey					91,406	[3] $13,121,911	[3] 13,121,911
New York			1,973	$197,300	35,686	4,496,436	4,719,137
North Carolina	(4)	(4)					[5] 72,613
Pennsylvania	(4)	(4)					[5] 73,690
South Carolina	800	90					463,472
Tennessee	[4] 25,464,000	[4] 2,877,432	573	57,300	34,796	4,384,296	[6] 7,352,539
Virginia			2,285	228,500	16,927	2,132,802	2,377,525
	25,490,000	2,880,370	4,831	483,100	178,815	24,135,445	28,217,995
Total, 1939	21,295,000	2,214,680	6,284	590,696	180,955	21,100,174	24,578,902

[1] Ore is magnetite-pyrite-chalcopyrite, flotation copper concentrates from which yielded gold, silver, and copper; Bureau of Mines not at liberty to publish figures for ore and copper.
[2] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.
[3] Estimated smelting value of recoverable zinc content of ore after freight, haulage, smelting, and manufacturing charges are added.
[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] Includes also value of copper from North Carolina and Pennsylvania.

MINING INDUSTRY

The total output of ores yielding gold, silver, copper, lead, or zinc in the Eastern States in 1940, excluding the magnetite-pyrite-chalcopyrite ore from Pennsylvania, was 3,674,815 tons—an increase of 8 percent over 1939. The quantity of gold-bearing sand and gravel handled at placer mines using draglines and other mechanical equipment in the Southern Appalachian region was 75,512 cubic yards; in addition, a small quantity of gravel for which figures are not obtainable was sluiced by hand. The gravel handled by machinery averaged 18.2 cents to the cubic yard in gold and silver. The gold ore (most of which was treated by cyanidation) averaged $3.84 to the ton in gold and about $0.07 in silver and copper. The copper, zinc, and zinc-lead ores of the Eastern States yield byproducts (besides gold and silver), the value of which would have to be considered to show the full value of the crude ore mined. Copper-iron ore from Tennessee and zinc-lead-pyrite ore from New York yield pyrite concentrates that are used in the manufacture of sulfuric acid, and sulfuric acid is also made from gases produced in roasting zinc sulfide concentrates from zinc and zinc-lead ores of Tennessee, New York, and Virginia. New Jersey zinc ore yields manganiferous zinc residuum which is converted into spiegeleisen, and zinc ore milled in Tennessee yields a tailing salable for its lime content. The quantity of the various types of ore mined in the Eastern States is shown in the table that follows.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in the Eastern States in 1940, with content in terms of recovered metals

Source	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (short tons)	Zinc (short tons)
Dry and siliceous gold ore	144,877	15,889	10,179	26,100	----------	----------
Copper ore	725,885	275	43,303	[1] 25,463,900	----------	(2)
Magnetite-pyrite-chalcopyrite ore	(3)	1,840	13,064	(1)	----------	----------
Lead ore	8,709	----------	529	----------	518	----------
Zinc ore	1,878,988	----------	----------	----------	----------	136,370
Zinc-lead ore	916,356	----------	35,720	----------	4,313	[2] 42,445
Total, lode mines	[4] 3,674,815	18,004	102,795	25,490,000	4,831	178,815
Total, placers	----------	452	30	----------	----------	----------
	[4] 3,674,815	18,456	102,825	25,490,000	4,831	178,815
Total, 1939	[4] 3,409,619	17,414	94,083	21,295,000	6,284	180,955

[1] Copper from magnetite-pyrite-chalcopyrite ore included with that from copper ore.
[2] Zinc from copper ore included with that from zinc-lead ore; Bureau of Mines not at liberty to publish separate figures.
[3] Bureau of Mines not at liberty to publish separate figures for ore and copper.
[4] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.

METALLURGIC INDUSTRY

All the principal producing base-metal mines in the Eastern States except the Fontana copper mine in North Carolina have concentrating mills at or near the mines, but a considerable tonnage of copper ore is smelted direct and some of the crude zinc ore is shipped to oxide plants. The ore from the Fontana mine is shipped to the Tennessee Copper Co. plant in Tennessee. The methods of treatment used in the various mills and other operating details, including the tonnage and grade of concentrates produced by some of the mills, are given in the Review by States that follows. Most of the concentrates are shipped to smelters operated by the companies that own the mines. The methods of recovering the gold and silver are shown in the following table.

Mine production of gold and silver in the Eastern States in 1940, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
Ore and old tailings amalgamated	10,630	932	361
Ore cyanided	134,096	14,655	9,204
Concentrates smelted	57,596	2,157	87,957
Ore smelted	20,642	260	5,273
Placer	----------	452	30
	----------	18,456	102,825
Total, 1939	----------	17,414	94,083

REVIEW BY STATES

ALABAMA

Only 5 fine ounces of gold and 3 fine ounces of silver were produced in Alabama in 1940. The metals were contained in a small lot of amalgam sold by an individual at Talladega and in several small lots recovered from about 900 tons of old tailings amalgamated at the Gold Log mine in Talladega County. The Hog Mountain mine in Tallapoosa County was idle throughout 1940.

GEORGIA

Gold production in Georgia increased from 670 fine ounces in 1939 to 961 ounces in 1940 and silver from 58 to 630 fine ounces; the State yielded also 25,200 pounds of recoverable copper in 1940 but none in 1939. The gold output in 1940 comprised 392 ounces recovered from ore amalgamated at lode mines and 428 ounces of placer gold, all sold to the New Orleans Mint, and 141 ounces contained in flotation copper concentrates shipped to smelters. Of the six mines that produced 94 percent of the State output of gold during the year, three were placers in White County—the Allison (Dixie Gravel Co.), equipped with a hydraulic elevator; the Ferey Mining Co. placer at Nacoochee, worked with a dragline, trommel screen, and sluices; and the Loud placer, equipped with a dragline and land dredge. The three lode mines among these six were the Hamilton in McDuffie County (ore treated in a 5-stamp amalgamation mill), the Lockhart in Lumpkin County, and the Magruder (or Seminole) in Lincoln County. The Magruder produced, besides gold, all the copper and most of the silver output of the State; the ore (about 3,760 tons) was concentrated by flotation in the 100-ton mill built in 1939 and operated 6 months in 1940, and the concentrates produced totaled 181 tons averaging 0.78 ounce of gold and 3.11 ounces of silver to the ton and 7.1 percent copper and 0.5 percent lead. Part of the concentrates were shipped to the Perth Amboy (N. J.) smelter and part to the Carteret (N. J.) smelter. Other lode properties producing a little gold during the year were the Arnold, Calhoun, and Rex in Lumpkin County and the Russell in Paulding County. Various small placers in Cherokee, Dawson, and Lumpkin Counties yielded some gold, most of which was purchased by dealers at Canton and Dahlonega for shipment to the New Orleans Mint.

MARYLAND

No production of gold or silver was made from mines in Maryland in 1940. The output in 1939 was 71 fine ounces of gold and 2 fine ounces of silver, produced in Montgomery County.

NEW JERSEY

The output of zinc ore in New Jersey in 1940 totaled 556,031 tons containing 91,406 tons of recoverable zinc as metal or in oxide compared with 606,504 and 88,716 tons, respectively, in 1939. The producing mines were the Mine Hill at Franklin and the Sterling Hill at Ogdensburg, both in Sussex County. The ore bodies in these mines are unique in that they are said to be the only ones in the world from which all three of the minerals franklinite, willemite, and zincite are being mined in commercial quantities. The minerals, ore deposits, and mining methods are described in recent publications of the Geological Survey and the Bureau of Mines.[1] In the reduction of the ores the franklinite (an iron-manganese-zinc oxide mineral) is removed from the crushed ore by magnetic separators and the willemite and zincite are concentrated on jigs and tables. The concentrates and some crude ore are shipped to smelters at Palmerton, Pa. Zinc is recovered as metal or in oxide, and a residue high in iron and manganese is converted into spiegeleisen.

New Jersey has a few deposits of copper ore, but none has been worked for many years. At Carteret and Perth Amboy are copper and lead smelters and refineries that treat ores, scrap, byproducts, and bullion from various States and foreign countries.

NEW YORK

The production of silver, lead, and zinc in New York continued in 1940 to come from St. Lawrence County in the northern part of the State. The producing mines were the Balmat about 8 miles southeast of Gouverneur and the Edwards at the town of Edwards about 12 miles northeast of the Balmat. Both mines are owned and operated by the St. Joseph Lead Co. The Balmat ore contains zinc, iron, and lead sulfides, with some silver associated with the lead; it is mined through a 1,300-foot inclined shaft and treated in the 1,000-ton selective flotation plant at the mine. The mill feed in 1940 totaled 316,048 tons of ore; it yielded 3,379 tons of lead concentrates averaging 59.58 percent lead, 46,991 tons of zinc concentrates averaging 56.23 percent zinc, and 72,238 tons of pyrite concentrates averaging 41.53 percent iron and about 50 percent sulfur. The lead concentrates contained considerable silver. The Edwards mine, which produces zinc ore, is opened by a vertical shaft 1,500 feet deep and an inclined shaft from the 1,500- to the 2,100-foot level. The mine is equipped with a 500-ton flotation mill, which treated 116,171 tons of ore and produced 22,678 tons of zinc concentrates assaying 58.33 percent zinc. The concentrates shipped from both mills contained (in terms of recoverable metals) 35,720 ounces of silver, 1,973 tons of lead, and 35,686 tons of zinc compared with an output in 1939 of 37,250 ounces of silver, 2,387 tons of lead, and 36,014 tons of zinc. The Universal Exploration Co. did some development at its Hyatt property near Emeryville and nearly completed construction of a 200-ton flotation mill.

NORTH CAROLINA

Production of gold in North Carolina increased from 495 fine ounces in 1939 to 1,943 in 1940 and that of silver from 3,961 to 6,480 fine ounces. The output of copper from the Fontana copper mine in Swain County—only producer of copper ore in the State during the year—increased 36 percent over 1939. The mine is operated by the North Carolina Exploration Co., which ships the crude ore to the Tennessee Copper Co. at Copperhill, Tenn. The ore contains very small quantities of gold and silver, some of which are recovered as

[1] Palache, Charles, The Minerals of Franklin and Sterling Hill, Sussex County, N. J.: Geol. Survey Prof. Paper 180, 1935, 135 pp.
Jackson, Chas. F., Knaebel, John B., and Wright, C. A., Lead and Zinc Mining and Milling in the United States, Current Practices and Costs: Bureau of Mines Bull. 318, 1935, pp. 44, 134.

byproducts in refining the copper bullion. The gain in gold production was due to reopening of the Condor (old Howie) mine near Waxhaw, Union County. The mine was under development during the first 8 months of the year and in production from September 1 through December; the ore was treated by cyanidation in the Capps mill near Charlotte, Mecklenburg County. The silver recovered from the gold ore treated at this mill and that derived from the Fontana copper ore comprised more than 99 percent of the State output of silver during the year. A little gold was recovered from ore amalgamated at the Nile property in Caldwell County, the Bucro in Franklin County, the Tribro in Halifax County, the Empire in Mecklenburg County, and the Golden Valley in Rutherford County. A 25-ton lot of ore containing 12 ounces of gold, 13 ounces of silver, and 131 pounds of copper was shipped to the Carteret (N. J.) smelter from the Aurum mine in Gaston County. A small lot of bullion and 2 tons of gold concentrates were shipped from the Nicholson mine in Halifax County. The 7 ounces of placer gold produced in the State during the year were recovered by individuals sluicing stream gravel in the vicinity of Morganton, Burke County; Essex, Halifax County; and Bostic, Rutherford County.

PENNSYLVANIA

Gold, silver, and copper are recovered as byproducts of iron mining at the Cornwall mine of the Bethlehem Steel Co. in Lebanon County. The mine is developed by an open pit and three inclined shafts 1,300 feet deep. The ore contains magnetite, and pyrite and chalcopyrite carrying a little gold and silver; it is treated in the company plants at Lebanon, comprising a 6,000-ton magnetic separation plant producing iron concentrates, a 2,000-ton sintering plant for handling the iron concentrates, and a 2,500-ton flotation mill in which the tailings from the magnetic plant are concentrated for the recovery of copper, gold, and silver.

SOUTH CAROLINA

From 1938 through 1940 South Carolina contributed the bulk of the output of gold from the Eastern States. The chief producer was the old Haile mine in the southern part of Lancaster County 3½ miles northeast of Kershaw. The mine is equipped with a 400-ton cyanide plant. The ore is mainly quartz and pyrite; part of that treated in 1940 was mined from open pits and part from underground workings. Operations at the property are described in a recent Bureau of Mines information circular.[2] According to this publication the total production from the mine, 1829 to 1936, inclusive, was 1,046,300 tons of ore yielding, in recovered gold calculated at $20.67 a fine ounce, a net value of $4,492,183. Adding the value of the gold recovered from 1937 to 1940 ($1,319,477 at $35 a fine ounce) makes a total of $5,811,660 in gold recovered from the mine from 1829 through 1940. The value of the silver recovered during the earlier years is not given, but it totaled only $10,902 during the last 4 years. The material treated from 1937 to 1939 (191,089 tons) included some old tailings, but all of that in 1940 (126,261 tons) was crude ore. The quantity of gold recovered in 1940 was 12,861 ounces compared with 13,551 in 1939.

[2] Newton, Edmund, Gregg, D. B., and Mosier, McHenry, Operations at the Haile Gold Mine, Kershaw, S. C.: Bureau of Mines Inf. Circ. 7111, 1940, 42 pp.

In York County, Southern Golds, Ltd., drove 60 feet of drift at the old Terry mine near Smyrna and shipped 63 tons of ore containing 81 ounces of gold, 38 ounces of silver, and 847 pounds of copper to the Carteret (N. J.) smelter. W. K. Hunter, of Hickory Grove, shipped 63 tons of gold ore to the Tennessee Copper Co. smelter at Copperhill, Tenn. In Union County, development was done at the Notts Hill property near Pauline and 120 tons of ore were treated in a 10-stamp amalgamation mill. In Chesterfield County near Jefferson, A. M. Miller worked the Kirkley mine on a small scale, and the Wandalyn Mining Co. recovered some gold from its Brewer placer.

TENNESSEE

The mine production of gold, silver, copper, lead, and zinc in Tennessee increased in 1940 over 1939. The output of zinc (principal metal produced) rose 7 percent and that of copper (second in importance) 31 percent. The gold, most of the silver, and some of the zinc were byproducts of the copper-iron mining, milling, and smelting operations of the Tennessee Copper Co. at Ducktown and Copperhill in Polk County. Important commercial products derived from the copper-iron ores (besides copper bullion and zinc concentrates) included sulfuric acid and copper sulfate manufactured in the company plants and iron sinter sold to blast furnaces in the Birmingham (Ala.) district. The copper bullion is shipped to an electrolytic refinery on the Atlantic seaboard, where the byproduct gold and silver are recovered; the zinc concentrates are shipped to the Donora (Pa.) smelter. In 1940 the company operated the Burra Burra and Eureka mines and the London and Isabella selective flotation mills. The rated capacity of the London mill is 1,350 tons of ore daily and that of the Isabella 850 tons; the tonnages treated during the year averaged less than the capacity of the mills. In addition to the ore from its own mines the company treated considerable copper-iron sulfide ore from the Fontana mine in Swain County, N. C., and a small tonnage of gold ore from a mine in South Carolina.

The principal zinc-producing mines of Tennessee continued to be the Mascot group in Knox County and the Grasselli and Davis groups in Jefferson County. The Mascot and Grasselli groups were operated by the American Zinc Co. of Tennessee, which concentrated the ore from both mines in its 3,800-ton Mascot mill. The mill is equipped with a differential-tension density cone, jigs, and flotation machines. Production from the Mascot mine in 1940 totaled 584,675 tons of ore yielding 25,142 tons of concentrates averaging 60.39 percent zinc, and that of the Grasselli was 328,424 tons yielding 14,848 tons of concentrates averaging 62.03 percent zinc. The Mascot is opened by a 520-foot shaft and an inclined shaft from the 520-foot level to the maximum depth of 850 feet. The Grasselli has two operating shafts and is 350 feet deep. Power-operated scrapers are used in both mines. The Davis group near Jefferson City is owned and operated by the Universal Exploration Co. The company 800-ton flotation mill used for treating sulfide ore was operated at near capacity throughout 1940, but the plant for concentrating carbonate ore remained idle. The average grade of the concentrates shipped in 1940 was 64.632 percent zinc, which is probably higher than that for any other mine in the United States. The Embree Iron Co.

produced lead, zinc, and manganese from its property near Embreeville, which is partly in Washington County and partly in Unicoi County. The output of lead and zinc in 1940 came from Unicoi County. The lead and zinc ores, of which 12,779 tons were produced in 1940, are carbonates and are mined from separate veins. The lead ore is concentrated in a separate plant by jigging and tabling; the zinc ore is treated in the log-washing plant, which is also used at times for treating manganese ore. The Imperial Mining Co. shipped 549 tons of zinc-lead sulfide and carbonate ores from the Imperial mine about 2 miles northwest of Goin, Claiborne County, to the Ozark Smelting & Refining Co. plant at Coffeyville, Kans.

VIRGINIA

Virginia mines produced 458 fine ounces of gold and 271 fine ounces of silver in 1940 compared with 364 and 1,780 ounces, respectively, in 1939. The silver in 1940 was derived from gold ore; none was reported recovered from zinc-lead ore, which yielded 1,396 ounces in 1939. No recoverable copper has been produced in the State since 1938. The peak year of gold production in Virginia since the $35 price for gold was established in January 1934 was 1938, when 2,943 ounces were recovered. Most of the output of gold in 1940 came from the Red Bank mine near Virgilina, Halifax County, which is equipped with a small amalgamation mill; the other gold-producing mines were the London-Virginia near Dillwyn, Buckingham County, and the Ruth in Goochland County.

From 1924 to 1940 the metal output of Virginia comprised chiefly zinc and lead, most of which came from one mine in Wythe County. Production from this mine increased materially after completion of a 750-ton mill in 1927, but the Bureau of Mines was not at liberty to publish the figures from 1928 to 1939 and therefore combined the Virginia figures, which included some zinc from another mine in a few of the years, with those of Tennessee for publication in the tables of this series showing production by States. For 1940, however, the operators of zinc and lead mines in Virginia and Tennessee permit figures reported by them to be published in such a manner as to show the output of each State. The recoverable zinc in concentrates shipped from Virginia mines was 16,927 tons in 1940 and the lead 2,285 tons. Some of the concentrates produced were not shipped during the year; they will be credited to production for the year of shipment. The Austinville zinc-lead mine and 2,000-ton flotation mill of the New Jersey Zinc Co. in Wythe County were operated throughout 1940. The Lacy-Butler Co., while prospecting 12 miles from Castlewood, Russell County, concentrated some zinc-lead carbonate ore from an old dump, using a washer, crusher, and jigs.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN IDAHO

(MINE REPORT)

By G. E. Woodward and Paul Luff

SUMMARY OUTLINE

The total value of the metal output from mines in Idaho was \$37,744,393 in 1940 compared with \$29,794,144 in 1939—an increase of nearly 27 percent (see fig. 1). The quantity and total value of each metal increased; the greatest gain in value was \$3,950,630 in zinc. The value of the gold production represented about 13 percent of the State total, silver 33 percent, copper 2 percent, lead 28 percent, and zinc nearly 24 percent. Production of gold in Idaho in 1940 (146,480 fine ounces) was the largest since 1871, and the output of zinc (141,202,000 pounds) was the largest in any year in the history of the State. Compared with 1939 the gold output increased nearly 26 percent, silver 2 percent, copper 33 percent, lead 15 percent, and zinc 48 percent. The gain in gold output was due chiefly to increased output from old producing lode mines and to new operations of bucket dredges at placer properties; the gain in output of zinc and lead resulted from a marked increase in output of zinc-lead ore from mines in the Coeur d'Alene region caused by the rise in the average sales price of zinc and lead; and the gain in output of silver and copper was due principally to the increase in production of silver-copper ore from the Mineral Point mine near Kellogg.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1936–40

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1936	\$35.00	\$0.7745	\$0.092	\$0.046	\$0.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052
1940	35.00	[6] .711+	.113	.050	.063

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was \$20.67+ (\$20.671835) per fine ounce.
[2] 1936–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–40: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] \$0.64646464. [5] \$0.67878787. [6] \$0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Idaho, 1936–40, and total, 1863–1940, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1936	281	828	1,807,530	80,291.40	$2,810,199	14,537,530	$11,259,317
1937	347	741	2,075,402	81,861.00	2,865,135	19,587,766	15,151,137
1938	305	463	1,999,147	103,513.00	3,622,955	18,993,676	12,278,740
1939	362	465	2,108,445	116,662.00	4,083,170	17,222,370	11,690,336
1940	378	548	2,556,687	146,480.00	5,126,800	17,552,240	12,481,593
1863–1940	--------	--------	(1)	7,479,342.00	164,916,373	452,902,547	310,344,151

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1936	2,954,000	$271,768	182,678,000	$8,403,188	98,200,000	$4,910,000	$27,654,472
1937	4,464,000	540,144	207,422,000	12,237,898	108,398,000	7,045,870	37,840,184
1938	4,278,000	419,244	184,354,000	8,480,284	88,060,000	4,226,880	29,028,103
1939	5,032,000	523,328	181,962,000	8,552,214	95,098,000	4,945,096	29,794,144
1940	6,698,000	756,874	209,668,000	10,483,400	141,202,000	8,895,726	37,744,393
1863–1940	[2] 94,138	29,458,191	[2] 5,413,140	575,970,866	[2] 794,283	106,930,683	1,187,620,264

[1] Figures not available. [2] Short tons.

Gold and silver produced at placer mines in Idaho, 1936–40, in fine ounces, in terms of recovered metals

Year	Sluicing and hydraulic		Drift mining		Dredges						Total	
					Dry-land [1]		Dragline floating [1]		Floating bucket			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1936	[2] 8,331.61	[2] 1,492	(2)	(2)	(2)	(2)	(2)	(2)	26,098.19	9,661	34,429.80	11,153
1937	4,286.00	1,399	433.00	65	2,369.00	325	4,490.00	1,327	28,962.00	9,171	40,540.00	12,287
1938	4,987.00	969	410.00	57	1,989.00	384	15,459.00	5,818	31,234.00	10,100	54,079.00	17,328
1939	5,443.00	1,638	196.00	26	4,475.00	1,332	9,576.00	4,389	28,973.00	7,490	48,663.00	14,875
1940	6,664.00	1,337	291.00	48	5,623.00	758	6,569.00	5,427	41,262.00	10,226	60,409.00	17,796

[1] A floating washing plant supplied with gravel by a dragline excavator is called a "dragline floating dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."
[2] Figures for sluicing and hydraulic include those for drift mining and dry-land and dragline dredging.

Gold.—The output of recoverable gold in Idaho was nearly 26 percent greater in 1940 than in 1939 and was the largest since 1871, when 212,850 ounces were produced. The output of gold from lode mines increased nearly 27 percent over 1939; most of the gain came from gold ore. The output of gold from placers increased 24 percent, owing to larger output from dredging. Approximately 46 percent of the State total in 1940 came from siliceous gold ore and 36 percent from all types of dredging operations. Twelve floating (bucket) dredges—4 more than in 1939—treated 7,941,853 cubic yards of gravel and recovered 41,262 ounces of gold—an increase of 12,289 ounces over 1939; 7 dragline dredges and 15 dry-land dredges treated 1,997,921 cubic yards of gravel and recovered 12,192 ounces of gold—a decrease of 1,859 ounces. Of the total placer gold, 82 percent came from the Boise Basin, Warren, Elk City, Pierce, Hoodoo, Orogrande, Beaver, and Carson districts, where dredges were operated. Of the total lode gold, 81 percent came from the Middle Boise, Yellow Pine, Warm Springs, Burgdorf-Marshall Lake, Carson, Mineral Hill, Ten Mile, Yankee Fork, and Boise Basin districts and the Coeur d'Alene

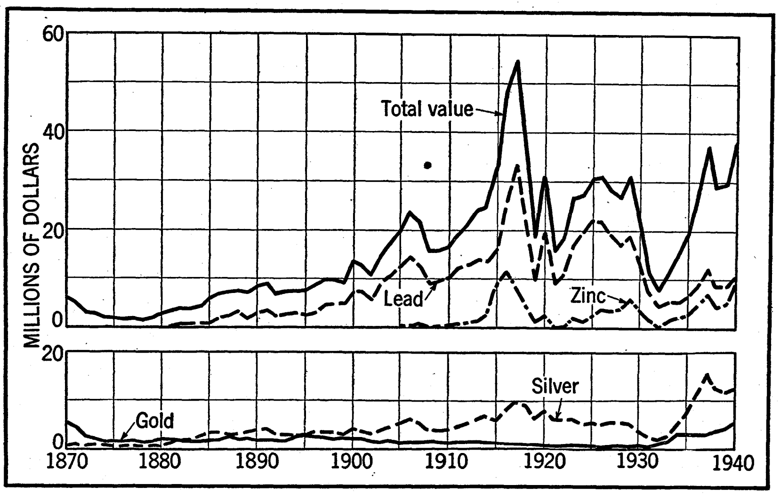

FIGURE 1.—Value of mine production of gold, silver, lead, and zinc and total value of gold, silver, copper, lead, and zinc in Idaho, 1870–1940. The value of copper has been less than $2,000,000 annually, except in a few years.

region. Substantial increases in output of gold were recorded in the Middle Boise, Yellow Pine, Elk City, Boise Basin, Hoodoo, Yankee Fork, and Orogrande districts, but large decreases in the Newsome, Warm Springs, and Burgdorf-Marshall Lake districts.

Talache Mines, Inc., operating lode property at Atlanta, was the largest gold producer in Idaho in 1940. It was followed by the Fisher-Baumhoff Co., which operated two bucket dredges near Centerville; Yellow Pine mine at Stibnite; Triumph mine near Ketchum; Warren Dredging Co. at Warren; Idaho-Canadian Dredging Co. at Idaho City; Golden Anchor mine at Burgdorf; De Lamar Milling Corporation at De Lamar; and Gold Producers, Inc., at Shoup.

Silver.—The output of recoverable silver in Idaho was 17,552,240 fine ounces in 1940—a 2-percent increase over 1939. Production from the Sunshine mine declined 1,230,618 ounces; but increases from the Mineral Point, Bunker Hill & Sullivan, Star, Silver Dollar, Page, Hecla, Tamarack, and Sherman properties more than offset this decrease. The Coeur d'Alene region produced 89 percent of the State total silver in 1940; the rest came chiefly from the Warm Springs, Bayhorse, Carson, Port Hill, Pend d'Oreille, Middle Boise, Blue Wing, and Boise Basin districts. Silver ore yielded 61 percent of the State total silver, zinc-lead ore nearly 31 percent, lead ore 5 percent, and gold-silver ore and gold ore nearly 3 percent. The yield of silver from silver ore decreased 453,502 ounces and from gold-silver ore 458,742 ounces, but that from zinc-lead ore increased 1,146,092 ounces, from gold ore 57,946 ounces, and from lead ore 42,448 ounces.

Eight mines—the Sunshine, Bunker Hill & Sullivan, Morning, Polaris, Hecla, Mineral Point, Triumph, and Page—produced 86 percent of the silver output of the State in 1940. All these mines except the Triumph are in the Coeur d'Alene region.

Copper.—The output of recoverable copper in Idaho in 1940 was 6,698,000 pounds—a 33-percent increase over 1939. The gain resulted chiefly from increased output of silver-copper ore from the Mineral Point mine and from shipments of copper ore from the Empire (Mackay Metals) mine. Silver ore (chiefly from mines in the Coeur d'Alene region) yielded 66 percent of the State total copper, zinc-lead ore 19 percent, copper ore 10 percent, and gold ore and lead ore together 4 percent.

The Sunshine mine produced about one-third of the total copper output of the State in 1940; most of the remainder came from the Mineral Point, Empire, Bunker Hill & Sullivan, Polaris, Triumph, Morning, and Hecla properties.

Lead.—The output of recoverable lead in Idaho was 209,668,000 pounds in 1940—a 15-percent increase over 1939. There were marked increases at the Star, Tamarack, Bunker Hill & Sullivan, Hecla, Sherman, and Page properties, but a large decrease at the Morning mine. More than 91 percent of the State total lead came from the Coeur d'Alene region and 5 percent from the Warm Springs district; considerable lead was produced also in the Port Hill, Bayhorse, and Pend d'Oreille districts. Zinc-lead ore from the Coeur d'Alene region and the Warm Springs district yielded 84 percent of the State total lead; and lead ore, chiefly from the Coeur d'Alene region, yielded 11 percent. Lead recovered from zinc-lead ore increased 27,229,995 pounds and that from lead ore 3,032,882 pounds.

In 1940 the combined lead output of the three largest producers—the Bunker Hill & Sullivan, Morning, and Hecla—was 138,817,322 pounds (135,073,600 pounds in 1939), or 66 percent of the State total; other important producers were the Page, Star, Triumph, Tamarack, Idaho-Continental, Blackhawk, and Dayrock properties.

Zinc.—The output of recoverable zinc in Idaho was 141,202,000 pounds in 1940—a 48-percent increase over 1939. The gain was due chiefly to increased output of zinc from mines in the Coeur d'Alene region; production in the Warm Springs district declined 718,822 pounds. The largest increase (22,023,000 pounds) in zinc output was attained by the Star mine, but substantial increases were made also at the Hecla, Tamarack, Bunker Hill & Sullivan, Page, and Morning properties. More than 89 percent of the State total zinc in 1940 came from the Coeur d'Alene region and nearly all the remainder from the Warm Springs and South Mountain districts. Zinc-lead ore concentrated yielded virtually all the zinc in 1940.

Five mines—the Morning, Star, Bunker Hill & Sullivan, Hecla, and Triumph—produced 82 percent of the State total zinc in 1940; the rest came chiefly from the Tamarack, Page, Frisco, and Interstate-Callahan properties.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1940, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Ada	2	10	74	$2,590	14	$10
Adams	3	4	331	11,585	436	310
Benewah	-	5	23	805	-	-
Blaine	36	1	10,216	357,560	863,235	613,856
Boise	40	80	27,197	951,895	71,467	50,821
Bonner	7	-	10	350	86,009	61,162
Bonneville	-	7	77	2,695	-	-
Boundary	1	-	-	-	96,061	68,310
Butte	3	-	-	-	907	645
Camas	11	5	2,152	75,320	37,177	26,437
Canyon	-	4	7	245	-	-
Cassia	4	-	19	665	263	187
Clark	1	-	-	-	7	5
Clearwater	5	26	3,417	119,595	644	458
Custer	40	11	5,116	179,060	278,467	198,021
Elmore	19	35	18,685	653,975	79,290	56,384
Gem	6	7	1,401	49,035	7,965	5,664
Gooding	-	1	3	105	-	-
Idaho	71	169	37,061	1,297,135	42,196	30,006
Jerome	-	13	289	10,115	24	17
Latah	1	8	2,701	94,535	173	123
Lemhi	43	62	9,487	332,045	85,320	60,672
Lewis	-	5	107	3,745	21	15
Nez Perce	-	5	47	1,645	7	5
Owyhee	25	17	7,694	269,290	248,985	177,056
Power	-	6	19	665	-	-
Shoshone	49	25	6,886	241,010	15,616,852	11,105,317
Twin Falls	-	14	188	6,580	14	10
Valley	8	22	13,225	462,875	20,243	14,395
Washington	3	6	48	1,680	16,463	11,707
	378	548	146,480	5,126,800	17,552,240	12,481,593
Total, 1939	362	465	116,662	4,083,170	17,222,370	11,690,336

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Ada	-	-	-	-	-	-	$2,600
Adams	23,000	$2,599	-	-	-	-	14,494
Benewah	-	-	-	-	-	-	805
Blaine	256,000	28,928	10,139,540	$506,977	14,214,000	$895,482	2,402,803
Boise	4,000	452	62,000	3,100	-	-	1,006,268
Bonner	6,000	678	1,152,000	57,600	-	-	119,790
Bonneville	-	-	-	-	-	-	2,695
Boundary	22,000	2,486	3,673,000	183,650	-	-	254,446
Butte	3,000	339	240	12	-	-	996
Camas	28,000	3,164	208,000	10,400	12,000	756	116,077
Canyon	-	-	-	-	-	-	245
Cassia	115	13	5,760	288	-	-	1,153
Clark	-	-	2,400	120	-	-	125
Clearwater	-	-	-	-	-	-	120,053
Custer	701,885	79,313	2,056,000	102,800	-	-	559,194
Elmore	8,469	957	-	-	-	-	711,316
Gem	4,531	512	29,000	1,450	-	-	56,661
Gooding	-	-	-	-	-	-	105
Idaho	9,000	1,017	27,600	1,380	-	-	1,329,538
Jerome	-	-	-	-	-	-	10,132
Latah	-	-	-	-	-	-	94,658
Lemhi	207,000	23,391	805,000	40,250	-	-	456,358
Lewis	-	-	-	-	-	-	3,760
Nez Perce	-	-	-	-	-	-	1,650
Owyhee	57,000	6,441	226,000	11,300	1,080,000	68,040	532,127
Power	-	-	-	-	-	-	665
Shoshone	5,359,000	605,567	191,218,460	9,560,923	125,896,000	7,931,448	29,444,265
Twin Falls	-	-	-	-	-	-	6,590
Valley	2,000	226	50,000	2,500	-	-	479,996
Washington	7,000	791	13,000	650	-	-	14,828
	6,698,000	756,874	209,668,000	10,483,400	141,202,000	8,895,726	37,744,393
Total, 1939	5,032,000	523,328	181,962,000	8,552,214	95,098,000	4,945,096	29,794,144

Gold and silver produced at lode mines in Idaho in 1940, by counties, in terms of recovered metals

County	Ore sold or treated	Gold	Silver	County	Ore sold or treated	Gold	Silver
	Short tons	*Fine ounces*	*Fine ounces*		*Short tons*	*Fine ounces*	*Fine ounces*
Ada	37	10		Elmore	83,366	18,396	79,214
Adams	442	303	436	Gem	3,896	807	7,889
Blaine	101,657	10,211	863,235	Idaho	42,985	16,648	37,028
Boise	9,957	4,132	65,700	Latah	3	7	7
Bonner	12,888	10	86,009	Lemhi	86,964	6,292	85,050
Boundary	30,000		96,061	Owyhee	66,562	4,966	244,350
Butte	48		907	Shoshone	1,917,235	4,953	15,616,530
Camas	7,867	2,135	37,170	Valley	132,690	12,967	20,129
Cassia	67	19	263	Washington	387	12	16,456
Clark	4		7				
Clearwater	9	29	7		2,556,687	86,071	17,534,444
Custer	59,623	4,174	277,996	Total, 1939	2,108,445	67,999	17,207,495

Gold and silver produced at placer mines in Idaho in 1940, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Drift mining		Dredges: Dry-land [1]		Dredges: Dragline floating [1]		Dredges: Floating bucket		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Ada	64	14									64	14
Adams	28										28	
Benewah	23										23	
Blaine	5										5	
Boise	1,541	353	29	5	88	21			21,407	5,388	23,065	5,767
Bonneville	77										77	
Camas	17	7									17	7
Canyon	7										7	
Clearwater	102	12					425	72	2,861	553	3,388	637
Custer	58	88							884	383	942	471
Elmore	288	76	1								289	76
Gem	20	7					574	69			594	76
Gooding	3										3	
Idaho	2,009	436	202	32	1,675	297	4,041	739	12,486	3,664	20,413	5,168
Jerome	289	24									289	24
Latah	25								2,669	166	2,694	166
Lemhi	1,110	86	37	7	1,049	97	44	8	955	72	3,195	270
Lewis	107	21									107	21
Nez Perce	47	7									47	7
Owyhee	82	22			1,161	74	1,485	4,539			2,728	4,635
Power	19										19	
Shoshone	272	51	19	4	1,642	267					1,933	322
Twin Falls	188	14									188	14
Valley	250	112			8	2					258	114
Washington	33	7	3								36	7
	6,664	1,337	291	48	[2]5,623	[2]758	[3]6,569	[3]5,427	[4]41,262	[4]10,226	60,409	17,796
Total, 1939	5,443	1,638	196	26	4,475	1,332	9,576	4,389	28,973	7,490	48,663	14,875

[1] A floating washing plant supplied with gravel by a dragline excavator is called a "dragline floating dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."
[2] Recovered from 794,821 cubic yards of gravel treated by 15 dry-land dredges.
[3] Recovered from 1,203,100 cubic yards of gravel treated by 7 dragline floating dredges.
[4] Recovered from 7,941,853 cubic yards of gravel treated by 12 floating bucket dredges.

MINING INDUSTRY

Increased activity at both lode and placer mines in Idaho in 1940, which was centered chiefly at properties near Atlanta, Stibnite, Elk City, Idaho City, Harvard, Custer, and Orogrande, resulted in the largest total output of gold in the State since 1871. The average sales price of zinc rose from 5.2 to 6.3 cents a pound, resulting in a large increase in the output of zinc-lead ore. The production of zinc in 1940 was by far the largest in the history of the State; there were also substantial increases in the output of copper and lead, but the output of silver increased only 2 percent.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Idaho in 1940, with content in terms of recovered metals

Source	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold ore	215	354,785	67,243	217,516	156,896	264,721	------------
Dry and siliceous gold-silver ore	25	63,727	6,226	264,201	13,388	95,929	------------
Dry and siliceous silver ore	34	460,481	652	10,787,758	4,432,055	1,666,140	------------
	[1] 270	878,993	74,121	11,269,475	4,602,339	2,026,790	------------
Copper ore	15	4,931	597	17,762	695,365	1,549	------------
Lead ore	72	164,508	658	867,066	110,134	22,183,303	------------
Lead-copper ore	1	232	------------	20,898	12,433	51,170	------------
Zinc ore	2	101	1	79	------------	------------	37,825
Zinc-lead ore	36	1,507,922	10,694	5,359,164	1,277,729	185,405,188	141,164,175
Total, lode mines	[1] 378	2,556,687	86,071	17,534,444	6,698,000	209,668,000	141,202,000
Total, placers	548	------------	60,409	17,796	------------	------------	------------
	926	2,556,687	146,480	17,552,240	6,698,000	209,668,000	141,202,000
Total, 1939	827	2,108,445	116,662	17,222,370	5,032,000	181,962,000	95,098,000

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

METALLURGIC INDUSTRY

Of the 2,556,687 tons of ore produced in 1940 in Idaho, 2,368,572 tons (93 percent) were treated at concentration plants, 142,457 tons (5 percent) were treated at amalgamation and cyanidation mills, and 45,658 tons (2 percent) were shipped crude to smelters.

Ore treated at concentration plants in 1940 comprised 202,967 tons of gold ore, 61,210 tons of gold-silver ore, 445,584 tons of silver ore, 160 tons of copper ore, 150,628 tons of lead ore, 101 tons of zinc ore, and 1,507,922 tons of zinc-lead ore.

Ore treated at straight amalgamation mills in 1940 comprised 4,026 tons, yielding 1,603 ounces of gold and 628 ounces of silver. Ore treated at combined amalgamation and concentration plants comprised 123,126 tons, yielding 18,138 ounces of gold and 10,407 ounces of silver in amalgamation bullion and 2,044 tons of concentrates containing 13,848 ounces of gold, 131,171 ounces of silver, and some copper and lead. About 800 pounds of quicksilver were consumed at amalgamation plants in Idaho.

Ore (15,305 tons) treated at straight cyanidation plants in 1940 yielded 2,228 ounces of gold and 4,607 ounces of silver; the plants used about 27,000 pounds of sodium cyanide (91-percent grade), 5,000 pounds of zinc dust, 5,000 pounds of zinc shavings, 125,000 pounds of lime, and 950 pounds of lead acetate.

The lead smelter and refinery of the Bunker Hill & Sullivan Mining & Concentrating Co. at Bradley were operated continuously in 1940 on ore and concentrates, chiefly from the Bunker Hill & Sullivan, Hecla, Sunshine, Polaris, and Crescent mines. The company early in the year completed building a plant designed to recover antimony and bismuth from concentrates produced at mills in the "Dry-Belt" section of the Coeur d'Alene region to eliminate these metals from regular lead-smelting operations; the new plant operated intermittently throughout the year. The electrolytic zinc plant of the Sullivan Mining Co. near Bradley operated throughout the year at a greatly increased rate, chiefly on zinc concentrates from the Bunker Hill & Sullivan, Star, and Hecla mills.

Details of the treatment of all ores produced in Idaho in 1940 are given in the tables that follow.

Mine production of metals in Idaho in 1940, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore amalgamated	127, 152	19, 741	11, 035	-----	-----	-----
Ore cyanided	15, 305	2, 228	4, 607	-----	-----	-----
Concentrates smelted	336, 004	55, 618	16, 783, 767	5, 852, 534	199, 567, 204	141, 202, 000
Ore smelted	45, 658	8, 484	735, 035	845, 466	10, 100, 796	-----
Placer	-----	60, 409	17, 796	-----	-----	-----
	-----	146, 480	17, 552, 240	6, 698, 000	209, 668, 000	141, 202, 000
Total, 1939	-----	116, 662	17, 222, 370	5, 032, 000	181, 962, 000	95, 098, 000

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Idaho in 1940, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Material treated	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pound*
Ada	36	8	-----	1	1	-----	-----	-----
Blaine	50	18	7	4	7	8	-----	-----
Boise	2, 170	1, 016	411	13	51	167	-----	-----
Camas	75	30	10	-----	-----	-----	-----	-----
Clearwater	7	8	2	-----	-----	-----	-----	-----
Custer	12, 046	1, 382	1, 522	164	1, 429	31, 010	-----	-----
Elmore	79, 847	8, 857	5, 441	1, 515	9, 041	72, 165	8, 469	-----
Idaho	24, 395	8, 087	3, 553	214	2, 804	26, 526	5, 602	5, 400
Latah	3	7	7	-----	-----	-----	-----	-----
Lemhi	7, 788	212	45	109	382	1, 120	105, 602	-----
Owyhee	11	7	8	2	4	97	-----	-----
Shoshone	684	104	29	21	123	78	-----	1, 900
Washington	40	5	-----	1	6	-----	-----	-----
	127, 152	19, 741	11, 035	2, 044	13, 848	131, 171	119, 673	7, 300
Total, 1939	111, 480	18, 008	9, 821	1, 572	9, 912	84, 330	302, 485	15, 225

Mine production af metals from amalgamation and cyanidation mills (with or without concentration equipment) in Idaho in 1940, by types of mills and by counties, in terms of recovered metals—Continued

CYANIDATION MILLS

County	Material treated	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Adams	350	277	100	--------	--------	--------	--------	--------
Blaine	8,520	941	3,863	--------	--------	--------	--------	--------
Cassia	15	4	--------	--------	--------	--------	--------	--------
Elmore	640	72	76	--------	--------	--------	--------	--------
Idaho	1,180	180	95	--------	--------	--------	--------	--------
Lemhi	4,600	754	473	--------	--------	--------	--------	--------
	15,305	2,228	4,607	--------	--------	--------	--------	--------
Total, 1939	10,418	1,559	3,071	--------	--------	--------	--------	--------
Grand total: 1940	142,457	21,969	15,642	2,044	13,848	131,171	119,673	7,300
1939	121,898	19,567	12,892	1,572	9,912	84,330	302,485	15,225

Mine production of metals from concentrating mills in Idaho in 1940, by counties, in terms of recovered metals

County	Ore treated	Concentrates smelted and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Blaine	92,004	35,465	8,837	849,119	249,481	10,080,077	14,214,000
Boise	6,850	171	911	4,346	227	28,154	--------
Bonner	12,520	824	3	53,955	2,100	910,578	--------
Boundary	30,000	2,595	--------	96,061	22,000	3,673,000	--------
Camas	97	20	2	1,176	--------	3,407	12,000
Custer	39,775	1,400	74	109,659	14,555	1,718,598	--------
Elmore	2,681	12	70	1,031	--------	--------	--------
Gem	3,772	765	752	6,826	4,531	26,430	--------
Idaho	17,112	241	5,226	6,474	3,398	22,200	--------
Lemhi	73,296	2,286	4,387	68,651	83,415	214,775	--------
Owyhee	66,131	2,553	4,513	236,372	52,550	225,345	1,080,000
Shoshone	1,891,905	283.063	4,415	15,202,626	5,299,962	182,647,595	125,896,000
Valley	132,429	4,565	12,580	16,300	642	9,745	--------
	2,368,572	333,960	41,770	16,652,596	5,732,861	199,559,904	141,202,000
Total, 1939	1,919,136	245,249	23,247	15,810,839	4,373,594	167,766,047	95,019,886

Gross metal content of concentrates produced from ores mined in Idaho in 1940, by classes of concentrates smelted

Class of concentrates	Concentrates produced	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	8,173	36,445	132,006	28,267	105,536	--------
Dry gold-silver	727	5,697	205,673	--------	--------	--------
Dry silver	814	5	46,035	21,807	14,060	--------
Copper	12,274	773	9,316,996	4,510,434	444,989	--------
Lead	148,629	4,530	5,366,809	1,086,698	197,896,413	17,706,297
Lead-copper	2,572	156	1,100,303	313,834	376,000	--------
Zinc	148,813	1,564	571,443	544,913	9,171,255	158,056,027
Zinc-lead	127	1	1,274	--------	23,375	116,993
Dry iron (from zinc-lead ore)	13,875	6,447	43,228	43,408	335,648	795,748
	336,004	55,618	16,783,767	6,549,361	208,367,276	176,675,065
Total, 1939	246,821	33,159	15,895,169	5,324,780	174,384,396	120,076,935

Mine production of metals from Idaho concentrates shipped to smelters in 1940, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ada	1	1	----------	----------	----------	----------
Blaine	35,469	8,844	849,127	249,481	10,080,077	14,214,000
Boise	184	962	4,513	227	28,154	----------
Bonner	824	3	53,955	2,100	910,578	----------
Boundary	2,595	----------	96,061	22,000	3,673,000	----------
Camas	20	2	1,176	----------	3,407	12,000
Custer	1,564	1,503	140,669	14,555	1,718,598	----------
Elmore	1,527	9,111	73,196	8,469	----------	----------
Gem	765	752	6,826	4,531	26,430	----------
Idaho	455	8,030	33,000	9,000	27,600	----------
Lemhi	2,395	4,769	69,771	189,017	214,775	----------
Owyhee	2,555	4,517	236,469	52,550	225,345	1,080,000
Shoshone	283,084	4,538	15,202,704	5,299,962	182,649,495	125,896,000
Valley	4,565	12,580	16,300	642	9,745	----------
Washington	1	6	----------	----------	----------	----------
	336,004	55,618	16,783,767	5,852,534	199,567,204	141,202,000
Total, 1939	246,821	33,159	15,895,169	4,676,079	167,781,272	95,019,886

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
Dry gold	8,173	36,445	132,006	25,311	79,069	----------
Dry gold-silver	727	5,697	205,673	----------	----------	----------
Dry silver	814	5	46,035	17,445	12,900	----------
Copper	12,274	773	9,316,996	4,138,217	390,120	----------
Lead	148,629	4,530	5,366,809	876,891	189,972,757	----------
Lead-copper	2,572	156	1,100,303	256,459	339,740	----------
Zinc	148,813	1,564	571,443	496,151	8,527,802	141,099,000
Zinc-lead	127	1	1,274	----------	21,750	103,000
Dry iron (from zinc-lead ore)	13,875	6,447	43,228	42,060	223,066	----------
	336,004	55,618	16,783,767	5,852,534	199,567,204	141,202,000

Gross metal content of Idaho crude ore shipped to smelters in 1940, by classes of ore

Class of ore	Ore	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold	9,212	5,272	30,447	26,698	230,593	----------
Dry and siliceous gold-silver	2,661	2,133	90,972	18,002	133,951	----------
Dry and siliceous silver	14,902	105	260,171	71,862	796,944	----------
Copper	4,771	573	17,746	707,722	1,997	----------
Lead	13,880	401	314,801	57,960	9,478,291	----------
Lead-copper	232	----------	20,898	14,627	53,524	----------
	45,658	8,484	735,035	896,871	10,695,300	----------
Total, 1939	67,411	15,273	1,299,434	398,153	15,247,934	89,378

Mine production of metals from Idaho crude ore shipped to smelters in 1940, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ada	1	1	----------	----------	----------	----------
Adams	92	26	336	23,000	----------	----------
Blaine	1,083	408	10,238	6,519	59,463	----------
Boise	937	2,154	60,776	3,773	33,846	----------
Bonner	368	7	32,054	3,900	241,422	----------
Butte	48	----------	907	3,000	240	----------
Camas	7,695	2,103	35,984	28,000	204,593	----------
Cassia	52	15	263	115	5,760	----------
Clark	4	----------	7	----------	2,400	----------
Clearwater	2	21	5	----------	----------	----------
Custer	7,802	1,289	135,805	687,330	337,402	----------
Elmore	198	356	501	----------	----------	----------
Gem	124	55	1,063	----------	2,570	----------
Idaho	298	351	380	----------	----------	----------
Lemhi	1,280	557	14,761	17,983	590,225	----------
Owyhee	420	442	7,873	4,450	655	----------
Shoshone	24,646	311	413,797	59,038	8,568,965	----------
Valley	261	387	3,829	1,358	40,255	----------
Washington	347	1	16,456	7,000	13,000	----------
	45,658	8,484	735,035	845,466	10,100,796	----------
Total, 1939	67,411	15,273	1,299,434	355,921	14,180,728	78,114

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous gold	9,212	5,272	30,447	24,668	147,308	----------
Dry and siliceous gold-silver	2,661	2,133	90,972	13,388	96,069	----------
Dry and siliceous silver	14,902	105	260,171	63,096	729,458	----------
Copper	4,771	573	17,746	685,734	1,549	----------
Lead	13,880	401	314,801	46,147	9,075,242	----------
Lead-copper	232	----------	20,898	12,433	51,170	----------
	45,658	8,484	735,035	845,466	10,100,796	----------

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1940, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Ada County:													
Black Hornet	2		37	10		10							$350
Boise		1			4	4							140
Highland (Boise River)		8			49	49		14	14				1,725
Snake River		1			11	11							385
Adams County:													
Rock Flat (Thorn Creek)		1			20	20							700
Seven Devils	3		442	303		303	436		436	23,000			13,514
Snake River		3			8	8							280
Benewah County:													
Tyson Creek (Camas Cove)		5			23	23							805
Blaine County:													
Mineral Hill and Camas	23		9,505	1,264		1,264	9,817		9,817	6,327	35,900	6,302	54,128
Sawtooth (Vienna)	3		102	60		60	2,752		2,752		3,200		4,217
Warm Springs	10	1	92,050	8,887	5	8,892	850,666		850,666	249,673	10,100,440	14,207,698	2,344,458
Boise County:													
Banner	1	3	40	1	8	9	3,780		3,780	106			3,015
Boise Basin	26	59	6,242	2,754	22,990	25,744	58,815	5,760	64,575	3,292	56,040		950,134
Boise River (Twin Springs)		4			16	16							560
Eight Mile Creek	1		2,389	705		705	502		502	239	900		25,104
Garden Valley		4			15	15							525
Grimes Pass	5		96	67		67	803		803	239	4,900		3,188
North Fork	1		33				1,523		1,523	124	160		1,105
South Fork of Payette River		10			36	36		7	7				1,265
Summit Flat	6		1,157	605		605	277		277				21,372
Bonner County:													
Lakeview	1		8				585		585	53	1,420		493
Pend d'Oreille	6		12,880	10		10	85,424		85,424	5,947	1,150,580		119,297
Bonneville County:													
Mt. Pisgah		4			69	69							2,415
South Fork of Snake River		3			8	8							280
Boundary County: Port Hill	1		30,000				96,061		96,061	22,000	3,673,000		254,446
Butte County:													
Antelope Creek	1		38				668		668	3,000			814
Lava Creek	2		10				239		239		240		182
Camas County:													
Beaver Creek (Mineral Hill)	2		6,224	1,709		1,709	19,724		19,724	16,823	141,500		82,817
Little Smoky and Carrietown	5	3	1,479	77	14	91	17,266	7	17,273	11,177	66,500	12,000	20,812
Skeleton Creek	4		164	349		349	180		180				12,343
South Fork of Boise River		2			3	3							105

Canyon County: Snake River		4			7	7							245
Cassia County:													
Blackpine	2		36	4		4	180		180	71	420		297
Stokes	2		31	15		15	83		83	44	5, 340		856
Clark County: Birch Creek	1		4				7		7		2, 400		125
Clearwater County:													
Burnt Creek		3			15	15							525
Clearwater River		2			11	11							385
Moose Creek and Independence Creek		5			9	9							315
North Fork of Clearwater River		4			9	9							315
Pierce	5	12	9	29	3, 344	3, 373	7	637	644				118, 513
Custer County:													
Alder Creek	6		4, 657	528		528	13, 853		13, 853	637, 646	84, 280		104, 599
Bayhorse	10	1	40, 393	39	1	40	194, 407		194, 407	60, 177	1, 869, 280		239, 909
Boulder	1		81	1		1	1, 035		1, 035		37, 180		2, 630
East Fork	1		1	6		6							210
Loon Creek		1			2	2							70
Rough Creek		1			1	1							35
Seafoam	8		120	50		50	2, 617		2, 617	124	7, 760		4, 013
Stanley and Stanley Basin	2	3	2, 057	438	31	469	27, 121	14	27, 135	1, 540	56, 900		38, 730
Yankee Fork	12	5	12, 314	3, 112	907	4, 019	38, 963	457	39, 420	2, 398	600		168, 998
Elmore County:													
Bear Creek	9	4	1, 367	137	9	146	104		104				5, 184
Black Warrior	1		2	13		13	7		7				460
Boise River (Twin Springs)		12			162	162		45	45				5, 702
Middle Boise	6	14	81, 988	18, 239	104	18, 343	78, 975	31	79, 006	8, 469			699, 144
Neal	1		2	3		3							105
Pine Grove	1		1	2		2	7		7				75
Snake River		5			14	14							490
Volcano	1		6	2		2	121		121				156
Gem County: West View	6	7	3, 896	807	594	1, 401	7, 889	76	7, 965	4, 531	29, 000		56, 661
Gooding County: Snake River		1			3	3							105
Idaho County:													
American, Bully, and Castle Creeks		2			12	12							420
Burgdorf-Marshall Lake	9	9	16, 714	8, 165	427	8, 592	28, 177	76	28, 253	1, 841	5, 400		321, 289
Camp Howard (Salmon River)		20			373	373		66	66				13, 102
Clearwater River (Pardee)		4			28	28		7	7				985
Dixie	10	16	1, 428	437	483	920	270	90	360				32, 456
Elk City	12	26	2, 685	759	6, 980	7, 739	509	1, 336	1, 845				272, 177
Florence and French Creek	3	25	41	53	150	203	31	52	83				7, 164
Kitchen Creek		1			11	11							385
Lolo Creek		1			3	3							105
Lower Salmon River		5			74	74		14	14				2, 600

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1940, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Idaho County—Continued.													
Maggie and Pete King Creeks	1	3	1	1	12	13		7	7				$460
Newsome		2			1,014	1,014		204	204				35,635
Orogrande	4	6	8,288	1,973	1,970	3,943	1,852	405	2,257	575	9,100		140,130
Ramey Ridge	3		1,145	575		575	540		540	3,761			20,934
Riggins		1			33	33		7	7				1,160
Robbins (Buffalo Hump)	3		913	910		910	1,291		1,291	1,186	9,300		33,367
Salmon River (Shoup)		5			68	68		17	17				2,392
Selway River		1			5	5							175
Simpson (Salmon River)		17			133	133		17	17				4,667
Snake River		6			121	121		21	21				4,250
South Fork of Clearwater River (Harpster)		2			4	4							140
Ten Mile	12	6	10,534	3,115	29	3,144	3,676	7	3,683	1,637	3,800		113,034
Warren	14	11	1,236	660	8,483	9,143	682	2,842	3,524				322,511
Jerome County: Snake River		13			289	289		24	24				10,132
Latah County:													
Gold Creek	1	3	3	7	8	15	7		7				530
Hoodoo		3			2,672	2,672		166	166				93,638
Moscow Mountain		2			14	14							490
Lemhi County:													
Blackbird	2		380	195		195	128		128	17,345			8,876
Blue Wing	1		41,946	15		15	65,707		65,707	72,000	194,000		65,086
Boyle Creek	1		1	6		6	14		14				220
Eldorado	1	1	11	5	1	6	128		128	4,956			861
Eureka	7	6	723	215	986	1,201	329	76	405	814	5,960		42,713
Gibbonsville (Dahlonega)	6	14	166	161	798	959	315	52	367	1,133	1,280		34,018
Indian Creek	1		900	221		221	14		14	248			7,773
Junction	2		3				45		45		2,320		148
Kirtley Creek		4			36	36		7	7				1,265
McDevitt	1		7,085	403		403	1,118		1,118	105,531			26,825
Mackinaw	3	18	49	31	1,209	1,240	90	114	204		460		43,568
Mineral Hill	3	9	28,314	3,619	29	3,648	2,527		2,527	1,044	20,500		130,620
Parker Mountain	1		8	22		22	121		121				856
Pratt Creek and Sandy Creek	1		2	1		1							35
Salmon River		4			122	122		21	21				4,285
Spring Mountain	4		55				443		443	354	36,940		2,202
Texas	7		5,366	788		788	13,725		13,725	3,000	543,540		64,856
Yellow Jacket	2	6	1,955	610	14	624	346		346	575			22,151
Lewis County:													
Clearwater River (Kamiah)		1			2	2							70
Salmon River		4			105	105		21	21				3,690

Nez Perce County: Snake River		5			47	47		7	7				1,650
Owyhee County:													
Carson or French	19	7	61,541	4,693	1,512	6,205	179,543	4,559	184,102				348,092
Castle Creek	3		45	10		10	1,440		1,440		140		1,381
Snake River		7			1,203	1,203		76	76				42,159
South Mountain	1		4,961	251		251	63,194		63,194	57,000	225,860	1,080,000	139,497
Steele	2	3	15	12	13	25	173		173				998
Power County: Snake River		6			19	19							665
Shoshone County:													
Beaver	7	14	39,475	499	1,770	2,269	66,960	291	67,251	23,575	2,202,540	2,756,159	413,667
Coeur d'Alene	1	3	2	5	58	63		14	14				2,215
Eagle	1		1,202	1		1	997		997		245,700	16,460	14,066
Evolution	5		390,887	532		532	10,326,593		10,326,593	4,244,699	717,100		7,877,481
Hunter	11		621,316	449		449	1,522,523		1,522,523	353,195	64,696,760	65,529,127	8,501,482
Lelande	7		268,765	341		341	1,252,350		1,252,350	266,053	42,448,940	18,036,746	4,191,321
Placer Center	3		66,339	142		142	193,012		193,012	52,717	8,146,280	8,378,000	1,083,308
St. Joe		4			13	13							455
Summit	3	4	8,686	2,200	92	2,292	1,499	17	1,516	2,292	70,740	26,968	86,793
Yreka	11		520,563	784		784	2,252,596		2,252,596	416,469	72,690,400	31,152,540	7,273,477
Twin Falls County: Snake River		14			188	188		14	14				6,590
Valley County:													
Big Creek	1	3	153	279	18	297	1,087		1,087	1,416	19,700		12,313
Deadwood Basin	2	4	4	6	6	12	76		76		300		489
Gold Fork		2			2	2							70
Lake City		2			23	23							805
Middle Fork of Salmon River		1			1	1							35
Pistol Creek	1		221	255		255	3,029		3,029	425	30,000		12,627
South Fork of Salmon River		7			88	88		24	24				3,097
Thunder Mountain	2	3	14	25	120	145	45	90	135	159			5,189
Yellow Pine	2		132,298	12,402		12,402	15,892		15,892				445,371
Washington County:													
Monroe Creek (Weiser)	1		40	11		11							385
Snake River		6			36	36		7	7				1,265
Washington (Mineral Creek)	2		347	1		1	16,456		16,456	7,000	13,000		13,178
Total Idaho	378	548	2,556,687	86,071	60,409	146,480	17,534,444	17,796	17,552,240	6,698,000	209,668,000	141,202,000	37,744,393

ADA COUNTY

Black Hornet district.—Small lots of gold ore from the Adelmann Brothers and Black Hornet mines were treated by amalgamation.

Highland (Boise River) district.—Small-scale placer operators along the Boise River recovered 49 fine ounces of gold and 14 fine ounces of silver in 1940.

Snake River district.—The only production in the Snake River district of Ada County in 1940 was cleanings from a dry-land washing plant. The Osborn and Hot Shot properties near Grand View were idle.

ADAMS COUNTY

Rock Flat (Thorn Creek) district.—Birdwell Bros. recovered a little gold from the Victory placer by hydraulicking in 1940.

Seven Devils district.—Gold ore from the Placer Basin mine treated by cyanidation in the Smith Mountain custom mill and copper ore from the Helena and South Peacock properties comprised the output of the Seven Devils district in 1940.

Snake River district.—Placer operators recovered a little gold in 1940 by sluicing at claims along the Snake River.

BENEWAH COUNTY

The output of Benewah County in 1940, as usual, was placer gold recovered by sluicing stream gravel from Tyson Creek.

BLAINE COUNTY

Mineral Hill and Camas district.—The value of the metal output of the Mineral Hill and Camas district was $54,128 in 1940, a 29-percent gain over 1939.

Sawtooth (Vienna) district.—Lessees shipped crude gold and gold-silver ore from the Vienna mine. High-grade silver ore was shipped from the Pilgrim and Silver King properties.

Warm Springs district.—With the exception of the Coeur d'Alene region, the Warm Springs district was the most important producing area in Idaho in 1940, although the value of its metal production decreased 9 percent from 1939. The chief output was, as usual, zinc-lead-silver ore from the Triumph-North Star-Independence groups operated the first quarter of the year by Snyder Mines, Inc., and the remainder by the Triumph Mining Co.

BOISE COUNTY

Banner district.—Small lots of high-grade silver ore were produced in 1940 from the Banner mine, and placer gold was recovered from claims on Crooked River, Gold Fork, and Edna Creek.

Boise Basin district (Centerville, Placerville, Idaho City, Pioneerville, Quartzburg).—In 1940 the Boise Basin district remained the chief gold-producing area in Idaho, and its output was 19 percent greater than in 1939. About 89 percent of the gold was recovered from placer operations, mostly by bucket dredges. The Fisher-Baumhoff Co., operating two bucket dredges, was the largest producer of placer gold; it was followed by the Idaho-Canadian Dredging Co. and The Grimes

Co. (operations suspended June 1), both using bucket dredges. An aggregate of 4,277,746 cubic yards of gravel was washed, from which 21,407 ounces of gold were recovered.

Boise River (Twin Springs) district.—Placer gold was recovered in 1940 by sluicing, chiefly at the Little Wonder and Last Chance claims near Twin Springs.

Eight Mile Creek district.—The Birthday mine near Lowman was operated throughout the year by Birthday Consolidated Gold Mines, Inc.; 2,131 tons of gold ore were concentrated, and 258 tons of crude ore were shipped to a smelter.

Garden Valley district.—Placer operators recovered gold from claims near Garden Valley; the chief producer was the Wash Creek property.

Grimes Pass district.—Sun Gold Mines, Inc., operated the J. S. mine near Grimes Pass in 1940 and shipped 57 tons of gold ore to a smelter in Utah. The remainder of the district output was mostly ore from the Golden Wave, Independence, and Grimes Pass properties.

North Fork district.—The output from the North Fork district in 1940 was silver ore from the Packer John claim near Smiths Ferry.

South Fork of Payette River district.—Placer gold and silver were recovered by hydraulicking and sluicing in 1940, chiefly at the Mary Antonette and Treasury No. 1 properties.

Summit Flat district.—The greater output of gold in 1940 from the Summit Flat district resulted from increases at the King, Rock Creek, and San Cristobal mines. The most important producer was the King mine, from which gold ore was treated by amalgamation.

BONNER COUNTY

Lakeview district.—A small lot of silver-lead ore was produced in 1940 from the Hewer mine.

Pend d'Oreille district.—The value of the metal output of the Pend d'Oreille district was nearly 18 percent greater than in 1939, owing to increased output of silver-lead ore from the Whitedelf mine near Clark Fork.

BONNEVILLE COUNTY

Mt. Pisgah district.—The Rosana, Lottie, McCoy Creek, and Lucky Strike placer claims were operated in 1940, and 69 fine ounces of gold were recovered by hydraulicking.

South Fork of Snake River district.—Placer gold was recovered by sluicing in 1940 at claims near Heise.

BOUNDARY COUNTY

The production from Boundary County in 1940 was 30,000 tons of silver-lead ore treated in the 70-ton flotation mill of the Idaho-Continental Mining Co.

BUTTE COUNTY

Antelope Creek district.—One car of crude copper ore was shipped in 1940 from the Copper Queen mine.

Lava Creek district.—A little silver ore from the Hub mine and lead ore from the Cactus Queen were produced in 1940.

CAMAS COUNTY

Beaver Creek (Mineral Hill) district.—The value of the metal output of the Beaver Creek district increased from $6,625 in 1939 to $82,817 in 1940 as a result of the large increase in output of gold ore from the Princess-Blue Ribbon mine near Fairfield; shipments of crude ore by the Royal Mining Corporation, Ltd., and by lessees aggregated 6,204 tons.

Little Smoky and Carrietown district.—There was a substantial rise in value of metal output in the Little Smoky and Carrietown district in 1940 owing to increased output of silver ore from the Silver Star mine and to shipments of gold-silver ore from the Grant mine.

Skeleton Creek district.—Virtually all the output of the Skeleton Creek district in 1940 was high-grade gold ore from the Red Horse mine and old mill cleanings from the El Oro mill.

CANYON COUNTY

A little placer gold was recovered by sluicing along the Snake River near Melba. The dry-land dredge operated near Wilder in 1939 by J. R. Rhodes was removed late in that year.

CASSIA COUNTY

Blackpine district.—A little silver ore was produced in 1940 from the Joveon & Busy Bee group and some gold ore from the Virginia mine.

Stokes district.—Gold ore was shipped from the Golden Eagle mine in 1940 and lead ore from the Lucky Strike claim.

CLEARWATER COUNTY

Burnt Creek district.—Nearly all the output in the Burnt Creek district in 1940 was placer gold from the Frank Bish claim near Elk River.

Clearwater River district.—Placer gold was recovered in 1940 by sluicing at various bars near Greer and Orofino.

Moose Creek and Independence Creek district.—A little placer gold was recovered in 1940 from the First Chance, Lilly, Pioneer, White Diamond, and Moose claims.

North Fork of Clearwater River district.—Various placer operators recovered small lots of gold in 1940 by sluicing at bars near Dent and Elk River.

Pierce district.—The value of the metal output of the Pierce district was 65 percent greater in 1940 than in 1939, due to increase in output of placer gold from bucket dredging and to new operation by a drag-line equipped with a floating washer. The Quartz Creek Dredging Co., operating a 2½-cubic foot bucket dredge, was by far the most important producer in Clearwater County.

CUSTER COUNTY

Alder Creek district.—The Empire mine at Mackay was operated continuously in 1940 by the Mackay Exploration Co., resulting in a substantial increase in total value of the metal output of the Alder Creek district. About 4,500 tons of crude copper ore containing gold and silver were shipped to a smelter in Utah. The rest of the district output was principally crude silver-lead ore from the White Knob and Horseshoe mines.

Bayhorse district.—Clayton Silver Mines continued to be the largest producer of silver and lead in Custer County. The company operated its mine and 100-ton flotation mill throughout 1940 and treated 39,292 tons of silver-lead ore. Lessees operated the Ramshorn mine and shipped several hundred tons of crude silver ore and copper-lead-silver ore. Other producers included the Riverview, Turtle, South Butte, and Big Ben properties.

Boulder district.—Lessees operated the Livingston mine in 1940 and shipped 2 cars of silver-lead ore.

Seafoam district.—The output of the Seafoam district in 1940 was principally silver ore from the Greyhound mine and gold ore from the Lake View mine.

Stanley and Stanley Basin district.—The value of the metal output of the Stanley and Stanley Basin district was much greater in 1940 than in 1939, owing to the increase in output of gold-silver ore from the Valley Creek mine operated by the Western Gold Exploration Co.

Yankee Fork district.—A gain of more than $92,500 in the value of metal output in the Yankee Fork district in 1940 resulted from the treatment, by amalgamation and concentration, of several thousand tons of gold ore and old tailings from the General Custer-Lucky Boy property and from the operation of a new bucket dredge by the Snake River Mining Co. This new 8-cubic foot bucket dredge was completed in August by the company at Sunbeam and washed 452,816 cubic yards of gravel during the last quarter of the year.

ELMORE COUNTY

Bear Creek district.—The output of the Bear Creek district in 1940 was principally old gold tailings (cyanided) from the Bonaparte property and gold ore (amalgamated and concentrated) from the Avalanche-Richmond group.

Black Warrior district.—Small lots of high-grade gold ore were produced in 1940 from the B. & A. Road claim.

Boise River (Twin Springs) district.—Placer gold and silver were recovered in 1940 by hydraulicking, chiefly at the Five Bars, Sunflower, and Honey Bee claims near Twin Springs.

Middle Boise (Atlanta) district.—The value of the metal output of the Middle Boise district was 60 percent greater in 1940 than in 1939, owing to the large increase in output of gold ore from the Boise-Rochester-Monarch groups. Talache Mines, Inc., operated the groups throughout the year, treated 79,119 tons of gold ore by amalgamation and concentration, and shipped 178 tons of rich gold ore to a smelter; this property, with a production of 18,160 fine ounces of gold in 1940, was the largest producer of gold in Idaho. Old tailings (2,681 tons) from the Minerva dump, containing gold and silver, were concentrated in a 60-ton flotation plant.

Snake River district.—A little placer gold was recovered in 1940 by sluicing bars along the Snake River near King Hill.

GEM COUNTY

West View district.—The $49,621 increase in value of metal output in the West View district in 1940 resulted from production of gold ore at the Lincoln group and from increase in output of placer gold. Huron Mines, Inc., treated about 3,600 tons of gold ore in its new 60-ton flotation mill from July 1 to October 3. M. A. Stickler placed a dry-land dredge on a property near Montour early in the year and treated about 100,000 cubic yards of gravel.

IDAHO COUNTY

American Creek (Bully, Mill, and Castle Creeks) district.—A little placer gold was recovered in 1940 from the Buck Meadows and Red Fir properties.

Burgdorf-Marshall Lake district.—The Golden Anchor mine continued to be the most important producer in the Burgdorf-Marshall Lake district, although its output of gold in 1940 was 24 percent less than that in 1939; 15,459 tons of gold ore were treated by amalgamation and flotation compared with 16,301 tons in 1939.

Camp Howard (Salmon River) district (White Bird).—The output of the Camp Howard district in 1940 was placer gold and silver; the chief operation was a power shovel and stationary washer at the Horseshoe Bend Bar.

Clearwater River (Pardee) district.—Placer gold and silver were recovered in 1940 from various claims along the Clearwater River.

Dixie district.—Most of the output in the Dixie district in 1940 was placer gold from the Dixie Placers (where a ¾-cubic yard dragline and stationary washer were operated nearly all the year) and lode gold from the Surprise, Ontario, and Slip Easy mines.

Elk City district.—There was a large increase in output of gold in the Elk City district in 1940, owing chiefly to gain in output of placer gold from dredging operations. Six dredges (one bucket line, three dry-land, and two dragline) operated in the district in 1940 compared with three dredges (one dragline and two dry-land) in 1939.

Florence and French Creek district.—Most of the output in the Florence and French Creek district in 1940 was placer gold from the Shamrock, Vinegar Jug, Water Lilly, and First Chance properties and lode gold from the Golden Dyke mine.

Kitchen Creek district.—In 1940, as in 1939, the output of the Kitchen Creek district was placer gold from the Kitchen Creek claim.

Lower Salmon River district.—The Sunshine placer south of Forest was the most important producer in the Lower Salmon River district in 1940.

Maggie and Pete King Creeks district.—Nearly all the output in the Maggie and Pete King Creeks district in 1940 was placer gold and silver from the Nugget claim.

Newsome district.—The output of gold in the Newsome district was much smaller in 1940 than in 1939, as the Ferris Mining Co. suspended dredging operations in July owing to exhaustion of profitable gravel.

Orogrande district.—The value of the metal output of the Orogrande district was $140,130 in 1940, a substantial gain over 1939. Nearly all the output came from two properties—the Penman Lode mine and the 2-cubic foot bucket dredge of the Mt. Vernon Gold Mining Co.

Ramey Ridge district.—There was a sharp decline in output of gold in the Ramey Ridge district in 1940, owing to decreased output of gold ore from the Snowshoe mine; the mine and 25-ton mill were closed in April.

Riggins (Salmon River) district.—The output in the Riggins district in 1940 was mostly gold clean-ups from the dredging plant of the Shorts Bar Mining Co., which was idle in 1940.

Robbins (Buffalo Hump) district.—In 1940, as in 1939, nearly all the output of the Robbins district was gold ore (concentrated) from the St. Louis mine.

Salmon River (Shoup) district.—Placer gold and silver were recovered in 1940 by drift mining and sluicing at various claims along the Salmon River below Shoup.

Simpson (Salmon River) district (Lucile).—The output of the Simpson district in 1940 was placer gold and silver, recovered principally by drift mining at the Katie B., Betty Jean, J. K. T., Twileger Bar, and Butcher Bar properties.

Snake River district.—Sluicing at claims on the Snake River below Lewiston recovered more gold in 1940 than in 1939.

Ten Mile district (Golden).—The most important output in the Ten Mile district in 1940 was gold ore (6,538 tons concentrated) from the Center Star mine.

Warren district.—The Warren Dredging Co. operated its 3½-cubic foot bucket dredge throughout the year and was again the most important gold producer in the Warren district. The 2½-cubic foot bucket dredge that formerly operated near Fairfield was moved in July to company property at Warren and began digging August 25.

JEROME COUNTY

Sluicing at various claims along the banks of the Snake River near Jerome, Murtaugh, Hansen, and Eden recovered more gold in 1940 than in 1939.

LATAH COUNTY

Gold Creek district.—A little placer gold was recovered in 1940 from the Busy Lee, Lead To, and Midway claims, and a small lot of gold ore was produced from the Warrior prospect.

Hoodoo district.—There was a notable increase in output of gold in the Hoodoo district in 1940, owing to new operation by Northwest Goldfields from May 30 to December 31 of a 4½-cubic foot bucket-line dredge on the North Fork of Palouse River.

Moscow Mountain district.—A little placer gold was recovered in 1940 from the Christenson and Leith claims.

LEMHI COUNTY

Blackbird district.—The output of the Blackbird district in 1940 comprised 189 tons of gold ore from the Blackbird mine and 191 tons of copper ore from the Uncle Sam group.

Blue Wing district.—Ima Mines Corporation operated its mine and 150-ton mill continuously in 1940 and treated 41,946 tons of ore containing hübnerite, galena, tetrahedrite, pyrite, and molybdenite. The tungsten mineral is concentrated by jigs, tables, and flotation followed by magnetic concentration, and bulk sulfide flotation is used to recover the lead and silver contents.

Boyle Creek district.—The metal ouput of the Boyle Creek district was small in 1940, as the Gibbonsville Mining & Exploration Co. was idle.

Eldorado district.—A little copper ore was produced in 1940 from the Mountain View claim, and placer gold was recovered from Wimpey Creek.

Eureka district.—There was a substantial increase in output of gold in the Eureka district in 1940, resulting chiefly from operation of a 3½-cubic foot bucket dredge by Fisher & Higgins at the McNutt property near Salmon; the dredge formerly operated at Warren but was moved to the McNutt property in June.

Gibbonsville district.—Placer gold recovered by hydraulicking at the Sundown property continued to be the chief output in the Gibbonsville district. Other placer producers included the Bingham, Bingo, Hughes Creek, Minnie Moore, Ransack, and Sheep Creek properties. Crude gold ore was shipped from the Clara Morris, Poormans Luck, Providencia, and Talisman mines.

Indian Creek district.—The Kittie Burton & Ulysses mine was operated in 1940 by the American-Idaho Gold Corporation, and about 900 tons of gold ore were treated in a 50-ton flotation plant.

Kirtley Creek district.—Placer gold and silver were recovered in 1940 by drift mining at various claims on Kirtley Creek.

McDevitt district.—The Tendoy Copper Queen Syndicate at Tendoy milled 7,085 tons of ore from the Copper Queen mine, which yielded amalgamation bullion containing 35 ounces of gold and 5 ounces of silver and 106 tons of copper concentrate containing 368 ounces of gold, 1,113 ounces of silver, and 109,434 pounds of copper.

Mackinaw district.—The Richardson placer at Leesburg was by far the largest producer of gold in the Mackinaw district in 1940; a 1¾-cubic yard dry-land dredge was operated at the property from May 16 to November 10. Other placer producers included the K. G. W., Mae Belle, and Big Jureano properties. The lode output of the district was principally gold ore concentrated from the Ringbone Cayuse mine.

Mineral Hill district.—In 1940, as in 1939, the most important operation in the Mineral Hill district was milling gold ore from the Grunter mine at Shoup; Gold Producers, Inc., operated the mine continuously and treated 27,500 tons of gold ore by flotation. Gold ore was produced also from the Monolith and Gold Hill properties. The producers of placer gold included the Cove Creek, Boulder, and Lord's Bounty claims.

Parker Mountain district.—A little gold ore from the White Rock claim was the only output in the Parker Mountain district in 1940.

Salmon River district.—Placer gold and silver were recovered in 1940 by various operators along the Salmon River from Shoup to the county line; most of the output was recovered by a floating washer, equipped with a suction nozzle, operated by Salmon River Dredging Co.

Spring Mountain district.—The output of the Spring Mountain district in 1940 was crude silver-lead ore, chiefly from the South Gilmore and Red Warrior mines.

Texas district.—There was a substantial increase in output of gold in the Texas district in 1940 but large decreases in output of silver and lead. The gain in gold resulted from the treatment by cyanidation of several thousand tons of gold ore from the Falls Creek property near Gilmore, and the loss in silver and lead resulted from the decline in shipments of crude silver-lead ore from the Latest Out mine.

Yellow Jacket district.—Gold ore (treated by concentration) from the Yellow Jacket mine continued in 1940 to be the chief output in the Yellow Jacket district. Gold ore was produced also from the Bryan mine, and small lots of placer gold were recovered from various claims along the Middle Fork of Salmon River.

LEWIS COUNTY

The metal output of Lewis County in 1940 was placer gold and silver recovered by sluicing, principally at the Spinner and Luoto properties on the Salmon River.

NEZ PERCE COUNTY

The metal output of Nez Perce County in 1940 was placer gold and silver recovered by various operators working along the Snake River below Lewiston.

OWYHEE COUNTY

Carson district (Silver City, De Lamar).—The output of gold and silver in the Carson district was greater in 1940 than in 1939, owing chiefly to the increase in treatment of old tailings (gold-silver) from the De Lamar dumps; about 59,000 tons were treated during the year in a 200-ton flotation plant by the De Lamar Milling Corporation.

Castle Creek district.—Crude gold-silver ore was produced in 1940 from the Friday and Knutson claims and silver ore from the Silver Rock mine.

Snake River district.—Four dry-land dredges operated in 1940 at various properties on the Snake River near Grand View, resulting in an increase of about 700 ounces in gold. The chief operators were John R. Rhodes at the Gray property, Cecil Rhodes at the Red Gold Bar & Gold Island group, and F. R. Knowlton at the Knowlton Placer.

South Mountain district.—The old Golconda mine was operated the last 6 months of 1940 by the South Mountain Mining Co., and about 5, 000 tons of zinc-lead-silver ore were shipped to the custom flotation mill at Tooele, Utah.

Steele district.—The output of the Steele district in 1940 comprised a little crude gold-silver ore from the Demming mine, a small lot of gold ore from the Morning Glory property, and a little placer gold from claims on Meadow Creek.

POWER COUNTY

The metal output of Power County in 1940 was, as usual, placer gold recovered at various claims along the Snake River near American Falls.

SHOSHONE COUNTY

COEUR D'ALENE REGION

The value of the metal output of the Coeur d'Alene region increased 29 percent in 1940, owing chiefly to the gain in output of zinc-lead-silver ore. The output of each of the metals increased—gold 16 percent, silver 3 percent, copper 30 percent, lead 17 percent, and zinc 57 percent. The output of zinc was the largest in the history of the region and resulted chiefly from marked increases at the Star, Hecla, and Tamarack mines; there were also substantial gains in output of lead from these properties. One of the most important features of the year was the substantial increase in production of silver and copper from the Mineral Point mine operated by the Coeur d'Alene Mines Corporation. Silver output from the Sunshine mine continued to drop, but the gold output of the region rose owing to operation of a new dry-land dredge at properties near Murray. More than 73 percent of the material produced in Shoshone County in 1940 was zinc-lead ore and old tailings, 22 percent silver ore, and 4 percent lead ore.

The following table gives the production of gold, silver, copper, lead, and zinc in the Coeur d'Alene region in 1939 and 1940 and the total for 1884 to 1940.

Mine production of gold, silver, copper, lead, and zinc in the Coeur d'Alene region, Shoshone County, 1939–40, and total, 1884–1940, in terms of recovered metals

Year	Mines producing		Ore	Gold (lode and placer)	Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer							
			Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1939	34	18	1,611,068	5,928	15,204,934	4,136,115	163,397,979	80,129,962	$22,805,024
1940	49	25	1,917,235	6,886	15,616,852	5,359,000	191,218,460	125,896,000	29,444,265
Total, 1884–1940			(1)	378,978	372,888,252	2 54,289	2 5,043,460	2 739,912	906,812,391

1 Figures not available.
2 Short tons.

Beaver district.—The value of the metal production of the Beaver district was $413,667 in 1940 compared with $63,819 in 1939. The largest output was zinc-lead ore and old tailings from the Interstate-Callahan property treated in the Galena flotation mill; the mine was worked throughout the year by Interstate Lease, and the tailings dump and 150-ton Galena mill were operated under lease by Zanetti Bros. The old Sunset mine was taken over in September by Sunset Lease, and several thousand tons of zinc-lead ore were treated in the Golconda custom mill. The rest of the district lode output was mostly gold ore from the Pony Gulch (Kennan) mine. The output of placer gold in the district increased greatly in 1940 owing to operation of a new 2½ cubic yard dry-land dredge at three properties—the Eyster, Mather & Harwood, and Thiard—by the Beaver Dredging Co.

Coeur d'Alene district.—The metal output of the Coeur d'Alene district in 1940 was mostly placer gold from the Beehive Bar and Mountain Lion properties.

Eagle district.—The Jack Waite mine was the only producer in the Eagle district in 1940; the output comprised 1,151 tons of zinc-lead milling ore and 51 tons of high-grade crude lead ore.

Evolution district.—There was a decrease in silver output from the Evolution district in 1940 but a large increase in copper output; the loss in silver resulted from the decline in output of silver ore from the Sunshine mine, and the gain in copper resulted from the increase in output of silver-copper ore from the Mineral Point mine. However, the Sunshine Mining Co. remained the largest producer of silver in the United States; it treated 278,810 tons of ore containing tetrahedrite, galena, pyrite, and siderite in its 1,100-ton flotation plant compared with 320,990 tons in 1939, and the output of silver fell from 9,414,514 to 8,183,896 ounces and that of copper from 2,711,416 to 2,510,537 pounds. The company built an experimental pilot plant for the extraction of antimony from the concentrates; the capacity of the plant is about 1,000 pounds of electrolytic antimony a day, and 1,980,374 pounds were recovered in 1940. The Polaris Mining Co. treated 48,860 tons (virtually the same quantity as in 1939) of silver ore in its 200-ton flotation plant. In October the Coeur d'Alene Mines Corporation completed building a 300-ton flotation plant at the Mineral Point mine and during the last 2 months of the year treated 9,216 tons of silver-copper ore in the new mill; during the first 10 months of the year the ore (41,993 tons) was treated in the Hercules custom mill. The Silver Dollar Mining Co. operated its property continuously, and 10,750 tons of silver ore were treated in the Silver Crescent mill. Several hundred tons of silver ore were also produced from the St. Elmo mine.

Hunter district (*Mullan*).—The value ($8,501,482) of the metal output of the Hunter district in 1940 was the greatest of any district in Idaho. The chief output was, as usual, zinc-lead ore from the Morning mine of the Federal Mining & Smelting Co.; 336,603 tons of zinc-lead ore were treated in the company 1,250-ton flotation mill, 357 tons of crude silver-lead ore were smelted, and 1,736 tons of old tailings (zinc-lead) were hauled by lessees to the Golconda custom mill. The property ranked first in the State in zinc output, second in lead, and third in silver. The Sullivan Mining Co. treated 214,464 tons of zinc-lead ore from its Star mine in 1940, compared with 48,860 tons in 1939. The company reported that the concentrates produced contained 220,150 ounces of silver, 14,577,946 pounds of lead, and 33,520,906 pounds of zinc. About 38,500 tons of silver-lead ore from the Gold Hunter mine were produced by lessees and treated in the 500-ton Gold Hunter mill.

Lelande district (*Burke, Mace, Frisco*).—The output of ore and the yield of silver, lead, and zinc in the Lelande district were much greater in 1940 than in 1939 owing to increased output of zinc-lead ore from the Hecla mine—by far the most important producer in the district. About 203,900 tons of zinc-lead ore were treated in the company 900-ton flotation mill, and 8,425 tons of crude silver-lead ore were smelted. The Hull Leasing Co. continued to work the Frisco property and treated 20,758 tons of zinc-lead ore by flotation. The Sherman Lead Co. operated its mine throughout the year, shipped 17,289 tons of silver-lead ore to the Hercules custom mill and 1,220 tons of similar ore to a smelter, and in November completed building a 300-ton flotation mill.

Placer Center district.—The large increase of $852,500 in value of the metal output of the Placer Center district in 1940 resulted chiefly from the marked rise in output of zinc-lead ore from the Tamarack mine. The Tamarack & Custer Consolidated Mining Co. worked the mine throughout the year and in February completed building a 300-ton flotation mill; 51,003 tons of zinc-lead ore were treated in the new mill and 5,118 tons of similar ore in the Hercules custom mill.

St. Joe district.—The metal output of the St. Joe district in 1940 was placer gold recovered by sluicing at the Grizzly, Haystack, Iron Hill, and Helen Evelyn claims.

Summit district (Murray).—The Golden Chest mine operated by Consolidated Gold Mines, Inc., continued in 1940 to be the most important producer in the Summit district, but its output of gold ore declined from 12,190 tons in 1939 to about 8,500 in 1940.

Yreka district (Kellogg).—The value of the metal output of the Yreka district was $7,273,477 in 1940—a 25-percent gain over 1939. Zinc-lead ore from the Bunker Hill & Sullivan mine continued to be by far the chief output in the district; 383,886 tons were concentrated in 1940 compared with 343,019 in 1939. The property was the largest producer of lead in Idaho in 1940 and ranked second in output of silver and third in zinc. There was also a large increase in zinc-lead ore production from the Page and Blackhawk mines, both operated by the Federal Mining & Smelting Co.; 88,660 tons of zinc-lead ore from the Page and 16,567 tons of similar ore from the Blackhawk were treated in the 500-ton Page flotation plant.

TWIN FALLS COUNTY

The metal output of Twin Falls County in 1940 was placer gold and silver recovered by sluicing at various properties along the Snake River.

VALLEY COUNTY

Big Creek district.—Lead ore containing considerable gold from the Sunday mine and placer gold recovered from the Hoot Mon claim were the chief output of the Big Creek district in 1940.

Deadwood Basin district.—A little gold ore was produced in 1940 from the Ranger claim and silver ore from the Rolling Stone prospect; small lots of placer gold came from various claims.

Lake City (McCall) district.—The metal output of the Lake City district in 1940 was placer gold recovered by hydraulicking at the Neely Hill and New Deal properties.

Pistol Creek district.—In 1940, as in 1939, the output of the Pistol Creek district was rich gold-lead ore from the Lucky Boy mine.

South Fork of Salmon River district.—Placer gold and silver were recovered in 1940, principally by sluicing at the Little Nugget, North Pole, Southwest Placer, and Repass properties.

Thunder Mountain district.—Nearly all the metal output of the Thunder Mountain district in 1940 was, as in 1939, placer gold and silver recovered by the sluicing of eroded-vein material from the Sunnyside property.

Yellow Pine district.—Virtually all the output from the Yellow Pine district in 1940 was antimony-gold ore from the Yellow Pine mine; 132,297 tons of ore containing stibnite, pyrite, and arsenopyrite were treated in a 400-ton flotation plant compared with 56,074 tons in 1939.

WASHINGTON COUNTY

Monroe Creek (Weiser) district.—A little gold ore from the Blue Dog mine was treated in 1940 by amalgamation and concentration.

Snake River district.—Small-scale placer operators worked various claims along the Snake River in Washington County in 1940; the chief producers were the Last Chance, Smith Bar, and Nagging Wife properties.

Washington district.—The metal output of the Washington district in 1940 comprised several cars of crude silver ore from the Silver Still mine and 1 car of silver-copper ore from a prospect near Mineral.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN MONTANA

(MINE REPORT)

By G. E. Woodward and Paul Luff

SUMMARY OUTLINE

The total value of the recoverable metals produced from Montana mines in 1940 was $55,825,078—a 36-percent increase over 1939 (see fig. 1). Although there were substantial gains in both quantity and value of each of the five metals, the greatest advances were in copper, zinc, and silver—the value of each rising more than $2,000,000. Metal production in Silver Bow County, by far the most productive area in Montana, was valued at $40,871,719 in 1940—a 48-percent gain over 1939 caused by the high rate of operations at the copper mines and zinc mines of the Anaconda Copper Mining Co. at Butte. There was a decrease in output of gold but a gain in that of silver from siliceous ores; the decline in gold output from lode mines, however, was more than offset by gains at placer mines.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1936–40

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1936	$35.00	$0.7745	$0.092	$0.046	$0.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052
1940	35.00	[6] .711+	.113	.050	.063

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+ ($20.671835) per fine ounce.
[2] 1936–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–40: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787. [6] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Montana, 1936–40, and total, 1862–1940, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1936	570	284	3,853,116	180,209.20	$6,307,322	11,600,563	$8,984,636
1937	615	406	4,898,009	202,252.00	7,078,820	11,812,093	9,136,654
1938	482	265	2,724,466	203,313.00	7,115,955	6,403,962	4,139,935
1939	594	282	3,792,780	264,173.00	9,246,055	9,087,571	6,168,533
1940	687	285	5,099,241	272,602.00	9,541,070	12,361,050	8,790,080
1862–1940			(1)	16,434,043.00	359,644,717	700,815,985	512,388,192

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1936	219,088,000	$20,156,096	38,118,000	$1,753,428	99,434,000	$4,971,700	$42,173,182
1937	289,056,000	34,975,776	35,914,000	2,118,926	78,336,000	5,091,840	58,402,016
1938	154,426,000	15,133,748	18,654,000	858,084	17,688,000	849,024	28,096,746
1939	195,654,000	20,348,016	33,110,000	1,556,170	69,598,000	3,619,096	40,937,870
1940	252,782,000	28,564,366	46,072,000	2,303,600	105,174,000	6,625,962	55,825,078
1862–1940	[2] 5,909,421	1,727,682,966	[2] 605,983	64,084,142	[2] 1,638,957	245,684,930	2,909,484,947

[1] Figures not available.
[2] Short tons.

Gold and silver produced at placer mines in Montana, 1936–40, in fine ounces, in terms of recovered metals

Year	Sluicing and hydraulic		Drift mining		Dredges						Total	
					Dry-land [1]		Dragline floating [1]		Floating bucket			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1936	[2] 2,803.02	[2] 338	(2)	(2)	15,666.66	2,615	2,645.77	778	19,300.35	1,923	40,415.80	5,654
1937	[2] 2,989.00	[2] 369	(2)	(2)	11,355.00	2,919	4,489.00	1,330	17,564.00	1,797	36,397.00	6,415
1938	[2] 3,896.00	[2] 351	(2)	(2)	5,721.00	1,533	4,375.00	1,410	21,356.00	3,240	35,348.00	6,534
1939	2,075.00	232	208.00	20	9,164.00	2,722	9,737.00	1,937	33,815.00	6,723	54,999.00	11,634
1940	2,163.00	272	281.00	41	11,252.00	2,640	11,439.00	1,302	39,012.00	7,400	64,147.00	11,655

[1] A floating washing plant supplied with gravel by a dragline excavator is called a "dragline dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."
[2] Figures for sluicing and hydraulic include those for drift mining.

Gold.—Montana ores and gravels yielded 272,602 fine ounces of gold in 1940 compared with 264,173 ounces in 1939—a gain of 3 percent; this output was the greatest since 1887, when 289,212 ounces were produced. In 1940, lode mines yielded 76 percent of the State total gold and placers 24 percent; output from lode mines decreased 719 ounces, but that from placer gravels increased 9,148 ounces. Siliceous ores yielded 66 percent of the total gold and base-metal ores 10 percent; there was a decrease from siliceous ore but increases from copper, lead, and zinc-lead ores. Gains were noted in output of recovered gold from Broadwater, Silver Bow, Park, Granite, Madison, and Beaverhead Counties but losses from Phillips, Deer Lodge, Lewis and Clark, and Jefferson Counties. Gold ore mined in 1940 totaled 803,173 tons compared with 815,949 tons in 1939; 555,214 tons were treated in amalgamation and cyanidation mills and 171,650 tons in concentrating mills, and 76,309 tons were shipped crude to smelters. Ore treated at amalgamation and cyanidation plants yielded 32 percent of the State total gold, that at concentrating mills 18 percent, and ores of all classes shipped crude to smelters 26 percent.

The leading producer of gold in Montana was again the West Mayflower property in Madison County, which was operated by the Anaconda Copper Mining Co. It was followed by the Winston dredge, operating on Prickly Pear Creek near Clancey; all the company-operated copper mines of the Anaconda Copper Co. at Butte;

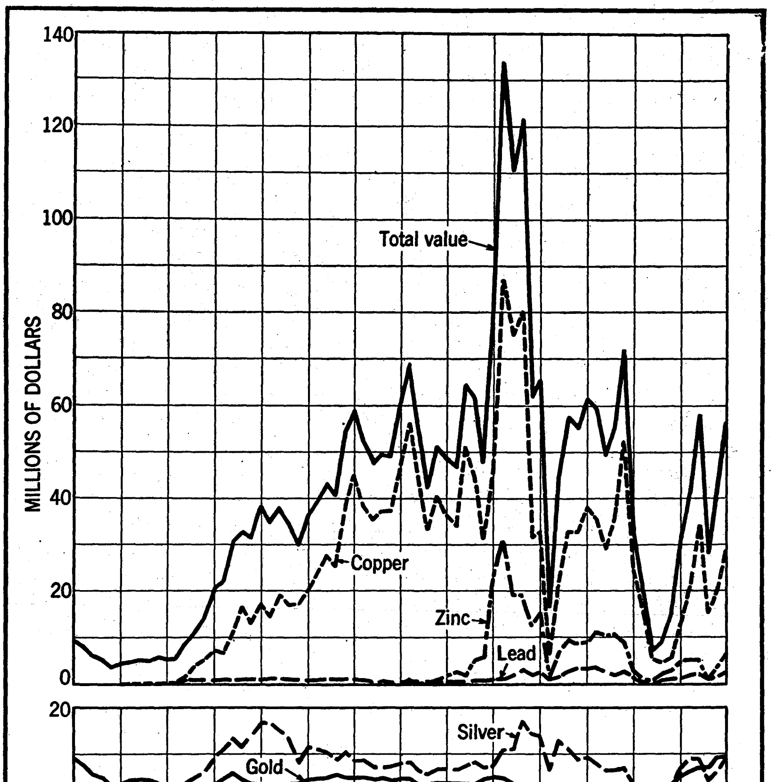

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value in Montana, 1870–1940.

the Ohio Keating mine in Broadwater County; the Jardine mine in Park County; the Ruby Gulch mine at Zortman; the Golden Messenger mine in Lewis and Clark County; the Perry-Schroeder dredge, also in Lewis and Clark County; the Highlands group in Silver Bow County; and the Porter Bros. dredge near Helena.

Silver.—The output of recoverable silver in Montana in 1940 was 12,361,050 fine ounces compared with 9,087,571 ounces in 1939—a 36-percent gain, which came mostly from the zinc-lead and copper ores of the Butte district in Silver Bow County although siliceous ores also made substantial gains. Copper ore yielded 49 percent of the State total silver, zinc-lead ore 25 percent, and siliceous ore 24 percent. Production of silver from Silver Bow, Beaverhead, Cascade, and Flathead Counties increased. Ores treated at concentration mills yielded 79 percent of the total silver and crude smelting ores 19 percent. The output of silver ore was 104,812 tons (a 41-percent decrease from 1939) and gold-silver ore 120,538 tons (a 117-percent gain).

The copper mines and zinc mines at Butte, operated by the Anaconda Copper Mining Co., and the Flathead mine in Flathead County, owned and operated by the same company, produced 71 percent of the State total silver. Other large silver producers included the Comet mine in Jefferson County; the Hecla mine (tailings) in Beaverhead County; the Lexington group in the Montana district, Cascade County; the Emma mine at Butte; and the Granite-Bimetallic mine (tailings) in Granite County.

Copper.—The value of the output of recoverable copper in Montana in 1940 showed the greatest gain of any of the metals under discussion. Copper ore and precipitates yielded recoverable gold, silver, copper, and lead valued at $32,873,902 or 59 percent of the State total value. The Anaconda Copper Mining Co. was, as usual, the only important copper producer in the State. The output of copper from the company mines increased 29 percent over 1939 but was less than in 1937. The company shipped 2,737,572 tons of copper ore to the mills in 1940 compared with 2,197,863 tons in 1939 and 3,068,665 in 1937; in addition, 510,972 tons of dump ore were treated at company mills, and 37,835 tons of copper ore were shipped crude to the smelter.

Lead and zinc.—The value of the output of recoverable lead and zinc in Montana showed sharp increases over 1939; production of lead rose 12,962,000 pounds and that of zinc 35,576,000 pounds as a result of the activities of the Anaconda Copper Mining Co. at company-owned and company-leased properties. The zinc mines owned by the company produced 362,479 tons of zinc-lead ore; and the Emma mine, leased by the company, produced 77,353 tons of zinc-lead ore. Gains were noted in the output of both lead and zinc at the Jack Waite mine. The Comet mine in Jefferson County showed an increase in lead but a decrease in zinc, owing to a higher lead content and a lower zinc content; the tonnage of zinc-lead ore milled was nearly the same as in 1939. Other producers of lead or zinc included the Flathead and Wild Pat mines. Concentrates smelted yielded 66 percent of the lead and 72 percent of the zinc; crude ore smelted yielded 28 percent of the lead and a little zinc; and slag fumed yielded 6 percent of the lead and 28 percent of the zinc.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Montana in 1940, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Beaverhead	49	12	13,181	$461,335	503,536	$358,070
Broadwater	56	28	26,551	929,285	27,322	19,429
Cascade	14	-----	3,569	124,915	730,959	519,793
Deer Lodge	17	8	6,816	238,560	24,705	17,568
Fergus	8	4	2,621	91,735	1,859	1,322
Flathead	3	-----	513	17,955	624,479	444,074
Gallatin	2	1	5	175	24	17
Granite	62	17	16,187	566,545	455,833	324,148
Jefferson	96	26	29,676	1,038,660	588,399	418,417
Judith Basin	1	-----	13	455	4,434	3,153
Lewis and Clark	93	39	43,825	1,533,875	136,253	96,891
Liberty	-----	1	3	105	-----	-----
Lincoln	14	8	2,204	77,140	19,513	13,876
Madison	168	31	63,491	2,222,185	232,740	165,504
Meagher	1	19	955	33,425	218	155
Mineral	3	21	1,410	49,350	3,562	2,533
Missoula	7	17	2,739	95,865	817	581
Park	5	7	10,828	378,980	12,967	9,221
Phillips	2	4	14,370	502,950	94,659	67,313
Powell	24	21	7,611	266,385	76,313	54,267
Ravalli	3	6	519	18,165	18,845	13,401
Sanders	9	2	350	12,250	37,208	26,459
Silver Bow	50	8	25,107	878,745	8,766,398	6,233,883
Stillwater	-----	2	50	1,750	7	5
Toole	-----	3	8	280	-----	-----
	687	285	272,602	9,541,070	12,361,050	8,790,080
Total, 1939	594	282	264,173	9,246,055	9,087,571	6,168,533

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaverhead	638,000	$72,094	1,650,000	$82,500	6,000	$378	$974,377
Broadwater	22,000	2,486	329,700	16,485	-----	-----	967,685
Cascade	22,000	2,486	1,910,700	95,535	1,425,000	89,775	832,504
Deer Lodge	11,000	1,243	-----	-----	-----	-----	257,371
Fergus	-----	-----	1,900	95	-----	-----	93,152
Flathead	109,000	12,317	7,175,200	358,760	-----	-----	833,106
Gallatin	-----	-----	15,800	790	-----	-----	982
Granite	164,000	18,532	284,300	14,215	205,000	12,915	936,355
Jefferson	431,000	48,703	4,244,100	212,205	1,547,000	97,461	1,815,446
Judith Basin	1,000	113	261,100	13,055	-----	-----	16,776
Lewis and Clark	31,000	3,503	3,710,600	185,530	28,924,000	1,822,212	3,642,011
Liberty	-----	-----	-----	-----	-----	-----	105
Lincoln	6,000	678	225,300	11,265	8,000	504	103,463
Madison	125,000	14,125	100,700	5,035	12,000	756	2,407,605
Meagher	-----	-----	-----	-----	-----	-----	33,580
Mineral	1,000	113	2,600	130	-----	-----	52,126
Missoula	5,000	565	-----	-----	-----	-----	97,011
Park	36,000	4,068	61,400	3,070	-----	-----	395,339
Phillips	-----	-----	-----	-----	-----	-----	570,263
Powell	9,000	1,017	104,200	5,210	7,000	441	327,320
Ravalli	8,000	904	50,900	2,545	407,000	25,641	60,656
Sanders	279,000	31,527	8,225,000	411,250	835,000	52,605	534,091
Silver Bow	250,884,000	28,349,892	17,718,500	885,925	71,798,000	4,523,274	40,871,719
Stillwater	-----	-----	-----	-----	-----	-----	1,755
Toole	-----	-----	-----	-----	-----	-----	280
	252,782,000	28,564,366	46,072,000	2,303,600	105,174,000	6,625,962	55,825,078
Total, 1939	195,654,000	20,348,016	33,110,000	1,556,170	69,598,000	3,619,096	40,937,870

Gold and silver produced at lode mines in Montana in 1940, by counties, in terms of recovered metals

County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
Beaverhead	92,439	11,096	503,387	Meagher	20	24	7
Broadwater	91,428	20,156	26,616	Mineral	63	13	3,486
Cascade	74,594	3,569	730,959	Missoula	451	392	713
Deer Lodge	22,906	6,766	24,698	Park	67,919	10,386	12,891
Fergus	65,788	2,611	1,859	Phillips	124,009	14,191	94,628
Flathead	32,137	513	624,479	Powell	10,390	3,402	75,804
Gallatin	24	1	24	Ravalli	10,088	170	18,824
Granite	67,469	10,288	455,293	Sanders	44,189	323	37,208
Jefferson	120,800	14,236	582,518	Silver Bow	3,764,610	25,085	8,766,398
Judith Basin	419	13	4,434				
Lewis and Clark	301,838	23,939	133,785		5,099,241	208,455	12,349,395
Lincoln	27,253	2,099	19,506	Total, 1939	3,792,780	209,174	9,075,937
Madison	180,407	59,182	231,878				

Gold and silver produced at placer mines in Montana in 1940, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Drift mining		Dredges						Total	
					Dry-land [1]		Dragline floating [1]		Floating bucket			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Beaverhead	71	5	------	------	85	14	1,929	130	------	------	2,085	149
Broadwater	106	13	15	1	2,560	288	3,714	404	------	------	6,395	706
Deer Lodge	50	7	------	------	------	------	------	------	------	------	50	7
Fergus	10	------	------	------	------	------	------	------	------	------	10	------
Gallatin	4	------	------	------	------	------	------	------	------	------	4	------
Granite	78	13	175	30	87	6	------	------	5,559	491	5,899	540
Jefferson	183	26	------	------	3,034	1,538	742	110	11,481	4,207	15,440	5,881
Lewis and Clark	218	44	35	3	1,278	199	3,063	608	15,292	1,614	19,886	2,468
Liberty	3	------	------	------	------	------	------	------	------	------	3	------
Lincoln	83	6	------	------	22	1	------	------	------	------	105	7
Madison	206	47	------	------	789	128	------	------	3,314	687	4,309	862
Meagher	113	19	------	------	818	192	------	------	------	------	931	211
Mineral	341	21	3	------	1,053	55	------	------	------	------	1,397	76
Missoula	159	6	------	------	507	66	1,681	32	------	------	2,347	104
Park	145	25	40	6	257	45	------	------	------	------	442	76
Phillips	4	------	------	------	175	31	------	------	------	------	179	31
Powell	246	30	10	1	587	77	------	------	3,366	401	4,209	509
Ravalli	39	3	------	------	------	------	310	18	------	------	349	21
Sanders	27	------	------	------	------	------	------	------	------	------	27	------
Silver Bow	22	------	------	------	------	------	------	------	------	------	22	------
Stillwater	50	7	------	------	------	------	------	------	------	------	50	7
Toole	5	------	3	------	------	------	------	------	------	------	8	------
	2,163	272	281	41	11,252	2,640	11,439	1,302	39,012	7,400	64,147	11,655
Total, 1939	2,075	232	208	20	9,164	2,722	9,737	1,937	33,815	6,723	54,999	11,634

[1] A floating washing plant supplied with gravel by a dragline excavator is called a "dragline dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."

MINING INDUSTRY

Continuous operation of the zinc and copper mines at Butte by the Anaconda Copper Mining Co. was responsible for most of the increase in metal output in Montana in 1940, although gains were made in metals from ore treated at cyanidation and amalgamation mills and crude ore shipped direct to smelters.

Placer gravels yielded 9,148 fine ounces more gold and 21 fine ounces more silver than in 1939. Seven connected-bucket floating dredges were in operation in 1940; they treated 9,280,898 cubic yards of gravel and recovered 39,012 fine ounces of gold. The gold was valued at $1,365,420, indicating an average recoverable gold value of 14.7 cents to the cubic yard treated. Draglines and power shovels with both dry-land and floating washing plants were reported in operation at 32 properties. The plants washed 4,761,812 cubic yards of gravel and recovered gold valued at $794,185, indicating an average recoverable gold value of 16.7 cents to the cubic yard washed.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Montana in 1940, with content in terms of recovered metals

Source	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	410	803,173	167,186	459,052	215,113	617,767	----------
Dry and siliceous gold-silver ore	75	120,538	11,230	881,541	244,959	633,521	----------
Dry and siliceous silver ore	77	104,812	3,053	1,571,060	745,514	1,892,280	----------
	[1] 555	1,028,523	181,469	2,911,653	1,205,586	3,143,568	----------
Copper ore	22	3,287,803	11,708	6,039,027	[2] 249,288,127	2,880	----------
Lead ore	115	29,454	3,036	262,996	30,085	11,236,487	----------
Lead-copper ore	4	71	5	1,673	4,742	12,132	----------
Zinc ore	3	[3] 174,181	142	23,236	13,588	2,792,880	29,569,600
Zinc-lead ore	22	579,209	12,095	3,110,810	2,239,872	28,884,053	75,604,400
Total, lode mines	[1] 687	5,099,241	208,455	12,349,395	[2] 252,782,000	46,072,000	105,174,000
Total, placers	285	----------	64,147	11,655	----------	----------	----------
	972	5,099,241	272,602	12,361,050	[2] 252,782,000	46,072,000	105,174,000
Total, 1939	876	3,792,780	264,173	9,087,571	[4] 195,654,000	33,110,000	69,598,000

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[2] Includes 5,624,886 pounds recovered from precipitates.
[3] Includes 163,923 tons of current slag fumed.
[4] Includes 4,004,361 pounds recovered from precipitates.

METALLURGIC INDUSTRY

Lode mines in Montana produced 5,099,241 tons of ore in 1940 compared with 3,792,780 tons in 1939. The ore was treated as follows: 89,361 tons at amalgamation plants, 466,024 tons at cyanidation mills, 4,101,902 tons at concentration mills, 278,031 tons shipped crude to smelters, and 163,923 tons treated at a slag-fuming plant.

Ten cyanidation mills treated 333,504 tons of gold ore, which contained 65,229 ounces of gold and 345,533 ounces of silver; the bullion and precipitates shipped contained 56,734 ounces of gold and 153,965 ounces of silver, indicating an average recovery of 87 percent of the gold and 45 percent of the silver. Ten mills treating 289,208 tons of gold ore reported the consumption of 140,210 pounds of sodium cyanide (91-percent grade), 210,163 pounds of calcium cyanide, 74,166 pounds of zinc dust, and 2,138,718 pounds of lime.

Ore treated at straight concentration plants increased from 2,836,478 tons in 1939 to 4,101,902 in 1940. The 1940 total comprised 259,019 tons of siliceous ores, 3,248,544 of copper ore, 5,130 of lead ore, 10,000 of zinc ore, and 579,209 of zinc-lead ore.

Details of the treatment of all ores produced in Montana in 1940 are given in the tables that follow.

Mine production of metals in Montana in 1940, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds	Zinc (pounds)
Ore amalgamated	89,361	9,664	2,178			
Ore cyanided	466,024	72,874	180,559			
Concentrates smelted [1]	662,832	54,596	9,810,936	243,768,261	30,653,348	76,011,400
Copper precipitates smelted	3,812			5,624,886		
Ore smelted	278,031	71,321	2,355,722	3,388,853	12,692,652	238,600
Slag fumed	163,923				2,726,000	28,924,000
Placer		64,147	11,655			
		272,602	12,361,050	252,782,000	46,072,000	105,174,000
Total, 1939		264,173	9,087,571	195,654,000	33,110,000	69,598,000

[1] Includes zinc concentrates treated at electrolytic plants.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Montana in 1940, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Ore treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Beaverhead	120	61	10					
Broadwater	2,112	916	216	17	5	19		
Deer Lodge	117	51	19	13	13		155	
Fergus	5	3						
Granite	220	80	298	7	43	24		
Jefferson	1,155	200	31	25	37	260	625	4,911
Lewis and Clark	1,430	215	84	34	90	1,377		6,922
Lincoln	18,285	1,273	242	286	484	10,259	5,264	88,657
Madison	8,059	1,010	269	242	1,058	456	3,412	
Park	57,812	5,831	1,009	2,295	3,486	857		
Powell	10	2						
Ravalli	31	19						
Sanders	5	3						
	89,361	9,664	2,178	2,919	5,216	13,252	9,456	100,490
Total, 1939	82,359	9,354	2,042	2,800	4,620	13,486	6,932	82,578

CYANIDATION MILLS

County	Ore treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Beaverhead	42,855	8,100	4,727					
Deer Lodge	17,443	4,526	514					
Fergus	65,730	2,578	1,530					
Granite	7,328	1,722	56					
Lewis and Clark	117,863	18,086	67,169	104	245	643	211	7,004
Madison	73,671	16,346	11,418					
Phillips	124,009	14,191	94,628					
Silver Bow	17,125	7,325	517					
	466,024	72,874	180,559	104	245	643	211	7,004
Total, 1939	490,429	68,278	126,015	22	71	138	40	9,860
Grand total: 1940	555,385	82,538	182,737	3,023	5,461	13,895	9,667	107,494
1939	572,788	77,632	128,057	2,822	4,691	13,624	6,972	92,438

Mine production of metals from concentrating mills in Montana in 1940, by counties, in terms of recovered metals

County	Ore treated (short tons)	Concentrates smelted and recovered metal					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Beaverhead	224	51	28	2,732	403	9,562	6,000
Broadwater	85,092	11,247	14,302	5,717	16,613	51,970	
Cascade	74,440	4,677	3,306	695,059	20,986	1,888,778	1,425,000
Granite	1,951	308	45	16,229	4,471	54,524	205,000
Jefferson	101,695	16,705	6,853	490,783	386,056	4,005,219	1,547,000
Lewis and Clark	9,535	444	776	11,768	9,003	328,637	
Lincoln	8,873	303	296	8,588	318	126,187	8,000
Madison	55,760	2,620	5,584	8,864	100,975	8,697	12,000
Mineral	25	4	10	4			
Missoula	72	1	13	2			
Park	9,991	275	1,064	7,528	35,804	24,852	
Powell	5,534	602	745	3,839	502	53,320	7,000
Ravalli	10,000	491	135	18,643	7,203	48,467	407,000
Sanders	42,006	4,983	135	28,090	48,820	6,245,690	835,000
Silver Bow	3,696,704	617,098	15,843	8,499,195	243,127,440	17,699,951	71,559,400
	4,101,902	659,809	49,135	9,797,041	243,758,594	30,545,854	76,011,400
Total, 1939	2,836,478	497,382	39,923	7,163,435	187,491,299	19,822,398	44,320,000

Gross metal content of concentrates produced from ore mined in Montana in 1940, by classes of concentrates smelted

Class of concentrates	Concentrates (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	15,964	22,741	12,454	25,731	112,772	
Dry gold-silver	1,204	2,670	370,459	10,408	103,577	
Dry silver	3	1	833	41	495	
Copper	515,399	14,514	5,960,354	247,553,402		
Lead	19,402	4,613	1,098,359	837,293	22,921,930	1,123,331
Zinc	77,707	4,143	2,043,560	1,267,596	8,110,823	84,459,069
Dry iron (from zinc-lead ore)	33,153	5,914	324,917	437,382	1,345,571	2,669,240
	662,832	54,596	9,810,936	250,131,853	32,595,168	88,251,640
Total, 1939	500,204	44,614	7,177,059	192,081,213	21,026,464	51,640,791

Mine production of metals from Montana concentrates shipped to smelters in 1940, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Beaverhead	51	28	2,732	403	9,562	6,000
Broadwater	11,264	14,307	5,736	16,613	51,970	----------
Cascade	4,677	3,306	695,059	20,986	1,888,778	1,425,000
Deer Lodge	13	13	----------	155	----------	----------
Granite	315	88	16,253	4,471	54,524	205,000
Jefferson	16,730	6,890	491,043	386,681	4,010,130	1,547,000
Lewis and Clark	582	1,111	13,788	9,214	342,563	----------
Lincoln	589	780	18,847	5,582	214,844	8,000
Madison	2,862	6,642	9,320	104,387	8,697	12,000
Mineral	4	10	4	----------	----------	----------
Missoula	1	13	2	----------	----------	----------
Park	2,570	4,550	8,385	35,804	24,852	----------
Powell	602	745	3,839	502	53,320	7,000
Ravalli	491	135	18,643	7,203	48,467	407,000
Sanders	4,983	135	28,090	48,820	6,245,690	835,000
Silver Bow	617,098	15,843	8,499,195	243,127,440	17,699,951	71,559,400
Total	662,832	54,596	9,810,936	243,768,261	30,653,348	76,011,400
1939	500,204	44,614	7,177,059	187,498,271	19,914,836	44,320,000

BY CLASSES OF CONCENTRATES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	15,964	22,741	12,454	22,610	108,249	----------
Dry gold-silver	1,204	2,670	370,459	8,699	99,431	----------
Dry silver	3	1	833	35	475	----------
Copper	515,399	14,514	5,960,354	241,412,644	----------	----------
Lead	19,402	4,613	1,098,359	711,309	22,004,908	----------
Zinc	77,707	4,143	2,043,560	1,204,207	7,705,220	76,011,400
Dry iron (from zinc-lead ore)	33,153	5,914	324,917	408,757	735,065	----------
	662,832	54,596	9,810,936	243,768,261	30,653,348	76,011,400

Gross metal content of Montana crude ore shipped to smelters in 1940, by classes of ore

Class of ore	Ore (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	76,309	56,399	233,100	47,103	169,165	----------
Dry and siliceous gold-silver	52,411	8,055	437,447	182,965	263,439	----------
Dry and siliceous silver	85,399	3,017	1,395,083	764,664	2,515,462	----------
Copper	39,259	1,399	87,364	2,440,500	3,001	----------
Lead	24,324	2,439	196,462	33,648	11,264,272	----------
Lead-copper	71	5	1,673	6,047	12,638	----------
Zinc	258	7	4,593	6,696	19,645	261,690
Total	278,031	71,321	2,355,722	3,481,623	14,247,622	261,690
1939	237,876	86,928	1,747,220	4,496,522	11,458,833	----------

Mine production of metals from Montana crude ore shipped to smelters in 1940, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Beaverhead	49,240	2,907	495,918	637,597	1,640,438	
Broadwater	4,224	4,933	20,664	5,387	277,730	
Cascade	154	263	35,900	1,014	21,922	
Deer Lodge	5,346	2,176	24,165	10,845		
Fergus	53	30	329		1,900	
Flathead	32,137	513	624,479	109,000	7,175,200	
Gallatin	24	1	24		15,800	
Granite	57,970	8,398	438,686	159,529	229,776	
Jefferson	17,950	7,146	91,444	44,319	233,970	
Judith Basin	419	13	4,434	1,000	261,100	
Lewis and Clark	9,087	4,527	52,744	21,786	642,037	
Lincoln	95	46	417	418	10,456	
Madison	42,917	35,184	210,871	20,613	92,003	
Meagher	20	24	7			
Mineral	38	3	3,482	1,000	2,600	
Missoula	379	379	711	5,000		
Park	116	5	3,497	196	36,548	
Powell	4,846	2,655	71,965	8,498	50,880	
Ravalli	57	16	181	797	2,433	
Sanders	2,178	185	9,118	230,180	1,979,310	
Silver Bow	50,781	1,917	266,686	2,131,674	18,549	238,600
	278,031	71,321	2,355,722	3,388,853	12,692,652	238,600
Total, 1939	237,876	86,928	1,747,220	4,151,368	10,683,164	

BY CLASSES OF ORE

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	76,309	56,399	233,100	43,754	163,525	
Dry and siliceous gold-silver	52,411	8,055	437,447	178,204	170,554	
Dry and siliceous silver	85,399	3,017	1,395,083	741,199	1,512,745	
Copper	39,259	1,399	87,364	2,386,202	2,880	
Lead	24,324	2,439	196,462	28,367	10,812,403	
Lead-copper	71	5	1,673	4,742	12,132	
Zinc	258	7	4,593	6,385	18,413	238,600
	278,031	71,321	2,355,722	3,388,853	12,692,652	238,600

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Montana in 1940, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Beaverhead County:													
Argenta	24	1	35,398	7,247	2	7,249	11,461		11,461	1,310	122,880	6,000	$268,535
Bald Mountain	1		300	156		156	218		218				5,615
Bannack	6	6	9,666	1,702	1,993	3,695	3,607	135	3,742	9,000			133,003
Big Hole	8	4	333	165	5	170	533		533	894	22,600		7,560
Blue Wing	4		1,187	48		48	14,168		14,168	584	1,900		11,916
Bryant	2		43,089	1,757		1,757	426,735		426,735	626,168	1,502,540		510,835
Horse Prairie Creek		1			85	85		14	14				2,985
Polaris	2		5				180		180	44	80		137
Vipond	2		2,461	21		21	46,485		46,485				33,791
Broadwater County:													
Backer	6	21	190	828	1,280	2,108	1,170	232	1,402	292	15,800		75,600
Beaver	19		14,516	2,284		2,284	10,506		10,506	4,168	127,000		94,232
Cedar Plains	12		73,558	15,264		15,264	3,188		3,188	16,885	12,980		539,064
Park	19	7	3,164	1,780	5,115	6,895	11,752	474	12,226	655	173,920		258,789
Cascade County: Montana	14		74,594	3,569		3,569	730,959		730,959	22,000	1,910,700	1,425,000	832,504
Deer Lodge County:													
Dry Gulch		1			15	15							525
French Gulch		4			27	27		7	7				950
Georgetown	11	1	21,099	6,630	2	6,632	661		661	11,000			233,833
Heber		2			6	6							210
Oro Fino	4		1,429	131		131	16,252		16,252				16,142
Silver Lake	2		378	5		5	7,785		7,785				5,711
Fergus County:													
Cone Butte	2		154	16		16	59		59				602
North Moccasin	1	3	65,576	2,562	9	2,571	1,471		1,471				91,031
Warm Springs	5	1	58	33	1	34	329		329		1,900		1,519
Flathead County: Hog Heaven	3		32,137	513		513	624,479		624,479	109,000	7,175,200		833,106
Gallatin County:													
Eldridge		1			4	4							140
Elk Creek	1		7	1		1							35
Johnson Gulch	1		17				24		24		15,800		807
Granite County:													
Alps	2	1	32	7	5	12	111		111	1,000			612
Boulder	14	1	884	494	3	497	3,351		3,351	6,779	19,040		21,496
Dunkleberg	2		58				609		609	221	25,400	7,000	2,169
First Chance	13	6	3,082	3,081	5,594	8,675	3,240	495	3,735	1,717	400		306,495
Flint Creek	17		54,730	4,517		4,517	441,720		441,720	150,018	237,180	198,000	513,492
Gold Creek	3	4	115	51	185	236	412	31	443	97	1,920		8,682

Henderson	5	3	727	172	94	266	4,898	7	4,905	3,478	360		13,209
Maxville	1		364	135		135	786		786	478			5,338
Moose Lake	1		9	8		8	38		38	212			331
Red Lion	3		7,460	1,821		1,821	83		83				63,794
Rock Creek	1	2	8	2	18	20	45	7	52				737
Jefferson County:													
Amazon	6		275	69		69	3,614		3,614	381	38,600		6,958
Bigfoot	1		68	17		17	204		204	451	280		805
Boulder	4	2	257	30	75	105	2,077	14	2,091	522	13,840		5,913
Cataract	21	5	60,446	7,127	88	7,215	462,517	45	462,562	360,487	3,807,860	1,546,000	909,984
Clancey	9	10	135	146	12,255	12,401	2,340	4,455	6,795	248	15,780		439,684
Colorado	16		45,841	1,213		1,213	84,579		84,579	64,708	252,220	1,000	122,586
Elkhorn	7	1	503	258	678	936	2,226	69	2,295	1,451	39,720		36,542
Golconda	3		21	7		7	457		457		1,240		632
Homestake	5	2	26	6	6	12	429		429		360		743
Lowland	3	2	308	21	2,221	2,242	1,177	1,284	2,461	1,407	4,440		80,601
Mitchell	1	2	12	5	107	112	31	14	45				3,952
Warm Springs	1		18	22		22	76		76		460		847
Whitehall	18	2	11,800	5,071	10	5,081	22,500		22,500	708	65,940		197,212
Willow Creek	1		1,090	244		244	291		291	637	3,360		8,987
Judith Basin County: Barker	1		419	13		13	4,434		4,434	1,000	261,100		16,776
Lewis and Clark County:													
Dry Gulch	3	3	44,210	8,642	12	8,654	17,647		17,647		80		315,443
Greenhorn	1	5	6		30	30	90		90		3,660		1,297
Heddleston	5		2,028	135		135	5,438		5,438	2,398	99,340		13,830
Helena	23	13	9,090	1,059	7,409	8,468	1,866	699	2,565	726	27,800		299,676
Lincoln	3	7	13	19	49	68	142	7	149	124	1,700		2,585
Marysville	20	5	52,752	7,607	4,359	11,966	41,251	810	42,061	9,903	181,420		458,910
Missouri River		3			8,004	8,004		938	938				280,807
Ophir Gulch	2		82	53		53	14		14	2,115			2,104
Rimini	14	3	5,008	668	23	691	41,694	14	41,708	10,743	655,200		87,818
Scratch Gravel	10		481	253		253	893		893	97	6,600		9,831
Smelter	1		163,923								2,726,000	28,924,000	1,958,512
Spokane Hills	2		15	7		7	38		38		1,720		358
Stemple	8		24,227	5,496		5,496	24,698		24,698	4,230	7,080		210,755
Wolf Creek	1		3				14		14	664			85
Liberty County: Corral Creek		1			3	3							105
Lincoln County:													
Cabinet	1		10	2		2							70
Libby	10	8	16,558	977	105	1,082	9,159	7	9,166	1,327	129,280		51,002
Sylvanite	1		10,575	1,118		1,118	10,229		10,229	4,407	84,680		51,136
Troy	2		110	2		2	118		118	266	11,340	8,000	1,255
Madison County:													
Cherry Creek (Havana)	3		249	409		409	10,793		10,793	478			22,044
Norris	30	2	37,929	12,793	1,334	14,127	14,632	194	14,826	1,575	5,060		505,419
Pony	12		55,456	5,769		5,769	8,678		8,678	101,531	340		219,576
Renova	5		24,497	21,539		21,539	131,923		131,923	1,124	80		847,808
Rochester	11	2	1,032	374	5	379	1,416		1,416	142	15,140		15,045
Sheridan	29	13	1,874	1,663	110	1,773	7,764	31	7,795	1,372	44,140	12,000	70,716
Silver Star	20		49,881	11,315		11,315	22,119		22,119	16,566	9,580		414,105
Tidal Wave	25		1,453	1,787		1,787	6,137		6,137	2,044	16,260		67,953
Virginia City	28	12	7,594	3,158	870	4,028	27,052	142	27,194	44	3,300		160,488
Washington	5	2	442	375	1,990	2,365	1,364	495	1,859	124	6,800		84,451

Mine production of gold, silver, copper, lead, and zinc in Montana in 1940, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Meagher County:													
Atlanta Creek		1			2	2							$70
Beaver Creek		11			804	804		180	180				28,268
Camas Creek		2			14	14							490
Thompson Gulch	1	5	20	24	111	135	7	31	38				4,752
Mineral County:													
Cedar Creek		21			1,397	1,397		76	76				48,949
St. Regis	3		63	13		13	3,486		3,486	1,000	2,600		3,177
Missoula County:													
Coloma	4		290	361		361	249		249	460			12,864
Copper Cliff	1		47	5		5	14		14	1,310			333
Elk Creek		3			520	520		66	66				18,247
Nine Mile	1	14	88	23	1,827	1,850	7	38	45				64,782
Wallace	1		26	3		3	443		443	3,230			785
Park County:													
Emigrant Creek		7			442	442		76	76				15,524
New World	4		10,107	1,069		1,069	11,025		11,025	36,000	61,400		52,393
Sheepeater (Jardine)	1		57,812	9,317		9,317	1,866		1,866				327,422
Phillips County: Little Rockies	2	4	124,009	14,191	179	14,370	94,628	31	94,659				570,263
Powell County:													
Big Blackfoot	2	1	19	11	4	15	31		31				547
Douglas Creek		1			5	5							175
Nigger Hill (Elliston)	11	2	5,906	934	3	937	9,474		9,474	3,292	67,840		43,296
Ophir	2	3	50	18	44	62	45	7	52	5,274			2,803
Pioneer		6			3,502	3,502		419	419				122,868
Washington Gulch	1	8	40	40	651	691	38	83	121		840		24,313
Zozell	8		4,375	2,399		2,399	66,216		66,216	434	35,520	7,000	133,318
Ravalli County:													
Curlew	1		10,047	144		144	18,793		18,793	8,000	50,900	407,000	47,494
Eight Mile	1		10	7		7	31		31				267
Overwich	1	6	31	19	349	368		21	21				12,895
Sanders County:													
Eagle	1		43,274	71		71	35,602		35,602	53,168	8,215,080	835,000	497,169
Noxon	1		5	3		3							105
Plains	1		3				474		474		100		342
Prospect Creek	2		27	8		8	149		149		6,440		708
Revais Creek	1		592	150		150	682		682	225,319			31,196
Trout Creek	1		13	25		25	204		204	513	3,380		1,247
Vermillion	2	2	275	66	27	93	97		97				3,324
Silver Bow County:													
Butte or Summit Valley	40		3,746,512	17,697		17,697	8,752,708		8,752,708	250,884,000	17,718,500	71,798,000	40,602,634
Divide Creek	4		135	18		18	931		931				1,292

German Gulch		2			6	6							210
Highland	2		17,136	7,328		7,328	519		519				256,849
Independence	3		799	40		40	11,984		11,984				9,922
Lost Child		1			2	2							70
Melrose	1		28	2		2	256		256				252
Silver Bow Creek		5			14	14							490
Stillwater County: Yellowstone River		2			50	50		7	7				1,755
Toole County: Gold Butte		3			8	8							280
Total Montana	687	285	5,099,241	208,455	64,147	272,602	12,349,395	11,655	12,361,050	252,782,000	46,072,000	105,174,000	55,825,078

BEAVERHEAD COUNTY

Argenta district.—The value of the metal output of the Argenta district was slightly higher in 1940 than in 1939. The Ermont property, largest producer in the district, operated throughout 1940 and treated 33,217 tons of gold ore in the 100-ton countercurrent cyanide mill. The gold output about equaled that of 1939. Among other producing mines in the district were the Goldfinch, May Day, Shafer, Ground Hog, Iron Mountain, Rosemont, and Hardly Able; all shipped ore crude to a smelter.

Bald Mountain district.—Lessees shipped gold ore from the Faithful group to a custom cyanide mill at Bannack in 1940.

Bannack district.—Placer gravels continued in 1940 to be the chief source of gold output in the Bannack district, although production from lode mines increased over 1939. Two cyanidation mills were active and treated the bulk of the ore. The Bannack-Apex Mining Co. operated its 50-ton cyanidation mill on company and custom ore from January until October and treated 8,218 tons of gold ore. The Priscilla property, with its 100-ton cyanidation mill, was operated from February to October and treated 1,120 tons of gold ore. Other producing lode mines in the district included the Gold Bug and Amazon. The Ralph E. Davis Syndicate used a dry-land dredge, removed 405,290 cubic yards of overburden, and washed 170,310 cubic yards of gravel from which about 2,000 ounces of gold were recovered. Equipment comprised a 5-cubic yard dragline, a 1½-cubic yard dragline, and two electric-powered washing plants. A small hydraulic plant at the Dark Horse placer washed about 20,000 yards of gravel.

Big Hole district.—The bulk of the metal output in 1940 from the Big Hole district came from the smelting of crude gold ore from the Star mine on Meadow Creek and from the amalgamation of gold ore from the North mine in Spring Gulch. A little placer gold was recovered by sluicing.

Blue Wing district.—The output from the Blue Wing district in 1940 was siliceous silver ore shipped crude to smelters from the Silver Buckle, Federal Star, Ingersoll group, and Silver Snow properties.

Bryant district.—There were 43,084 tons of silver tailings and 5 tons of lead ore shipped crude to smelters in 1940 from the Hecla mine west of Melrose.

Horse Prairie Creek district.—A dry-land dredge, operated at the Gold Leaf placer, recovered all the output from the Horse Prairie Creek district in 1940.

Polaris district.—Two small lots of siliceous silver ore shipped direct to smelters from the Homestake and Silver King properties comprised the production from the Polaris district in 1940.

Vipond district.—Lessees working the Lone Pine & Argyle property shipped 2,411 tons of silver ore to the Anaconda smelter in 1940; the rest of the output from the Vipond district was silver ore shipped crude from the Monte Cristo mine.

BROADWATER COUNTY

Backer district.—The value of the metal output from the Backer district declined in 1940 owing to the decrease in gold recovered from placer gravels. The Fair Play Placers, Inc., operating in Confederate

Gulch, was again the largest producer of placer gold in the district; the dragline floating dredge of the company washed 170,000 cubic yards of gravel. Three other properties (the Rose, Confederate Gulch, and Boulder Bar group), each equipped with a dry-land dredge, washed a total of 156,000 cubic yards of gravel. The remainder of the placer gold produced was recovered from several small sluicing operations, principally in Confederate Gulch. Most of the lode output came from the unusually rich gold ore at the Superior mine, treated by amalgamation. Among other producing lode mines were the Blind Mike, Cooper, and Elizabeth.

Beaver district.—The Custer mine and 75-ton flotation mill, operated by lessees, was again the largest producer in the Beaver district, but the quantity of gold ore shipped crude and gold concentrates was slightly less than in 1939. A new 50-ton flotation mill was completed in November on the property of the Native Silver Mining Co. about 5 miles from Winston; after treating a small tonnage of gold ore the mill was closed for the remainder of the winter. Gold ore shipped crude to a smelter and gold ore milled, making lead concentrates, comprised the output from the East Pacific property. Among other producing mines in the district in 1940 were the Iron Age, Vosburg, Midas, and Emma.

Cedar Plains district.—The value of the metal output from the Cedar Plains district was $132,457 greater in 1940 than in 1939, owing to increased output from the Ohio Keating and Keating properties. The M & M Mining Co., operating the Ohio Keating mine, produced and shipped over 6,000 tons of gold concentrates from its 80-ton flotation mill. The 100-ton flotation plant of the C. G. Gold Corporation treated 30,129 tons of gold ore from the Keating property during 1940 and made 4,000 tons of gold concentrates; in addition, considerable gold ore from the property was shipped crude to a smelter. Other production from the district included lead ore from the Camp Bird and gold ore from the Robert E. Lee and Hard Cash properties, all shipped crude to smelters.

Park district.—The value of metal production from the Park district was more than double that in 1939 (a gain of $155,402), owing to the large increase in placer-gold output. The Cooley Gravel Co., formerly operating in Colorado, moved its dragline floating dredge to Indian Creek; dredging was begun in April and terminated in December; and during this period, 662,119 cubic yards of gravel were washed. The Wilson Placers, which began operating the dry-land dredge in March, washed 500,000 cubic yards of gravel and recovered 2,063 fine ounces of gold. The rest of the placer output came from small sluicing operations near Warm Springs. The Marietta Mines shipped considerable lead and gold ore crude to smelters and produced most of the metal output from lode mines in the district. Gold ore from the Diamond Hill mine was treated in a 5-stamp amalgamation plant.

CASCADE COUNTY

Montana district.—Seven flotation mills operated in the Montana district in 1940 and treated a total of 74,405 tons of ore of all classes. Concentrates derived from these ores raised the total value of metal production in the district to more than twice that in 1939. The Montana Silver Queen Mining Co., which changed its name to Lexington Mining Co. in June 1940, treated 22,097 tons of gold-silver ore in its 75-ton flotation mill and produced the bulk of the gold and silver output of the district. A new 70-ton flotation mill was constructed and put in operation by the Klies Mining Co. during June 1940; the 20,800 tons of zinc-lead ore treated contained 60 ounces of gold, 78,208 ounces of silver, about 7,800 pounds of copper, 1,693,120 pounds of lead, and 2,371,200 pounds of zinc. Among other important producers in the Montana district were the Florence Mining Co., which treated 11,000 tons of silver ore in a 50-ton flotation mill; the Hartley property, from which about 8,500 tons of zinc-lead ore were treated in a 40-ton flotation mill; the London & Star property, from which 2,030 tons of lead ore were treated in a 35-ton flotation plant; and the Queen of the Hills property, from which 550 tons of silver ore were milled in a 60-ton flotation plant. Some ore was shipped crude to smelters from the Commonwealth, Peabody, and Silver Belt mines.

DEER LODGE COUNTY

Dry Gulch district.—Sluicing on Modesty Creek recovered some gold in 1940.

French Gulch district.—Sluicing operations on California Creek in the French Gulch district recovered some gold and silver.

Georgetown district.—The Southern Cross Holdfast group continued to be the chief producer in the Georgetown district. During 1940 consolidation of the Holdfast group and the Southern Cross mine was effected, enabling the operators of both properties to treat gold ore in the 65-ton cyanide plant at the Holdfast property; 17,443 tons of gold ore, containing 4,700 ounces of gold and 700 ounces of silver, were handled at the plant. In addition, 3,507 tons of gold ore were shipped crude to the Anaconda Copper smelter from the Southern Cross group. The 100-ton amalgamation-concentration plant at the Cable property was operated from May to October and treated a small tonnage of gold ore for testing purposes. Among other producers were the Gold Coin and Revenue properties. A small amount of placer gold was recovered from sluicing.

Heber district.—A little placer gold was obtained from gravels in the Heber district in 1940.

Oro Fino district.—Crude ore was shipped to smelters in 1940 from the Champion, Independent, Banker, and Grizzly Bear mines.

Silver Lake district.—Silver ore was shipped crude to smelters from the Silver Reef and Silver King properties in 1940.

FERGUS COUNTY

Cone Butte district.—A total of 154 tons of gold ore from the Thomas group and Old Glory mines was treated by cyanidation in 1940.

North Moccasin district.—The lode output of the North Moccasin district came from the Barnes King property 20 miles north of Lewiston. A larger tonnage was treated in 1940 than in 1939, but it was of lower grade; the mine was equipped with a 200-ton cyaniding plant.

Warm Springs district.—Most of the metal production from lode mines in the Warm Springs district was crude ore shipped to smelters; the Mathiews, Argentite, and Betty were the chief producers. A little gold ore from the Maginnis group was treated by amalgamation.

FLATHEAD COUNTY

Hog Heaven district.—The Flathead property, worked by the Anaconda Copper Mining Co., shipped crude to smelters 16,277 tons of silver ore and 15,700 tons of lead ore in 1940. The rest of the production from the Hog Heaven district was gold-silver ore from the Eudora mine and silver ore from the Grant property.

GALLATIN COUNTY

Gold ore from the Beacon mine, lead ore from the Last Chance mine, and a small amount of placer gold from the Jewel Placer comprised the production reported from Gallatin County in 1940.

GRANITE COUNTY

Alps district.—The output from the Alps district in 1940 comprised gold ore (amalgamated) from the Bitterroot Lemhi Mining property, a car of copper ore shipped crude to a smelter from the Hidden Treasure mine, and a little placer gold.

Boulder district.—Most of the gold recovered from lodes in the Boulder district came from the Gold King and Gold Mountain mine; the output comprised 383 tons of gold ore containing 314 ounces of gold. A little gold was recovered from the Montana-Tonopah Placer.

Dunkleberg district.—A car of lead ore was shipped crude from the Blue Belle property, and a car of zinc-lead ore was shipped to the Anaconda zinc plant from the Forest Rose mine.

First Chance district.—The value of the metal output from the First Chance district was more than double that in 1939 due to placer operations. The 6-cubic foot electrically driven Yuba bucket dredge of the Star Pointer Exploration Co. operated near Bearmouth all of 1940 and washed 1,943,700 cubic yards of gravel. A small dry-land dredge was operated on the Cayuse ground. The rest of the placer output came from small slucing operations. During 1940, lessees continued to operate the Mitchell-Mussigbrod group, again the largest lode producer in the district. The Grant & Hartford group of claims also was operated by lessees and produced a substantial quantity of gold.

Flint Creek district.—Old tailings from the Granite-Bimetallic, operated by the Philipsburg Mining Co., were shipped to the Washoe and Tacoma smelters in 1940 and yielded the bulk of the gold and silver output of the Flint Creek district. The Taylor-Knapp Co. shipped silver ore crude to smelters from the Two Percent mine. The Contact Mines Corporation operated the Silver Prince (Scratch All) group throughout 1940 and shipped silver ore crude to smelters and zinc-lead milling ore to the Anaconda zinc mill. Old tailings from manganese concentrates and zinc-lead ore treated in the Anaconda plant comprised the output of the Trout Mining Division of American Machine & Metals, Inc. Gold-silver smelting ore was shipped to the smelter from the property of the Moorlight Mining Co.

Gold Creek district.—Most of the lode output from the Gold Creek district in 1940 came from the Golden Gate mine, which shipped gold ore crude to Washoe. Nearly all the placer gold produced was recovered from hydraulic and drift mining operations by the Master Mining Co. on upper Gold Creek.

Henderson district.—Lessees shipped gold ore crude to a smelter from the Sunrise property in 1940. The dry-land dredge operated by H. J. Schneider & Bros. on the New Deal ground was the chief producer of placer gold.

Maxville district.—The Miller mine was the only producer in the Maxville district in 1940; it shipped gold ore and gold-silver ore crude to Washoe.

Moose Lake district.—A small lot of gold ore was shipped from the Banner property in 1940.

Red Lion district.—The total value of metal output from the Red Lion district declined in 1940, chiefly because of the small tonnage of gold ore treated in the cyanide plant of the Red Lion Mining Co. Virtually all the remaining output came from gold ore shipped crude from the Lilly Dixon mine.

Rock Creek district.—A little gold-silver ore was shipped from the Ozark property to Washoe. Placer gold was recovered principally from the Basin property in Basin Gulch.

JEFFERSON COUNTY

Amazon district.—Crude ore was shipped to smelters in 1940 from the Adolphus, Wilbur Silver, Pilot, East Mint, Gold Point, and Winchester mines.

Bigfoot district.—A small lot of gold ore was shipped to smelters from the State property in 1940.

Boulder district.—Crude ore was shipped to smelters from several mines in the Boulder district in 1940, including the Baltimore, Ida, and Ing properties. Some gold was produced from placers near Boulder.

Cataract district.—The total value of metal output of the Cataract district gained $121,500 in 1940 over 1939, due almost entirely to increased output of metals from zinc-lead ore at the Comet property. The Basin Montana Tunnel Co. operated the property and 200-ton flotation mill throughout the year. Although the quantity treated was 57,825 tons in 1940 compared with 59,420 in 1939, the zinc-lead ore had a higher gold, silver, and lead content, which increased the value. The Boulder, Congo, Crystal, Bullion, Morning Glory, and Josephine mines were among the other producers in 1940. Most of the gold recovered from placer gravels came from the dragline floating dredge operated on Basin Creek 13 miles north of Basin.

Clancey district.—In 1940, as usual, the bulk of the metal output from the Clancey district came from placer operations. Winston Bros. Co. operated its 6-cubic foot electrically powered Yuba dredge throughout the year and was again the largest producer of placer gold in Montana. A total of 1,880,436 cubic yards of gravel was washed compared with 1,787,413 in 1939. The Jefferson Placers operated a dry-land dredge on Clancey Creek from July to November and washed 195,420 cubic yards of gravel, from which 588 ounces of gold were recovered. Otis Williams Co. recovered some gold on Prickly Pear Creek, using a small dry-land dredge. The rest of the placer output came from several small sluicing operations. The output from lode mines was ore shipped crude to smelters and came chiefly from the Sullivan, Panama, and Emma mines.

Colorado district.—The Alta property near Wickes was operated all of 1940 by Eathorne & Fox and was again the leading producer in the Colorado district. Old tailings totaling 43,810 tons were treated in the 200-ton flotation mill, and 1,741 tons of lead concentrates were shipped to East Helena. About 1,500 tons of gold-silver ore were shipped crude to smelters from the Bluebird mine, which was operated throughout 1940. Other active mines in the Colorado district included the Pen Yan, Yellow Jacket, and Blizzard.

Elkhorn district.—The placer gold produced in the Elkhorn district in 1940 came from gravels on Elkhorn Creek. Winston Bros. Co., using a Bodinson floating washing plant and a 3½-cubic yard electric-powered dragline, began operations May 19 and continued until November 4, except for a shut-down during August and September; during this period, 272,766 cubic yards of gravel were washed. Most of the lode output came from crude ore shipped to smelters from the Golden Curry, Klondyke, and Center Reef mines.

Golconda district.—The output from the Golconda district in 1940 comprised gold ore and lead ore shipped crude to smelters.

Homestake district.—The output from the Homestake district in 1940 comprised gold, silver, and lead ore shipped crude to smelters and some gold recovered from sluicing operations on Betty Creek.

Lowland district.—Virtually all the placer-gold output from the Lowland district came from operations on the Autumn placer. Kit Carson Placers operated this property from April through October and used a dry-land washing plant, a 2-cubic yard Diesel dragline, and a ¾-cubic yard gasoline-powered dragline. The plant treated 180,000 cubic yards of gravel and recovered 1,283 ounces of fine gold. The lode output came from the Montreal Star, Golden Eagle, and Storehouse properties.

Mitchell district.—Placer gold was produced from the Lewis Placer and the John & Jim group in 1940.

Warm Springs district.—Gold ore was shipped crude to smelters from the Katie mine near Blue Grouse Creek.

Whitehall district.—Lessees operating the Golden Sunlight mine throughout 1940 shipped crude to Washoe 10,854 tons of gold ore, which contained 4,693 ounces of gold and 20,109 ounces of silver.

Willow Creek district.—The output from the Willow Creek district in 1940 comprised gold ore from the Deer Horn mine, treated by amalgamation and concentration, and a small shipment of crude gold ore.

JUDITH BASIN COUNTY

Barker district.—Production from the Glendennin group, operated by Thorson Bros., comprised 419 tons of lead ore sent crude to East Helena for treatment. This was the only output in 1940 reported from Judith Basin County.

LEWIS AND CLARK COUNTY

Dry Gulch district.—The Golden Messenger mine was operated all of 1940 by the Golden Messenger Corporation; the metal output was higher in 1940 because higher-grade ore was treated in the 150-ton cyanidation mill. The production comprised 44,152 tons of gold ore cyanided, which contained 8,535 ounces of gold and 22,076 ounces of silver.

Greenhorn district.—Placer gold was recovered in 1940 by sluicing operations, chiefly in Skelly, Louis, and Jeff Davis Gulches. A small lot of lead ore was shipped crude from the Lincoln mine.

Heddleston district.—A total of 1,520 tons of gold ore and old tailings from the Andrew Brown property was cyanided in 1940. The Mike Horse Mining & Milling Co. shipped several cars of lead ore crude to smelters.

Helena district.—Both placer and lode production in the Helena district decreased in 1940 from 1939; however, placer gravels remained the chief source of metal values. Porter Bros. Corporation operated its 6-cubic foot electric-powered Yuba dredge on the Last Chance Gulch placer all the year and washed 1,720,557 cubic yards of gravel. The rest of the placer output came from small sluicing operations near Helena. The Montana Consolidated Mines Corporation treated gold ore from the Spring Hill mine by cyanidation and concentration and produced the bulk of the lode output; operations stopped in April.

Lincoln district.—Placer gold contributed the larger portion of the value of the metal output from the Lincoln district in 1940. Sluicing was carried on chiefly in McClellan Gulch, Park Creek, and Sauer Kraut Gulch. The Gold Dollar, Lincoln, and Mazuma mines shipped ore crude to a smelter.

Marysville district.—The value of the metal output of the Marysville district in 1940 increased $46,453 over 1939, chiefly because of gains at lode mines. The Martin Mining Co. treated over 30,000 tons of old tailings from the Eck mine in a 125-ton roasting and cyanide plant and was the largest producer of lode gold and silver. Lessees shipped 914 tons of gold ore and 6 tons of lead ore, which contained 1,001 ounces of gold and 1,360 ounces of silver, to smelters from the Shannon mine. The J. C. Archibald Co. treated 11,107 tons of tailings from the Bald Butte mine in a 100-ton cyanide plant, and the precipitates sold to the Midvale refinery contained 956 ounces of gold and 1,339 ounces of silver. The 50-ton flotation mill of the Rex Mining Co. treated 6,505 tons of gold ore from the Empire group of mines; 267 tons of lead concentrates were produced, which contained 636 ounces of gold, 2,559 ounces of silver, 9,520 pounds of copper, and 170,173 pounds of lead. Lessees operated the Bald Butte and Drumlummon properties throughout 1940 and shipped 2,099 tons of gold ore crude to smelters. Other mines producing included the Penobscot, Piegan-Gloster, and Neenan groups. Ralph Davis, Inc., operating a dragline floating dredge on Silver Creek, treated 776,505 cubic yards of gravel and was again the leading producer of placer gold in the district. The Holmes Gulch Mining Co., Inc., using a dry-land dredge, washed 289,000 cubic yards of gravel.

Missouri River district.—The Perry-Schroeder Mining Co. operated throughout 1940 its Yuba bucket dredge on the Missouri River 15 miles from Helena and treated 1,736,200 cubic yards of gravel. The dredge is electric-powered and is equipped with ninety-two 6-cubic foot buckets.

Ophir Gulch district.—Gold ore was shipped direct to smelters from the Nora Darling and Beverly properties in 1940.

Rimini district.—Most of the lode production in the Rimini district in 1940 came from crude lead ore shipped from the Armstrong mine and gold-silver ore milled from the Little Lilly mine; output was reported at 12 other lode properties in the district. Some gold was recovered from placers, chiefly in Monitor Gulch.

Scratch Gravel district.—The Ajax property, largest producer in the Scratch Gravel district in 1940, shipped 273 tons of gold ore which contained 116 ounces of gold and 420 ounces of silver.

Smelter district.—The fuming plant of the Anaconda Copper Mining Co. continued to treat slag from the lead smelter of the American Smelting & Refining Co. at East Helena and was active throughout 1940. The value of the output of zinc-lead fume sent to Great Falls was $509,972 higher than in 1939.

Spokane Hills district.—Gold ore from the Grubstake mine shipped crude to a smelter and lead ore from the Black Jack mine comprised the output from the Spokane Hills district in 1940.

Stemple district.—The Gould mine operated by the Standard Silver-Lead Mining Co. produced nearly all the metal output in the Stemple district in 1940. Gold ore treated in the 80-ton cyanide plant totaled 23,044 tons; cyanide bullion shipped to the Seattle Assay Office and slag to East Helena contained 5,238 ounces of gold and 19,940 ounces of silver.

LIBERTY COUNTY

A little placer gold was recovered from the Antelope mine in the Corral district in 1940.

LINCOLN COUNTY

Libby district.—The Courageous Mining Co. treated 7,500 tons of gold ore from the Branagan mine in its 150-ton amalgamation and flotation-concentration mill. The Glacier Silver-Lead Mining Co. treated 8,473 tons of gold ore in its 150-ton flotation mill and produced 240 tons of lead concentrates. The Snowshoe mine near Libby was equipped with a new 100-ton concentrating mill by the operators, Roark and Clark, and 300 tons of lead ore were treated as a test in 1940.

Sylvanite district.—The Morning Glory Mines, operating the Sylvanite (Keystone) property, ceased work in August after treating 10,575 tons of gold ore by amalgamation and concentration.

Troy district.—The output from the Troy district in 1940 was zinc-lead milling ore from the Red Shirt mine and gold ore from the Big Nugget mine.

MADISON COUNTY

Cherry Creek (Havana) district.—Gold-silver ore was shipped crude to smelters in 1940 from the East Riverside, New Havana, and September Syndicate properties.

Norris district.—There was a substantial increase in lode-gold output from the Norris district in 1940, owing chiefly to large gains in gold by cyanidation. The 60-ton cyanide plant of the Boaz mine treated 15,965 tons of gold ore in 1940 compared with about 1,500 tons in 1939; the bullion sent to the Seattle Assay Office contained 7,072 ounces of fine gold compared with a total of 2,511 ounces of gold from shipments of crude ore and bullion in 1939. The Revenue mine was operated the entire year by Revenue Mine Developing Group, Inc.; 20,533 tons of gold ore were cyanided compared with 26,280 tons in 1939, but the gold contained in the cyanide bullion totaled 4,044 fine ounces, or slightly more than in 1939. Among other lode mines making sizable production were the Emperor, Grubstake, New York Belle, Galena, and Lexington. Virtually all the placer-gold output came from the bucket dredge operated by Homer Wilson on Norwegian Placer. The dredge is equipped with sixty-three 5-cubic foot buckets and in 1940 washed 190,000 cubic yards of gravel from which 1,328 ounces of gold were recovered—a slight increase over 1939.

Pony district.—The value of metal output from mines in the Pony district decreased from $275,762 in 1939 to $219,576 in 1940, owing chiefly to the smaller tonnage of gold ore treated from the Mammoth mine (18,624 tons compared with 28,324 in 1939) by the Liberty Montana Mines Co. in its 120-ton flotation mill. Gold ore milled from the Atlantic-Pacific by the Montana Southern Mining Co. was 36,583 tons, about the same as in 1939.

Renova district.—The West Mayflower mine, owned and operated by the Anaconda Copper Mining Co., was again the largest gold producer in Montana. In 1940, 23,823 tons of gold ore containing 20,933 ounces of gold and 131,192 ounces of silver were shipped to the Anaconda smelter.

Rochester (Rabbit) district.—The Lively Mining Co. operated the Hidden Treasure mine from April to December and produced most of the lode output in the Rochester district in 1940. Crude ore shipped to smelters included ore from Franz group, Gold Crown, Gold Hill, and Half Sole mines.

Sheridan district.—The Sheridan Gold Mining & Milling Co. was again the largest producer in the Sheridan district; in 1940 the company shipped gold ore crude to a smelter from the Homestake and Uncle Sam, Occidental, and Lakeshore mines. Zinc-lead milling ore also was shipped from the Lakeshore mine to the Anaconda mill.

Silver Star district.—Victoria Mines, Inc., operating the Broadway (Victoria) mine, treated 37,174 tons of gold ore in 1940 (32,991 in 1939) in the 100-ton straight cyanidation mill and shipped 1,282 tons of gold ore (5,314 in 1939) direct to smelters. The Green Campbell Mining Co. operated the Green Campbell mine throughout the year, treated 6,650 tons of gold ore in the 25-ton amalgamation-flotation mill, and shipped 341 tons of gold ore crude to smelters; the output of gold from the property increased 417 ounces.

Tidal Wave district.—The Hi-Ridge mine in Dry Gulch was operated throughout 1940 by lessees and was the chief producer in the Tidal Wave district. About 600 tons of gold ore, which contained over 1,000 ounces of gold, were shipped to Anaconda.

Virginia City district.—The decline in lode output in the Virginia City district in 1940 was due to smaller tonnages of gold ore shipped crude to smelters. Five mines—the Bartlett, East & West Mapleton, High Up, St. John, and Alameda—shipped an aggregate of 5,661 tons of gold ore, which contained 2,534 ounces of gold; the Bartlett mine was the largest producer. Among other producing lode mines in the district were the Apex, Easton-Pacific, El Fleda, and U. S. Grant. Gold was recovered by amalgamation from the Cedar Hill, Gold Bar, Mitchel, and Valley View. The Howe Dredging Co., operating claims in Alder Gulch, was the largest producer of placer gold; equipment was a dry-land dredge, and 42,500 cubic yards of gravel were washed.

Washington district.—In 1940 the Gold Creek Mining Co., operating a floating connected-bucket dredge equipped with seventy-six 4½-cubic foot buckets, washed 772,955 cubic yards of gravel and recovered 1,986 ounces of fine gold.

MEAGHER COUNTY

Beaver Creek district.—A dry-land dredge operated on Thomas Creek by the T. C. Mines treated 107,000 cubic yards of gravel in 1940 and recovered 723 ounces of gold.

Camas Creek district.—Some gold was recovered by sluicing.

Thompson Gulch district.—Nearly all the placer output came from operation of a dry-land dredge on the Josephine placer. The lode output came from the Snowbank mine in upper Thompson Gulch.

MINERAL COUNTY

Cedar Creek district.—Placer gravels treated by Superior Mines, Inc., using a dry-land dredge, yielded the bulk of the gold output from the Cedar Creek district in 1940.

St. Regis district.—The metal output from the St. Regis district in 1940 consisted of silver ore shipped crude from the Last Chance mine, gold concentrates from gold ore milled at the Lenora mine, and lead ore from the Wilson mine shipped crude to a smelter.

MISSOULA COUNTY

Coloma district.—Nearly all the metal output from the Coloma district came from gold ore shipped crude to smelters from the Mammoth and East Mammoth group, Dandy, and Dixie mines. A little gold ore from the Dandy mine was treated in a 25-ton flotation mill.

Copper Cliff district.—Lessees shipped gold ore from the Copper Cliff mine in 1940.

Elk Creek district.—Most of the gold produced in the Elk Creek district in 1940 came from a dry-land dredge operated by Norman Rogers at Elk Creek, which treated 110,000 cubic yards of gravel.

Nine Mile district.—The Weaver Dredging Co. moved a dragline floating dredge from California to Montana in 1940 and operated it from July 5 to December 12. During this period, 250,636 cubic yards of gravel from Nine Mile Creek were washed and yielded 1,681 fine ounces of gold. Smelting ore was shipped from the Martina mine 10 miles north of Stark.

Wallace district.—Copper ore from the Hidden Treasure mine was shipped crude to a smelter in 1940.

PARK COUNTY

Emigrant Creek district.—Most of the placer gold produced in the Emigrant Creek district in 1940 was recovered by the Crown Mining Co., using mechanical equipment.

New World district.—The McLaren Gold Mines Co. treated 9,291 tons of gold ore and tailings from the Estelle mine by flotation and shipped copper concentrates rich in gold to a smelter. Lead ore was shipped crude from the Irma, Big Blue, and Black Warrior mines.

Sheepeater (Jardine) district.—The Jardine Mining Co. operated throughout 1940 at the Jardine property 6 miles north of Gardiner. The amalgamation and concentration mill (capacity raised from 185 to 300 tons) treated 57,812 tons of gold ore.

PHILLIPS COUNTY

Little Rockies district.—The Ruby Gulch Mining Co. continued to operate the Ruby Gulch property in 1940 and treated about 84,000 tons of gold ore in the 300-ton cyanidation plant; the output was slightly larger than in 1939. The Little Ben Mining Co. operated throughout the year, and 40,009 tons of ore from the August mine were treated in the 150-ton cyanide plant; the output of gold decreased about 1,200 ounces from 1939.

POWELL COUNTY

Big Blackfoot district.—A little gold ore was shipped crude to smelters from the Higgins and Hill Top mines in 1940.

Nigger Hill (Elliston) district.—Big Dick Mines, Inc., treated 5,500 tons of gold ore from the Big Dick property in the 50-ton flotation plant. The gold concentrates (578 tons) were shipped to East Helena for smelting.

Ophir district.—Lessees recovered some placer gold by hydraulicking on the Levi Davis placer. Gold ore and copper ore were shipped crude to smelters from the Victory and Morning Star mines.

Pioneer district.—The Pioneer Placer Dredging Co., operating its bucket dredge in 1940 from January 1 to November 14 in Pioneer Gulch, Gold Creek, and Pike's Peak Creek, treated 1,037,050 cubic yards of gravel and recovered slightly less gold than in 1939. The dredge is equipped with eighty 9-cubic foot buckets.

Washington Gulch district.—A dry-land dredge, operated by the McKenzie Placers at the Toole Patent in Jefferson Gulch, recovered most of the placer gold output in the Washington Gulch district in 1940.

Zozell (Emery) district.—Nearly all the output from the Zozell district in 1940 came from ore shipped crude to smelters; the active mines included the Blue Eyed Maggie, Emery Consolidated, Emma Darling, and Hidden Hand.

RAVALLI COUNTY

Curlew district.—The output from the Curlew district in 1940 came from the Curlew mine; it comprised 10,000 tons of old tailings which were treated in the 70-ton flotation mill and produced 491 tons of zinc concentrates, and 47 tons of gold-silver ore which was shipped crude to a smelter.

Eight Mile district.—Gold ore was shipped crude from the Gold Leaf mine in 1940.

Overwich district.—A little gold ore from the Washington mine was amalgamated in 1940. Placer gold was recovered from the gravels of Hughes Creek.

SANDERS COUNTY

Eagle district.—The Jack Waite mine, which extends over the State line into Idaho, was worked throughout 1940 by the American Smelting & Refining Co. The output was greater than in 1939, as 41,711 tons of zinc-lead ore (36,028 tons in 1939) of about the same grade were treated in the flotation plant at Duthie, Idaho. In addition, the company shipped 1,563 tons of rich lead ore crude to a smelter.

Revais Creek district.—Copper ore from the Drake group was shipped crude by the Green Mountain Mining Co. in 1940.

Vermillion district.—Gold ore from the Razorback mine and a small lot of custom ore were milled in a 5-ton flotation plant.

Other districts.—Production was also reported from the Heidelburg mine in the Noxon district, the Dog Lake mine in the Plains district, the Montana Standard property in the Prospect Creek district, and the Ambassador group in the Trout Creek district.

SILVER BOW COUNTY

The total value of the metal output from mines in Silver Bow County in 1940 gained $13,194,360 over 1939, as production of both copper ore and zinc-lead ore from mines at Butte increased. The following table gives the output of mines in Silver Bow County, which includes the Butte or Summit Valley district, in 1939 and 1940 and the total from 1882 to the end of 1940.

Production of gold, silver, copper, lead, and zinc in Silver Bow County, Mont., 1939–40, and total, 1882–1940, in terms of recovered metals

Year	Mines producing	Ore (short tons)	Gold (lode and placer) (fine ounces)	Silver (lode and placer) (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
1939	57	2,498,922	22,036	6,114,455	194,533,471	9,415,341	40,032,288	$27,677,359
1940	58	3,764,610	25,107	8,766,398	250,884,000	17,718,500	71,798,000	40,871,719
1882–1940		(1)	1,923,326	508,783,544	[2] 5,879,248	[2] 207,106	[2] 1,471,821	2,373,911,414

[1] Figures not available. [2] Short tons.

Butte or Summit Valley district.—The output of copper ores from all copper mines of the Anaconda Copper Mining Co. at Butte gained sharply in 1940 over 1939 owing to the greatly increased rate of operations throughout the year. In 1940, 2,737,572 tons of copper ore were sent to the copper concentrator at Anaconda compared with 2,197,863 tons in 1939, and 3,812 tons of mine-water precipitates were treated compared with 2,007 in 1939. In addition, 510,972 tons of mine-dump material containing about 1 percent copper were concentrated at Anaconda, and 37,835 tons of copper ore were sent crude to the smelter. All zinc mines of the Anaconda Copper Mining Co. were operated throughout 1940; the output comprised 362,479 tons of zinc-lead ore treated at the Anaconda zinc concentrator compared with 200,036 tons in 1939. The output of recoverable metals in 1940 (from all classes of ore) increased decidedly over 1939—gold over 5,500 ounces, silver over 2,000,000 ounces, copper about 56,000,000 pounds, lead nearly 5,000,000 pounds, and zinc over 18,000,000 pounds. Development work at the copper mines comprised 1,278 feet of shaft sinking, 183,578 feet of drifting, and 11,776 feet of diamond drilling; development at the zinc mines comprised 20,632 feet of drifts and 2,765 feet of diamond drilling. Operations were continued throughout the year at the Emma mine, leased by the Anaconda Copper Mining Co. from the Butte Copper & Zinc Co.; the production was 77,353 tons of zinc-lead ore treated at the Anaconda zinc concentrator. In addition, the company produced 34,813 short tons of manganese ore. The Timber Butte mill was cleaned up in 1940, and 238 tons of high-grade zinc cleanings were shipped to the Anaconda zinc smelter.

Divide Creek district.—The output from the Divide Creek district in 1940 was gold ore and silver ore shipped crude to smelters, chiefly from the Climax mine.

Highland district.—The Butte Highlands Mining Co. operated the Highlands Group (Tilton) throughout 1940 and treated 17,125 tons of gold ore in the 75-ton cyanide plant.

Independence district.—Silver ore was shipped crude to smelters from the Brilliant, Deadwood, and Goldflint mines.

Melrose district.—A little gold-silver ore was shipped from the Annie property in 1940.

STILLWATER COUNTY

Placer gold was recovered in Stillwater County in 1940 from sluicing operations on the Yellowstone River.

TOOLE COUNTY

Placer gold was recovered in the Gold Butte district in 1940 from drift and sluice mines.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEVADA

(MINE REPORT)

By Charles White Merrill and H. M. Gaylord

SUMMARY OUTLINE

The total value of gold, silver, copper, lead, and zinc recovered from ores, old tailings, and gravels in Nevada in 1940—$37,089,777—was greater than in any year since 1918 (see fig. 1). The quantity of gold produced exceeded that in any year since 1916, and its value was greater than in any year since 1912. The quantity of copper produced in 1940 was surpassed only in the record year 1928, when the output was 158,876,883 pounds. Each of the five metals exceeded 1939 in both quantity and value—gold increased 6 percent in both quantity and value, silver 20 percent in quantity and 26 percent in value, copper 18 percent in quantity and 28 percent in value, lead 77 percent in quantity and 88 percent in value, and zinc 90 percent in quantity and 130 percent in value. The total value of the five metals was 22 percent greater than in 1939; of this total, copper comprised 48 percent, gold 36, silver 10, zinc 4, and lead 2 percent.

White Pine County continued in 1940 to be the largest contributor to the mineral output of the State; it ranked first in copper and second in gold production. Humboldt County was the leading gold producer, and Esmeralda the leading silver producer; Lincoln County led in both lead and zinc output.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

Yardage figures used in measuring material treated in placer operations are "bank measure"; that is, the material is measured in the ground before treatment.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1936–40

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1936	$35.00	$0.7745	$0.092	$0.046	$0.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052
1940	35.00	[6] .711+	.113	.050	.063

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+($20.671835) per fine ounce.

[2] 1936–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–40: Treasury buying price for newly mined silver.

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

[4] $0.64646464. [5] $0.67878787. [6] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Nevada, 1936–40, and total, 1859–1940, in terms of recovered metals

Year	Mines producing [1]		Ore, old tailings, etc. (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1936	661	119	6, 584, 138	286, 370	$10, 022, 950	5, 068, 786	$3, 925, 775
1937	682	117	7, 565, 466	281, 332	9, 846, 620	4, 864, 750	3, 762, 884
1938	795	130	5, 880, 021	296, 434	10, 375, 190	4, 355, 471	2, 815, 658
1939	891	104	6, 894, 999	361, 518	12, 653, 130	4, 316, 029	2, 929, 668
1940	895	115	8, 338, 259	383, 933	13, 437, 655	5, 175, 928	3, 680, 660
1859–1940 [2]			(3)	24, 409, 043	532, 878, 181	574, 876, 092	530, 132, 454

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1936	141, 392, 000	$13, 008, 064	21, 424, 000	$985, 504	26, 954, 000	$1, 347, 700	$29, 289, 993
1937	149, 206, 000	18, 053, 926	18, 694, 000	1, 102, 946	28, 472, 000	1, 850, 680	34, 617, 056
1938	92, 338, 000	9, 049, 124	9, 358, 000	430, 468	17, 888, 000	858, 624	23, 529, 064
1939	133, 194, 000	13, 852, 176	8, 472, 000	398, 184	12, 456, 000	647, 712	30, 480, 870
1940	156, 908, 000	17, 730, 604	14, 998, 000	749, 900	23, 666, 000	1, 490, 958	37, 089, 777
1859–1940 [2]	[4] 1, 386, 583	401, 871, 526	[4] 507, 336	54, 011, 361	[4] 243, 710	33, 193, 934	1, 552, 087, 456

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Compiled by Chas. W. Henderson, supervising engineer, field offices, Denver, Colo. From 1904 (when first satisfactory annual canvass of mine production was made) to 1940, inclusive, the output was as follows: Gold, 12,582,166.51 ounces, valued at $288,394,948; silver, 286,463,243 ounces, $192,974,231; copper, 1,384,657 short tons, $401,224,898; lead, 269,545 short tons, $31,374,799; zinc, 243,710 short tons, $33,193,934; total value, $947,162,810.
[3] Figures not available.
[4] Short tons.

Gold.—Almost three-fourths of the recoverable gold output of Nevada in 1940 was derived from dry ores, chiefly gold ore, and virtually all the gold from base-metal ores came from copper ore; placer gold comprised 10 percent of the State total. Four companies

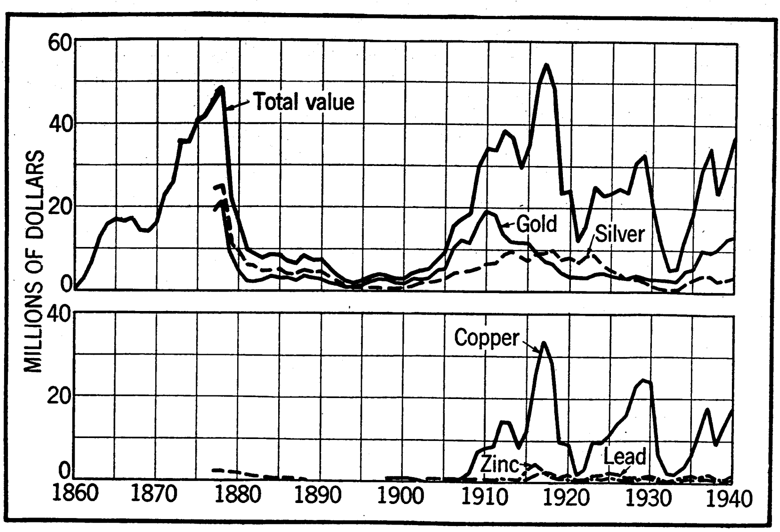

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value in Nevada, 1860–1940.

produced 38 percent of the State total gold; the 10 leading mines, listed in the following table, supplied 56 percent. Four of the mines listed (Getchell, Manhattan dredge, Northumberland, and Gold Standard) have begun production since March 1, 1938, and together they produced 29 percent of the State total gold in 1940.

Ten leading gold-producing mines in Nevada in 1940, in order of output

Rank	Mine	District	County	Rank in 1939	Operator	Source of gold
1	Getchell	Potosi	Humboldt	1	Getchell Mine, Inc	Gold ore.
2	Emma Nevada, Pit, and Taylor.	Robinson	White Pine	2	Consolidated Coppermines Corporation.	Copper ore.
3	Ruth and Copper Flat Pit.	do	do	4	Nevada Consolidated Copper Corporation.	Do.
4	Manhattan dredge	Manhattan	Nye	5	Manhattan Gold Dredging Co.	Dredge.
5	Mary	Silver Peak	Esmeralda	3	Black Mammoth Consolidated Mining Co. and Prescott Lease.	Gold ore.
6	Keystone	Comstock	Storey	7	Dayton Consolidated Mines Co. and lessees.	Do.
7	Northumberland	Northumberland	Nye	61	Northumberland Mining Co.	Do.
8	Gold Standard	Imlay	Pershing	65	Standard Cyaniding Co.	Do.
9	Overman	Comstock	Storey	11	Consolidated Chollar Gould & Savage Mining Co.	Do.
10	Silver Hill and Succor	do	do	10	Silver Hill Mining Co	Do.

Silver.—The 10 leading silver-producing mines in Nevada in 1940, listed in the following table, produced 54 percent of the State total recoverable silver; the first 2 yielded almost one-fourth of the total. As in preceding years, most of the silver was a byproduct of ore mined chiefly for other metals.

Ten leading silver-producing mines in Nevada in 1940, in order of output

Rank	Mine	District	County	Rank in 1939	Operator	Source of silver
1	Nivloc	Silver Peak	Esmeralda	1	Desert Silver, Inc	Silver ore.
2	Pioche Nos. 1 and 2	Pioche	Lincoln	3	Combined Metals Reduction Co.	Zinc-lead ore and gold-silver ore.
3	Mizpah	Tonopah	Nye	2	Lessees of The Tonopah Mining Co. of Nevada.	Gold-silver ore.
4	Dan Tucker	Sand Springs	Churchill	51	Summit King Mines, Ltd.	Do.
5	Rip Van Winkle	Merrimac	Elko	22	Rip Van Winkle Mining Co.	Zinc-lead ore.
6	El Dorado Rover group.	Eldorado Canyon	Clark	13	El Dorado Rover Mining Co.	Gold-silver ore.
7	Crown Point	Comstock	Storey	7	Sutro Tunnel Coalition, Inc.	Do.
8	Overman	do	do	5	Consolidated Chollar Gould & Savage Mining Co.	Gold ore.
9	Bristol Silver	Jack Rabbit	Lincoln	8	Bristol Silver Mines Co.	Copper ore.
10	Techatticup, Jubilee, and Red Butte.	Eldorado Canyon	Clark	9	Diamond Gold Mining Co.	Gold-silver ore.

Copper.—Nearly 99 percent of the recoverable copper output of Nevada in 1940 came from mines operated by the following companies: The Nevada Consolidated Copper Corporation, working the Ruth mine at Ruth and the open pit at Copper Flat (in the Robinson district, White Pine County); the Consolidated Coppermines Corporation, working the Emma Nevada, open pit, and Taylor mines at Kimberly (also in the Robinson district); and the Mountain City Copper Co., working the Mountain City mine at Mountain City (in the Cope district, Elko County).

Lead and zinc.—The Combined Metals Reduction Co. in the Pioche district, Lincoln County, produced 91 percent of the recoverable zinc and 70 percent of the recoverable lead output of Nevada in 1940.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1940, by counties, in terms of recovered metals

County	Mines producing [1]		Gold						Silver (lode and placer)	
			Lode		Placer		Total			
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Churchill	37		10,337	$361,795			10,337	$361,795	484,179	$344,305
Clark	56		24,927	872,445			24,927	872,445	468,348	333,047
Douglas	4		13	455			13	455	1,042	741
Elko	58	4	3,808	133,280	569	$19,915	4,377	153,195	345,871	245,953
Esmeralda	58	9	36,447	1,275,645	100	3,500	36,547	1,279,145	812,738	577,947
Eureka	33	12	8,087	283,045	316	11,060	8,403	294,105	147,395	104,814
Humboldt	46	7	71,727	2,510,445	215	7,525	71,942	2,517,970	114,415	81,362
Lander	45	9	8,899	311,465	2,482	86,870	11,381	398,335	122,648	87,216
Lincoln	36		7,088	248,080			7,088	248,080	783,589	557,219
Lyon	45	3	6,233	218,155	4,969	173,915	11,202	392,070	64,433	45,819
Mineral	86	10	3,946	138,110	78	2,730	4,024	140,840	161,086	114,550
Nye	125	17	32,595	1,140,825	26,693	934,255	59,288	2,075,080	616,614	438,481
Ormsby	3		25	875			25	875	228	162
Pershing	70	33	13,228	462,980	2,308	80,780	15,536	543,760	38,430	27,328
Storey	38	2	45,722	1,600,270	16	560	45,738	1,600,830	492,173	349,990
Washoe	22	6	2,031	71,085	31	1,085	2,062	72,170	7,595	5,401
White Pine	133	3	70,908	2,481,780	135	4,725	71,043	2,486,505	515,144	366,325
	895	115	346,021	12,110,735	37,912	1,326,920	383,933	13,437,655	5,175,928	3,680,660
Total, 1939	891	104	328,960	11,513,600	32,558	1,139,530	361,518	12,653,130	4,316,029	2,929,668

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Churchill	2,000	$226	84,000	$4,200			$710,526
Clark	24,000	2,712	396,000	19,800	876,000	$55,188	1,283,192
Douglas			6,000	300			1,496
Elko	27,184,000	3,071,792	1,852,000	92,600	918,000	57,834	3,621,374
Esmeralda	6,000	678	24,000	1,200			1,858,970
Eureka	12,000	1,356	118,000	5,900			406,175
Humboldt	14,000	1,582	148,000	7,400	4,000	252	2,608,566
Lander	1,134,000	128,142	108,000	5,400			619,093
Lincoln	676,000	76,388	11,524,000	576,200	21,546,000	1,357,398	2,815,285
Lyon	140,000	15,820					453,709
Mineral	8,000	904	208,000	10,400			266,694
Nye	8,000	904	370,000	18,500			2,532,965
Ormsby							1,037
Pershing	10,000	1,130	30,000	1,500			573,718
Storey							1,950,820
Washoe			6,000	300			77,871
White Pine	127,690,000	14,428,970	124,000	6,200	322,000	20,286	17,308,286
	156,908,000	17,730,604	14,998,000	749,900	23,666,000	1,490,958	37,089,777
Total, 1939	133,194,000	13,852,176	8,472,000	398,184	12,456,000	647,712	30,480,870

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

MINING INDUSTRY

Expansion of production at the three large copper mines and several new and expanded gold-mine operations in Nevada in 1940 were the principal causes for the greater tonnage of ore treated compared with 1939. Increases were as follows: Copper ore, 25 percent; gold ore, 41 percent; and zinc-lead ore, 183 percent. The tonnage of old tailings treated declined 28 percent. Cessation of old-tailings cyanidation by the Bradshaw Syndicate, Inc., in the Goldfield district, Esmeralda County, and the Caliente Cyaniding Co. in the Ferguson district, Lincoln County, terminated the large-scale working of old tailings in the State; both operations had been profitable owing to the revaluation of gold. The connected-bucket dredge of the Manhattan Gold Dredging Co. in the Manhattan district, Nye County, was the principal producer of placer gold in the State in 1940. In addition, 3 dragline dredges, 10 nonfloating washing plants with mechanical excavators, 85 (45 dry) small-scale hand-method mines, and 17 drift mines were in operation. Late in the year the world's largest dragline dredge, equipped with a dragline excavator using a 14-cubic yard bucket, was installed at Dayton, Lyon County. Quicksilver consumption at placer mines was 745 pounds in 1940.

ORE CLASSIFICATION

The following table classifying ores produced in Nevada in 1940 shows that nearly 74 percent of the tonnage of ore (including old tailings) sold or treated was copper ore, 20 percent gold ore and old tailings, 3 percent gold-silver ore and old tailings, almost 2 percent zinc-lead ore, 1 percent silver ore and old tailings, and the remainder lead, zinc, and lead-copper ores.

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore and old tailings sold or treated in Nevada in 1940, with content in terms of recovered metals

Source	Ore and old tailings treated		Gold	Silver	Copper	Lead	Zinc
	Ore	Old tailings					
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold ore	1,257,126	437,325	238,220	678,255	73,200	65,500	----------
Dry and siliceous gold-silver ore	233,986	8,314	39,342	1,910,417	334,900	391,400	----------
Dry and siliceous silver ore	105,105	2,144	5,716	1,274,948	16,400	219,100	----------
	1,596,217	447,783	283,278	3,863,620	424,500	676,000	----------
Copper ore	6,158,388	--------	59,325	339,810	156,434,000	435,900	----------
Lead ore	7,080	--------	1,118	235,396	32,400	2,016,100	----------
Lead-copper ore	9	--------	--------	224	800	2,600	----------
Zinc ore	1,968	--------	1	132	----------	126,500	1,044,100
Zinc-lead ore	126,814	--------	2,299	723,724	16,300	11,740,900	22,621,900
Total, lode mines	7,890,476	447,783	346,021	5,162,906	156,908,000	14,998,000	23,666,000
Total, placers	----------	--------	37,912	13,022	----------	----------	----------
	7,890,476	447,783	383,933	5,175,928	156,908,000	14,998,000	23,666,000
Total, 1939	6,273,643	621,356	361,518	4,316,029	133,194,000	8,472,000	12,456,000

METALLURGIC INDUSTRY

Of the 8,338,259 tons of lode material sold or treated in 1940 in Nevada 76 percent was ore sent to concentrating mills, 17 percent was ore sent to amalgamation and cyanidation mills, 5 percent was old tailings sent to amalgamation and cyanidation mills, and 2 percent was ore (including small quantity of old tailings) sent to smelters. The principal metallurgic change that took place during 1940 was the cessation of cyanidation at two large old-tailings dumps—Goldfield and Delamar. Flotation was employed at concentration mills to the virtual exclusion of gravity concentration. A much larger tonnage of material was cyanided in 1940 than was amalgamated, and cyanidation was used in treatment of old tailings almost to the exclusion of other methods. Of the gold recovered as bullion, cyanidation supplied 90 percent and amalgamation 10 percent; of the silver recovered as bullion, 99 percent was derived by cyanidation and 1 percent by amalgamation. The total quantity of crude ore shipped to smelters increased 6 percent over 1939. The Northumberland Mining Co., Northumberland district, Nye County, operated its 280-ton countercurrent-cyanidation plant (completed late in 1939) throughout 1940; plans were made for expanding the daily capacity to 360 tons in 1941. Summit King Mines, Ltd., began to operate its new 65-ton cyanide plant in the Sand Springs district, Churchill County, January 5, 1940. The Combined Metals Reduction Co., Pioche district, Lincoln County, had a 1,000-ton selective-flotation mill under construction. Adelaide Crown Mines, Gold Run district, Humboldt County, built a 150-ton cyanide plant. The West Coast Mines Co., Inc., Barrett Springs district, Humboldt County, began to construct a 200-ton flotation mill late in 1940.

Quicksilver consumption in Nevada in 1940 at mills using amalgamation was 3,791 pounds in recovering 23,131 ounces of gold and 24,741 ounces of silver from 121,010 tons of material treated.

Data obtained on cyanide consumption in 1940 at Nevada mills are nearly complete. In the treatment of 981,853 tons of the ore, 418,662 tons of the old tailings, and 204 tons of concentrates, 375,342 pounds of 91-percent sodium cyanide and 1,405,560 pounds of commercial-grade calcium cyanide (50-percent NaCN equivalent) were used, with a recovery of 141,611 ounces of gold and 1,436,729 ounces of silver; in terms of 98-percent NaCN, the consumption was 1,037,256 pounds, or 0.74 pound to the ton of material treated compared with 0.64 pound in 1939. The decline in proportion of old tailings treated accounts for the higher average consumption of cyanide in 1940.

Custom mills were operated in various parts of Nevada during 1940. Those of importance were at Silver City, Lyon County; Westgate, Churchill County; Gold Point, Esmeralda County; and Nelson, Clark County. Most of the custom mills obtained part of their mill feed from mines controlled by the mill operators. Large quantities of ore and concentrates were shipped out of the State, principally to lead and copper smelters in the Salt Lake Basin. The Bauer (Utah) plant of the Combined Metals Reduction Co. treated all the company zinc-lead ore mined at Pioche, Lincoln County. The McGill copper smelter at McGill in White Pine County, operated by the Nevada Consolidated Copper Corporation, continued in 1940 to be the only smelter and the most important metallurgical plant in the State; the concentrator (18,000 tons daily capacity), operated by the same company, was the largest mill in the State.

Mine production of metals in Nevada in 1940, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore, old tailings, and concentrates amalgamated	121,010	23,131	24,741			
Ore, old tailings, sands, slimes, and concentrates cyanided	1,730,446	200,913	2,101,800			
Concentrates smelted:						
Flotation	316,874	70,149	1,135,021	143,315,100	11,730,100	22,468,000
Gravity	1,214	609	25,748	203,800	6,700	
Ore and old tailings smelted	203,003	51,219	1,875,596	13,389,100	3,261,200	1,198,000
Total, lode mines		346,021	5,162,906	156,908,000	14,998,000	23,666,000
Total, placers		37,912	13,022			
		383,933	5,175,928	156,908,000	14,998,000	23,666,000
Total, 1939		361,518	4,316,029	133,194,000	8,472,000	12,456,000

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Nevada in 1940, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Material treated		Recovered in bullion		Concentrates smelted and recovered metal				
	Ore [1]	Old tailings	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Churchill	126		20	20					
Clark	31,323	40	3,164	3,873	619	4,775	97,151	2,300	2,800
Douglas	16		10						
Elko	744		124	240	1	3	120		
Esmeralda	906		94	53					
Humboldt	16,065		2,922	2,932	7	15	44		300
Lander	10,593		3,360	4,882					
Lyon	4,775		868	1,018					
Mineral	735	140	566	600					
Nye	11,425		3,389	4,249	17	46	59		
Ormsby	48		14	197					
Pershing	6,001		2,998	2,767	15	52	1,257		1,400
Storey	33,806		4,911	3,645					
Washoe	1,207	3,060	691	265	3	12	43		
	117,770	3,240	23,131	24,741	662	4,903	98,674	2,300	4,500
Total, 1939	304,302	3,657	33,050	44,458	1,137	9,449	85,277	2,900	1,200

CYANIDATION MILLS

County	Ore [1]	Old tailings	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
Churchill	35,195		9,788	443,993	3	43	51		
Clark	67,849	200	12,052	193,229	120	82	130	1,000	1,100
Douglas	25		1	475					
Elko	6,699	500	1,758	15,585					
Esmeralda	130,336	305,000	32,707	784,269					
Eureka	3,895		1,257	3,328					
Humboldt	362,756		66,580	40,023					
Lander	10,065		1,559	416					
Lincoln		110,700	1,688	9,778					
Lyon	11,912	17,414	5,345	60,494	1	3	23		
Mineral	2,383	170	1,197	8,660					
Nye	93,797	50	18,022	44,725					
Ormsby	4	100	11	31					
Pershing	213,163	101	9,362	15,909					
Storey	353,394	3,427	39,407	477,588	514	1,386	10,876		
Washoe	245	16	179	1,287					
White Pine		1,050		2,010					
	1,291,718	438,728	200,913	2,101,800	638	1,514	11,080	1,000	1,100
Total, 1939	895,285	[2] 612,081	162,986	1,626,049	496	3,397	84,517	600	6,100
Grand total:									
1940	1,409,488	441,968	224,044	2,126,541	1,300	6,417	109,754	3,300	5,600
1939	1,199,587	[2] 615,738	196,036	1,670,507	1,633	12,846	169,794	3,500	7,300

[1] Figures under "Ore" include both raw ore and concentrates amalgamated or cyanided, but not raw ore concentrated before amalgamation or cyanidation of concentrates.
[2] Yielded also 2,000 pounds of copper from cyanide precipitates.

Gross metal content of concentrates from concentrating mills treating Nevada ore in 1940, by classes of concentrates

Class of concentrates	Concentrates produced	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	12,760	4,077	23,074	296	369,248	530,794
Dry gold-silver	490	1,778	108,753	4,302	24,322	----------
Copper	271,018	57,408	211,891	147,582,874	966	----------
Lead	9,991	770	616,131	15,042	11,344,355	1,253,806
Zinc	22,529	308	91,166	7,813	646,654	25,049,722
	316,788	64,341	1,051,015	147,610,327	12,385,545	26,834,322
Total, 1939	255,075	68,542	560,538	126,934,047	5,432,366	13,980,852

Mine production of metals from concentrating mills in Nevada in 1940, in terms of recovered metals

BY COUNTIES

	Ore treated	Concentrates smelted and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Clark	30,781	302	1,587	95,832	900	58,800	----------
Elko	151,480	38,931	455	245,455	15,630,000	1,259,800	918,000
Esmeralda	150	5	17	6	----------	----------	----------
Humboldt	109	7	28	215	----------	800	4,000
Lander	6,000	1,386	331	35,431	206,800	11,900	----------
Lincoln	96,477	42,575	2,276	501,370	----------	10,399,800	21,546,000
Mineral	5,005	27	650	6,585	----------	100	----------
Nye	7,517	101	1,957	1,080	100	----------	----------
White Pine	5,995,865	233,454	57,040	165,041	127,677,800	----------	----------
	6,293,384	316,788	64,341	1,051,015	143,515,600	11,731,200	22,468,000
Total, 1939	4,964,600	255,075	68,542	560,538	119,672,600	5,168,700	11,688,000

BY CLASSES OF CONCENTRATES

	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
Dry gold	12,760	4,077	23,074	100	221,600	----------
Dry gold-silver	490	1,778	108,753	3,900	18,900	----------
Copper	271,018	57,408	211,891	143,495,600	----------	----------
Lead	9,991	770	616,131	12,000	10,891,000	----------
Zinc	22,529	308	91,166	4,000	599,700	22,468,000
	316,788	64,341	1,051,015	143,515,600	11,731,200	22,468,000

Gross metal content of concentrates produced from ores mined in Nevada in 1940, by classes of concentrates

Class of concentrates	Concentrates produced	Gross metal content: Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	13,808	7,047	34,853	3,442	371,210	530,794
Dry gold-silver	730	5,204	205,898	4,900	25,409	----------
Copper	271,018	57,408	211,891	147,582,874	966	----------
Lead	10,003	791	616,961	15,121	11,348,317	1,253,806
Zinc	22,529	308	91,166	7,813	646,654	25,049,722
	318,088	70,758	1,160,769	147,614,150	12,392,556	26,834,322
Total, 1939	256,708	81,388	730,332	126,938,301	5,440,237	13,980,852

Mine production of metals from Nevada concentrates shipped to smelters in 1940, in terms of recovered metals

	Concentrates	Gold	Silver	Copper	Lead	Zinc
BY COUNTIES						
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Churchill	3	43	51	----------	----------	----------
Clark	1,041	6,444	193,113	4,200	62,700	----------
Elko	38,932	458	245,575	15,630,000	1,259,800	918,000
Esmeralda	5	17	6	----------	----------	----------
Humboldt	14	43	259	----------	1,100	4,000
Lander	1,386	331	35,431	206,800	11,900	----------
Lincoln	42,575	2,276	501,370	----------	10,399,800	21,546,000
Lyon	1	3	23	----------	----------	----------
Mineral	27	650	6,585	----------	100	----------
Nye	118	2,003	1,139	100	----------	----------
Pershing	15	52	1,257	----------	1,400	----------
Storey	514	1,386	10,876	----------	----------	----------
Washoe	3	12	43	----------	----------	----------
White Pine	233,454	57,040	165,041	127,677,800	----------	----------
	318,088	70,758	1,160,769	143,518,900	11,736,800	22,468,000
Total, 1939	256,708	81,388	730,332	119,676,100	5,176,000	11,688,000
BY CLASSES OF CONCENTRATES						
Dry gold	13,808	7,047	34,853	2,900	223,100	----------
Dry gold-silver	730	5,204	205,898	4,400	19,700	----------
Copper	271,018	57,408	211,891	143,495,600	----------	----------
Lead	10,003	791	616,961	12,000	10,894,300	----------
Zinc	22,529	308	91,166	4,000	599,700	22,468,000
	318,088	70,758	1,160,769	143,518,900	11,736,800	22,468,000

Gross metal content of Nevada crude ore shipped to smelters in 1940, by classes of ore

Class of ore	Ore	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold	55,956	[1] 34,670	[1] 151,339	[1] 76,507	73,506	1,288
Dry and siliceous gold-silver	56,578	[2] 11,503	[2] 811,946	133,418	381,769	13,373
Dry and siliceous silver	34,125	[3] 1,377	[3] 491,617	19,292	[3] 272,917	11,700
Copper	41,317	2,087	151,715	13,636,295	456,167	
Lead	6,830	1,118	234,653	41,448	2,095,179	
Lead-copper	9		224	1,012	2,725	
Zinc	1,959				179,530	1,288,407
Zinc-lead	664	13	2,179	378	102,711	298,527
	197,438	[4] 50,768	[4] 1,843,673	[1] 13,908,350	[3] 3,564,504	1,613,295
Total, 1939	187,087	51,103	1,865,584	14,011,132	3,600,491	1,353,378

[1] Includes gold, silver, and copper in 55 tons of old tailings, metal content of which was not reported separately.
[2] Includes gold and silver in 80 tons of old tailings, metal content of which was not reported separately.
[3] Includes gold, silver, and lead in 124 tons of old tailings, metal content of which was not reported separately.
[4] Includes gold and silver in 259 tons of old tailings, metal content of which was not reported separately.

Mine production of metals from Nevada crude ore shipped to smelters in 1940, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Churchill	1,342	486	40,115	2,000	84,000	
Clark	4,907	3,267	78,133	19,800	333,300	876,000
Douglas	36	2	567		6,000	
Elko	26,235	[1] 1,452	[1] 82,328	[1] 11,554,000	590,800	
Esmeralda	3,899	3,629	28,389	6,000	24,000	
Eureka	18,158	[2] 6,830	[2] 144,043	12,000	118,000	
Humboldt	3,741	2,182	71,167	14,000	146,900	
Lander	15,696	[3] 3,645	[3] 81,260	927,200	[3] 94,100	
Lincoln	20,026	2,896	256,929	675,100	1,034,900	
Lyon	470	17	181	140,000		
Mineral	5,358	1,533	145,217	8,000	207,900	
Nye	31,463	9,169	557,136	7,900	370,000	
Pershing	883	807	17,893	10,000	28,600	
Storey	2	18	14			
Washoe	3,436	1,149	5,847		6,000	
White Pine	61,786	13,686	334,454	12,200	124,000	322,000
	197,438	[4] 50,768	[4] 1,843,673	[1] 13,388,200	[3] 3,168,500	1,198,000
Total, 1939	187,087	51,103	1,865,584	13,515,000	3,235,500	768,000

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous gold	55,956	[1] 34,670	[1] 151,339	[1] 70,300	57,600	
Dry and siliceous gold-silver	56,578	[2] 11,503	[2] 811,946	125,800	280,400	
Dry and siliceous silver	34,125	[3] 1,377	[3] 491,617	16,400	[3] 217,700	
Copper	41,317	2,087	151,715	13,142,200	435,900	
Lead	6,830	1,118	234,653	32,400	1,964,300	
Lead-copper	9		224	800	2,600	
Zinc	1,959				125,700	1,040,100
Zinc-lead	664	13	2,179	300	84,300	157,900
	197,438	[4] 50,768	[4] 1,843,673	[1] 13,388,200	[3] 3,168,500	1,198,000

[1] Includes gold, silver, and copper from 55 tons of old tailings, metal content of which was not reported separately.
[2] Includes gold and silver from 80 tons of old tailings, metal content of which was not reported separately.
[3] Includes gold, silver, and lead from 124 tons of old tailings, metal content of which was not reported separately.
[4] Includes gold and silver from 259 tons of old tailings, metal content of which was not reported separately.

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1940, by counties and districts, in terms of recovered metals [1]

County and district [1]	Mines producing [2]		Ore and old tailings	Gold			Silver (lode and placer) [3]	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Churchill County:											
Broken Hills	2		70	13		13	997				$1,164
Eastgate	4		3,415	1,139		1,139	14,012				49,829
Fairview	14		4,636	1,059		1,059	71,629	800	78,000		91,991
Fireball	1		29	5		5	3				177
Holy Cross	1		68	39		39	9,187		6,000		8,198
Jessup	2		27	6		6	14				220
Sand Springs	4		20,717	4,932		4,932	294,805				382,259
Wonder	5		5,997	1,225		1,225	91,468	1,200			108,055
Clark County:											
Crescent	2		270	106		106	2,804	200	3,000		5,877
Eldorado Canyon	7		87,680	12,947		12,947	455,597	1,400	13,500		777,958
Gold Butte	2		3,820	773		773	229				27,218
Searchlight	29		3,565	3,815		3,815	6,462	18,000	14,000		140,854
Sunset	1		49	23		23	58	400	1,200		951
Yellow Pine	15		35,899	7,263		7,263	3,198	4,000	364,300	876,000	330,334
Douglas County:											
Gardnerville	3		61	3		3	1,042		6,000		1,146
Silver Glance	1		16	10		10					350
Elko County:											
Centennial	1		503	220		220	201		3,000		7,993
Contact	2		144	3		3	610	18,000			2,573
Cope	15	(4)	144,307	680	(4)	680	[5] 52,758	27,084,500	9,600		[5] 3,122,346
Cornucopia	2		107	12		12	1,708				1,635
Delano	2		1,088	7		7	33,140	6,000	411,800		45,079
Ferber	1		13	1		1	65	1,100			205
Gold Circle	6		6,767	1,766		1,766	14,641				72,221
Island Mountain	1	1	7	31	31	62	10				2,177
Jarbidge	6	(6)	744	307	4	311	443				11,200
Kinsley	1		17				63	1,800			248
Lime Mountain	1		1,153	399		399	1,876	39,700			19,785
Loray	1		5				90				64
Mardis	1		116	317		317	311	1,000			11,429
Merrimac	3		29,793	41		41	222,209	16,000	1,263,900	918,000	282,287
Mud Springs	4		329	5		5	2,669		2,500		2,198
Railroad	1		48	1		1	606	7,700	400		1,356
Rock Creek	1		6	2		2	1,271				974
Spruce Mountain	2		630	9		9	8,034	8,200	124,000		13,155

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1940, by counties and districts, in terms of recovered metals [1]—Continued

County and district [1]	Mines producing [2]		Ore and old tailings	Gold			Silver (lode and placer) [3]	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
Elko County—Continued.			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Tecoma	4		36				626		20,600		$1,475
Tuscarora	3	1	99	7	2	9	4,339		16,200		4,211
Esmeralda County:											
Desert (Gilbert)	6		622	465		465	1,385				17,260
Divide	6		1,248	788		788	8,806				33,842
Dyer	3		80	18		18	3,825	200	2,800		3,513
Goldfield	10		307,098	5,818		5,818	6,830	4,100			208,950
Hornsilver	9		16,483	5,521		5,521	26,702	900	1,200		212,385
Klondyke	2		112	46		46	3,898		12,600		5,012
Lida	1	4	56	13	27	40	599				1,826
Lone Mountain	2		75	16		16	266				749
Montezuma	2		35	1		1	619	300	7,400		879
Oneota	1		876	55		55	48				1,959
Palmetto	1		4	12		12					420
Silver Peak	15		139,116	23,694		23,694	759,746	500			1,369,610
Sylvania		5			73	73	14				2,565
Eureka County:											
Buckhorn	2		2,129	533		533	4,912				22,148
Cortez	3		9,997	3,726		3,726	82,585	6,700	78,500		193,819
Diamond	2		1,587	21		21	19,924				14,903
Eureka	23		8,318	3,787		3,787	35,087	200	36,500		159,344
Lynn	1	12	5	19	316	335	27				11,744
Safford	2		97	1		1	4,860	5,100	3,000		4,217
Humboldt County:											
Awakening (Slumbering Hills)	10		9,058	1,612		1,612	8,948		3,100		62,938
Barrett Springs	12		1,855	860		860	45,938	13,100	79,600		68,227
Central [7]		1			1	1					35
Donnelly	1		15	4		4	3				142
Gold Run	9	2	23,630	2,822	37	2,859	37,592	700	61,300		129,941
Leonard Creek		2			64	64	7				2,245
National	2		233	310		310	1,475				11,899
Paradise Valley	1		2				3				2
Rebel Creek	1		418	42		42	9,948	200	1,500		8,642
Red Butte	1		9	1		1	132		800	4,000	421
Sawtooth [7]	1	(6)	17	5	15	20	149		1,700		891
Sulphur	1		821	3		3	3,974				2,931
Varyville	1	1	29	21	2	23	153				914
Warm Springs	3		5,765	1,066		1,066	267				37,500

Lander County:											
Battle Mountain [8]	23	6	13,520	3,161	807	3,968	47,627	828,700	56,100	-	269,196
Bullion	9	3	17,444	2,071	1,675	3,746	52,265	300,900	29,600	-	203,758
Hilltop	4	-	734	270	-	270	10,170	4,300	22,100	-	18,273
Lewis	2	-	53	7	-	7	4,511	100	200	-	3,474
McCoy	1	-	10,000	1,524	-	1,524	4,839	-	-	-	56,781
New Pass	2	-	568	1,860	-	1,860	342	-	-	-	65,343
Reese River	4	-	204	6	-	6	2,894	-	-	-	2,268
Lincoln County:											
Caliente	3	-	88	79	-	79	935	300	4,700	-	3,699
Comet	3	-	898	193	-	193	6,761	1,300	29,100	-	13,165
Ferguson (Delamar)	3	-	111,721	3,495	-	3,495	13,760	600	1,400	-	132,248
Jack Rabbit	1	-	10,530	118	-	118	119,052	664,900	430,500	-	185,448
Pahranagat	7	-	166	4	-	4	7,172	1,900	10,100	-	5,960
Patterson	1	-	5	-	-	-	94	-	-	-	67
Pioche	14	-	105,747	3,119	-	3,119	633,638	6,500	11,039,400	21,546,000	2,469,854
Tempiute	2	-	35	3	-	3	1,225	100	8,700	-	1,422
Viola	2	-	108	77	-	77	952	400	100	-	3,422
Lyon County:											
Buckskin	-	1	-	-	27	27	14	-	-	-	955
Cambridge	3	-	242	21	-	21	10	-	-	-	742
Palmyra	7	-	4,968	662	-	662	14,739	-	-	-	33,651
Pine Grove	1	-	1	2	-	2	-	-	-	-	70
Ramsey	1	-	1	3	-	3	-	-	-	-	105
Silver City	25	2	23,820	2,972	4,942	7,914	22,213	-	-	-	292,786
Talapoosa	3	-	4,960	2,537	-	2,537	27,270	-	-	-	108,187
Yerington	5	-	560	36	-	36	187	140,000	-	-	17,213
Mineral County:											
Aurora	9	1	5,553	837	1	838	8,861	-	-	-	35,631
Bell	2	-	431	447	-	447	321	-	-	-	15,873
Columbus (Candelaria)	8	-	4,273	855	-	855	58,992	2,000	99,800	-	77,091
East Walker	6	1	542	263	4	267	319	-	-	-	9,572
Fitting	5	-	78	36	-	36	210	100	-	-	1,420
Garfield	1	-	798	437	-	437	42,635	2,000	43,200	-	47,999
Hawthorne	12	4	798	404	27	431	43,903	2,800	55,100	-	49,376
Mountain View	2	-	42	17	-	17	443	200	-	-	933
Pilot Mountain	3	-	40	17	-	17	240	-	-	-	766
Pine Grove	2	(6)	32	19	1	20	7	-	-	-	705
Rand	3	-	38	51	-	51	125	-	-	-	1,874
Regent	8	4	474	251	45	296	762	-	-	-	10,902
Santa Fe	4	-	28	12	-	12	387	-	700	-	730
Silver Star	21	-	664	300	-	300	3,881	900	9,200	-	13,822
Nye County:											
Athens	1	-	1,376	712	-	712	824	-	-	-	25,506
Belmont	2	-	80	-	-	-	1,395	-	-	-	992
Bullfrog	12	-	5,200	1,842	-	1,842	7,630	500	4,000	-	70,153
Cloverdale	4	2	83	10	3	13	511	-	400	-	838
Current Creek	1	-	591	136	-	136	160	-	-	-	4,874

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1940, by counties and districts, in terms of recovered metals [1]—Continued

County and district [1]	Mines producing [2]		Ore and old tailings	Gold			Silver (lode and placer) [3]	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Nye County—Continued.											
Eden	2		49	4		4	47				$173
Ellendale	2		55	8		8	601				707
Fairplay	1		38	3		3	313				328
Golden Arrow	5		763	235		235	11,740		200		16,583
Jackson	4		425	228		228	1,241				8,862
Johnnie	5	2	438	191	32	223	338		1,900		8,141
Mammoth	6		414	121		121	5,533	400	23,500		9,390
Manhattan	21	10	16,414	6,249	25,119	31,368	11,263	100			1,105,900
Millett	7		269	295		295	2,924	300	4,400		12,658
Morey	2		882	52		52	18,992				15,325
Northumberland	1		76,466	11,918		11,918	8,646				423,278
Phonolite	3		10,593	3,391		3,391	22,360				134,585
Quartz Mountain	2		787	107		107	16,544	6,000	272,400		29,808
Reveille	2		24				793				564
Round Mountain	6	2	3,429	1,369	1,536	2,905	8,681				107,848
Silver Bow	2		160	19		19	3,348				3,046
Silverton	1		81	1		1	460				362
Tolicha	1		25	8		8	18				293
Tonopah	10		11,879	4,252		4,252	358,018				403,411
Troy	1		549	164		164	39				5,768
Tybo	10		12,997	1,057		1,057	130,169	600	53,800		132,318
Union	6	1	241	123	3	126	1,561	100	9,400		6,001
Ormsby County: Delaware	3		152	25		25	228				1,037
Pershing County:											
Antelope	7	2	559	202	101	303	2,244	3,700	15,500		13,394
Central [7]	6		232	53		53	5,043		8,300		5,856
Echo	1		101	4		4	367				401
Imlay	6	7	212,369	8,954	640	9,594	7,577				341,178
Kennedy	6		522	260		260	5,608	6,100	4,200		13,987
Placerites		1			39	39	4				1,368
Rochester	15	8	1,272	420	101	521	8,142	200	1,700		24,133
Rosebud	1	6	52	289	1,298	1,587	3,814				58,257
Sawtooth [7]		1			37	37	7				1,300
Seven Troughs	11		3,735	2,671		2,671	2,291				95,114
Sierra	8	3	1,060	163	18	181	827		100		6,928
Spring Valley	3		8	101		101	2,067				5,005
Staggs		1			5	5	3				177
Trinity	3	3	100	3	55	58	357		200		2,294
Unionville	1	1	1	1	14	15	6				529
Storey County: Comstock	38	2	359,131	45,722	16	45,738	492,173				1,950,820

Washoe County:											
Galena	1	1	33	10	4	14	1,645		1,100		1,715
Granite Range	1		3,341	1,130		1,130	2,593				41,394
Jumbo	1	1	3,076	21	12	33	125				1,244
Leadville	1		41	1		1	1,101		4,900		1,063
Peavine	1	1	160	22	2	24	983				1,539
White Horse	14	3	958	732	13	745	280				26,274
White Pine County:											
Aurum	6		623	14		14	1,672	2,400	3,700	149,900	11,579
Bald Mountain	3		53	12		12	65				466
Cherry Creek	17		15,303	1,557		1,557	97,515	700	500		123,943
Duck Creek	10		46	1		1	911		33,300		2,348
Eagle	4		81	4		4	1,363	1,000	15,200		1,982
Ellison	1		5				130	1,000			205
Granite	1		608	33		33	2,425				2,879
Newark	3		210	2		2	1,978				1,477
Osceola	13	3	8,122	6,877	135	7,012	5,573		1,500		249,458
Piermont	2		140	6		6	2,368				1,894
Robinson	39		6,018,787	61,939		61,939	260,364	127,680,000	3,900	172,100	16,791,890
Shoshone	1		5				18		3,600		193
Taylor	9		12,932	385		385	107,029				89,585
Ward	6		2,474	64		64	19,565				16,153
White Pine	18		2,219	14		14	14,168	4,900	62,300		14,234
Other districts [9]	17	3	343,255	67,222	628	67,850	11,497				2,382,926
Total Nevada	895	115	8,338,259	346,021	37,912	383,933	5,175,928	156,908,000	14,998,000	23,666,000	37,089,777

[1] Only those districts shown separately for which Bureau of Mines is at liberty to publish figures; other producing districts listed in footnote 9 and their output included under "Other districts."
[2] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[3] Source of total silver as follows: 5,162,906 ounces from lode mines and 13,022 ounces from placers.
[4] Included under "Other districts."
[5] Exclusive of placer output, which is included under "Other districts."
[6] Output from property not classed as a "mine."
[7] Central and Sawtooth districts lie in both Humboldt and Pershing Counties.
[8] Battle Mountain district lies in both Humboldt and Lander Counties.
[9] Includes following districts: Desert (White Plains), Dixie Valley, and Eagleville in Churchill County; Cope (placer) in Elko County; Battle Mountain (all placer), Florence, and Potosi in Humboldt County; Bellehelen, Cactus Springs, and San Antone in Nye County; Haystack and Loring in Pershing County; and Pyramid and Stateline Peak in Washoe County.

CHURCHILL COUNTY

Operation of a custom cyanide mill by the Westgate Mining & Milling Corporation continued to be an important factor in the expanding metal production of Churchill County; in 1940 the company handled over 9,000 tons of ore from more than 60 shippers.

Dixie Valley district.—The Comstock-Keystone Mining Co. cyanided high-grade ore from the Dixie mine throughout 1940; the company added five cyanide tanks to its plant.

Eastgate district.—I. L. Kent operated the Sonny Boy mine in 1940 and shipped 1,414 tons of gold-silver ore; 1,185 tons treated in a custom cyanide plant yielded 483 ounces of gold and 8,291 ounces of silver, and 229 tons shipped to a smelter contained 121 ounces of gold and 2,357 ounces of silver.

Fairview district.—Lessees shipped a small tonnage of argentiferous lead ore from the Chalk Mountain mine to a smelter in 1940. Several groups of lessees worked the Nevada Hills mine and produced a substantial quantity of gold-silver ore, most of which was shipped to a custom cyanide plant.

Sand Springs district.—Summit King Mines, Ltd., operated the Dan Tucker mine in 1940; operation of a new 65-ton cyanide plant was begun January 5 and continued throughout the year. The Dan Tucker Extension Mining Co. shipped 287 tons of ore yielding 43 ounces of gold and 12,781 ounces of silver to a custom cyanide plant.

Wonder district.—Several groups of lessees worked the Nevada Wonder mine in 1940; 4,871 tons of ore shipped to a custom cyanide plant yielded 972 ounces of gold and 64,146 ounces of silver, and 756 tons of ore shipped to a smelter contained 220 ounces of gold, 21,227 ounces of silver, and 1,284 pounds of copper.

CLARK COUNTY

Eldorado Canyon district.—The El Dorado Rover Mining Co. operated the Rand, Quaker City, Magnolia, Poppy, Crown, Nevada-Eagle, and Cross mines throughout 1940; 38,188 tons of ore treated in the company 100-ton all-slime cyanide plant yielded 6,044 ounces of gold and 185,101 ounces of silver. The Oro Plata (Belmont Phoenix) mine was worked by P. H. Springer, Jr., until taken over by the Tonopah Belmont Development Co. in April 1940; the combined production was 882 tons of smelting ore, which contained 220 ounces of gold, 59,663 ounces of silver, 285 pounds of copper, and 6,884 pounds of lead. The Diamond Gold Mining Co. operated the Techatticup, Jubilee, and Red Butte mines throughout 1940; the ore was treated in a 135-ton flotation mill. W. W. Hartman worked the Wall Street mine and treated the ore in a 50-ton amalgamation-flotation mill.

Gold Butte district.—The Lakeshore Gold Mining Co. operated the Utah mine in 1940.

Searchlight district.—The Blossom mine was productive in 1940. Lessees at the Quartette mine shipped 533 tons of ore and 200 tons of old tailings to various plants using different metallurgical methods; the total metal recovery was 204 ounces of gold, 278 ounces of silver, 16,800 pounds of copper, and 10,600 pounds of lead. F. P. Jackson worked the Valley mine.

Yellow Pine district.—The Chiquita Mining Co., Ltd., operated the Chiquita mine and the 100-ton cyanide plant at the property during 1940. O. F. Schwartz (Barefoot Lease) worked the Keystone-Barefoot mine; 9,343 tons of ore treated by amalgamation and concentration yielded bullion containing 1,134 ounces of gold and 107 ounces of silver and 377 tons of concentrates containing 1,347 ounces of gold, 102 ounces of silver, and 1,844 pounds of copper; in addition, 13 tons of smelting ore contained 30 ounces of gold, 4 ounces of silver, and 212 pounds of copper. J. A. Frederickson shipped lead ore and zinc-lead ore from the Milford No. 2 mine. The Yellow Pine Mining Co. shipped a substantial tonnage of zinc ore from the Yellow Pine mine during the year.

ELKO COUNTY

Centennial district.—The Bull Run mine was productive in 1940.

Cope district.—The Mountain City Copper Co. (third-largest copper producer in Nevada) was active throughout 1940. Part of the ore was treated in the company 400-ton flotation mill, and high-grade ore was shipped for direct smelting. Morrison & Knudsen Co., Inc., operated a dragline dredge, equipped with a dragline excavator using a 2-cubic yard bucket, on upper Van Duzer Creek from September 22 to November 16.

Delano district.—Lessees on the Net Group shipped a substantial tonnage of lead ore to a smelter during 1940.

Gold Circle district.—Esmeralda Gold Mines, Ltd., worked the Esmeralda mine in 1940; gold ore was treated in a 30-ton cyanide plant.

Lime Mountain district.—Lessees operated the Lime Mountain mine throughout 1940 and shipped to a smelter 1,098 tons of ore and 55 tons of old tailings containing 399 ounces of gold, 1,876 ounces of silver, and 40,912 pounds of copper.

Merrimac district.—The Rip Van Winkle Mining Co. treated argentiferous zinc-lead ore from the Rip Van Winkle mine by selective flotation in 1940; lead concentrates and zinc concentrates were shipped to smelters.

Spruce Mountain district.—Lessees worked the Missouri Monarch group (Black Forest and Monarch mines) during 1940; 143 tons of silver ore, 38 tons of copper ore, and 407 tons of lead ore shipped to a smelter contained 3 ounces of gold, 7,882 ounces of silver, 8,106 pounds of copper, and 128,618 pounds of lead.

ESMERALDA COUNTY

Desert (Gilbert) district.—Lessees at the Homestake mine in 1940 shipped to custom cyanide plants 418 tons of ore from which 346 ounces of gold and 726 ounces of silver were recovered; in addition, 1 ton of high-grade ore shipped to a smelter contained 32 ounces of gold and 46 ounces of silver.

Divide district.—Lessees on the Tonopah Divide mine shipped 1,195 tons of ore containing 756 ounces of gold and 8,365 ounces of silver to a smelter during 1940.

Goldfield district.—The Goldfield Combination Fraction Mining Co. operated the Combination Fraction mine in 1940. Lessees working underground at the Goldfield Consolidated property shipped 1,085 tons of ore containing 1,527 ounces of gold, 519 ounces of silver, and

3,892 pounds of copper. At the same property, the Bradshaw Syndicate, Inc., cyanided old tailings in a 1,400-ton cyanide plant from March 1 to November 15; old tailings that can be worked profitably have been exhausted.

Hornsilver district.—The Ohio Mines Corporation operated the Gold Point and Tokop groups throughout 1940; in addition to company ore, custom material was treated in the company 65-ton all-slime cyanide plant.

Silver Peak district.—The Black Mammoth Consolidated Mining Co. and E. L. Cord (Prescott Lease) worked the Mary mine until August 1, 1940, when the latter became the sole lessee of the property. Desert Silver, Inc., leading silver producer in the State, worked the Nivloc mine; 69,016 tons of silver ore cyanided in the company 300-ton plant yielded 4,215 ounces of gold and 743,032 ounces of silver.

EUREKA COUNTY

Cortez district.—The Cortez Metals Co. shipped 1,468 tons of silver ore containing 98 ounces of gold, 51,011 ounces of silver, 6,447 pounds of copper, and 97,802 pounds of lead to a smelter in 1940. Greenan & Co., Inc., worked the Roberts group (Mill Canyon) from January 1 until August 19; 3,895 tons of ore treated in the company 40-ton cyanide plant yielded 1,257 ounces of gold and 3,328 ounces of silver, and 3,413 tons of ore shipped to a smelter contained 1,608 ounces of gold and 25,314 ounces of silver. Lessees worked the Ventura mine and shipped 1,221 tons of ore containing 763 ounces of gold, 2,932 ounces of silver, 799 pounds of copper, and 3,559 pounds of lead.

Diamond district.—J. L. Bay, G. Sharer, and C. J. Samuel began production at the new Eagle Roost mine July 1, 1940; 410 tons of ore contained 4 ounces of gold and 10,630 ounces of silver. At the end of the year, the mine consisted of an open stope 8 feet wide, 20 feet long, and 30 feet deep.

Eureka district.—Lessees shipped 686 tons of ore and 80 tons of old tailings containing 280 ounces of gold and 8,987 ounces of silver from the Eureka-Croesus mine in 1940. The Eureka Corporation, Ltd., shipped gold ore from the Oswego and Richmond-Eureka mines, and the Windfall Mining & Milling Co. shipped gold ore from the Windfall mine.

HUMBOLDT COUNTY

Awakening (Slumbering Hills) district.—The Austin Bros. Gold Mining Co. operated the Jumbo group from May 1 until December 15, 1940; 5,000 tons of ore amalgamated in the company 25-ton mill contained 993 ounces of gold and 686 ounces of silver. G. Lowell worked the Morning mine.

Barrett Springs district.—The West Coast Mines Co., Inc., operated the Pansy Lee mine throughout 1940; 1,318 tons of ore shipped to a smelter contained 495 ounces of gold, 41,102 ounces of silver, 7,838 pounds of copper, and 99,500 pounds of lead. During the year, construction was begun on a 200-ton flotation plant, change house, assay office, shop buildings, and roads.

Gold Run district.—Adelaide Crown Mines operated the Adelaide Crown mine from September 8 until the end of 1940; 21,691 tons of ore yielded 1,470 ounces of gold and 30,674 ounces of silver; the ore was treated in the company's new 150-ton cyanide plant. Marigold Mines, Inc., shipped gold ore from the Marigold mine to a smelter during the year.

Potosi district.—Getchell Mine, Inc., operated the Getchell mine throughout 1940 and continued to hold first rank among Nevada gold producers. Ore was treated in the company 1,000-ton cyanide plant; oxidized ore was treated by agitation of slimes and leaching of sands, and sulfide ore containing a large percentage of arsenic was roasted and treated in the cyanide slime plant. During the year the company paid $585,000 in dividends, bringing the total dividend disbursements to $1,305,000 during less than 3 years of production.

Warm Springs district.—In 1940 the Curley Luck Gold Corporation treated 3,394 tons of ore from the Ashdown mine by amalgamation and concentration; amalgamation bullion contained 509 ounces of gold and 76 ounces of silver, and 2 tons of concentrates shipped to a smelter contained 10 ounces of gold and 9 ounces of silver. The Homer Verne Mining Co. worked the Homer Verne mine in the Boyd Basin section of the Warm Springs district from May 1 to October 30; 2,165 tons of ore amalgamated yielded 484 ounces of gold and 173 ounces of silver.

LANDER COUNTY

Battle Mountain district.—In 1940, as in former years, lessees at the numerous small mines in the Battle Mountain district produced much of the ore shipped to smelters. The Copper Canyon Mining Co., which operated mines of the Copper Canyon and Copper Basin groups, was the leading producer in the district; 8,247 tons of copper ore containing 1,559 ounces of gold, 15,506 ounces of silver, and 843,400 pounds of copper were shipped to a smelter. On September 6 a 6-month option to acquire a substantial equity in the company for examination and exploration was granted to the International Smelting & Refining Co. Lessees on the Plumas mine shipped 2,277 tons of ore containing 535 ounces of gold, 16,455 ounces of silver, 1,466 pounds of copper, and 16,061 pounds of lead to a smelter during 1940. Other productive properties were the Annex, Armor-Trinity, Bailey Day, Bentley, Bluebird, Bon Ami, Buena Vista, Buzzard, Eldorado, Galena, Gold Butte, Gold Cash, Good Chance, Honeycomb, Independence group, Moonlight, Nevada, San Miguel, Treasure Vault, Vail, and White. The treatment of 9,276 cubic yards of gravel, largely in a dry concentrator to which gravel was delivered by a tractor and scraper, yielded 426 ounces of gold and 59 ounces of silver at the Box Canyon Placers. Battle Mountain Placers operated a dragline dredge at the Vail placers for a short period in 1940.

Bullion district.—Ore was coarsely crushed and cyanided at the Goldacres property during 1940. Triplett Gulch Mines, Inc., operated a nonfloating washing plant, to which gravel was delivered by bulldozers and carry-alls, from January 1 until December 15; 120,000 cubic yards of gravel yielded 1,627 ounces of gold and 160 ounces of silver.

Hilltop district.—Lessees shipped gold-silver ore from the Paymaster mine during 1940.

McCoy district.—The Nevada United Gold Mining Co. worked the Gold Dome mine in 1940.

New Pass district.—W. H. Smith amalgamated 320 tons of ore from the Thomas W. mine; the bullion contained 1,778 ounces of gold and 29 ounces of silver.

LINCOLN COUNTY

Ferguson (Delamar) district.—The Caliente Cyaniding Co. operated a 600-ton cyanide plant and recovered 1,688 ounces of gold and 9,778 ounces of silver from 110,700 tons of old tailings at the Delamar and Bamberger dumps between January 1 and December 9, 1940; the operation was discontinued with the exhaustion of old tailings of value. The Delamar Exploration Co. shipped gold ore to a smelter.

Jack Rabbit district.—The Bristol Silver Mines Co. operated the Bristol Silver mine throughout 1940; 10,530 tons of ore shipped to a smelter contained 118 ounces of gold, 119,052 ounces of silver, 772,112 pounds of copper, and 448,578 pounds of lead.

Pioche district.—Lessees shipped both silver ore and lead ore from the Apex mine in 1940. The Combined Metals Reduction Co. (affiliate of the National Lead Co.) worked the Pioche Nos. 1 and 2 mines throughout the year and was the largest producer of both lead and zinc in the State. Virtually all the ore was shipped to the company 600-ton selective-flotation mill at Bauer, Utah. After midyear a 1,000-ton selective-flotation mill was under construction at the Pioche property for early completion and operation in 1941.

LYON COUNTY

Palmyra district.—Gold-silver ore from the Hully-Logan mine was shipped to a custom cyanide plant during 1940.

Silver City district.—A lessee shipped 835 tons of ore containing 331 ounces of gold and 540 ounces of silver from the Buckeye mine to custom cyanide and amalgamation plants in 1940. The Dayton mine was operated by lessees, who delivered their ore to the Dayton Consolidated Mines Co. custom cyanide mill on the property. The Dayton Douglas Cyanidation Co. treated 14,752 tons of old tailings in a cyanide leaching plant between April 1 and November 15 and recovered 407 ounces of gold and 10,890 ounces of silver. Lessees shipped 1,226 tons of ore containing 544 ounces of gold and 1,532 ounces of silver from the South Comstock mine. The Oro Neva Dredging Co. operated a dragline dredge, equipped with a dragline excavator using a 4-cubic yard bucket, on the Rae placers between Dayton and Silver City and recovered 3,365 ounces of gold and 1,703 ounces of silver from 644,455 cubic yards of gravel. The Contractor's Corporation operated a dry-land washing plant on Gold Canyon from March 1 to August 15.

Talapoosa district.—The Talapoosa mine was worked during 1940.

Yerington district.—A. Lilja operated the Mason Valley mine from January 1 to May 30, 1940; 358 tons of ore containing 2 ounces of gold, 81 ounces of silver, and 128,318 pounds of copper were shipped to a smelter.

MINERAL COUNTY

Bell district.—Lessees operated the Olympic (Omco) mine throughout 1940 and shipped 407 tons of ore to a custom mill; 441 ounces of gold and 314 ounces of silver were recovered.

Columbus (Candelaria) district.—Lessees shipped 749 tons of silver ore from the Diablo mine to a smelter in 1940; the ore contained 28 ounces of gold, 15,224 ounces of silver, 1,780 pounds of copper, and 20,621 pounds of lead. The Silver King and Silver Surprise mines were active.

Garfield district.—The Mabel mine was operated continuously in 1940; 130 tons of gold-silver ore shipped to a custom cyanide plant yielded 48 ounces of gold and 1,669 ounces of silver, and 668 tons of gold-silver ore shipped to a smelter contained 389 ounces of gold, 40,966 ounces of silver, 2,707 pounds of copper, and 46,083 pounds of lead.

Hawthorne district.—The Ashby (Eldorado No. 1) and Lucky Boy mines were the leading producers in the Hawthorne district in 1940.

NYE COUNTY

Athens district.—Ore from the Warrior mine was treated at a custom cyanide plant in 1940.

Bullfrog district.—C. A. Liddell operated the Homestake mine and shipped 3,665 tons of ore to custom cyanide plants; 1,277 ounces of gold and 2,664 ounces of silver were recovered. The Polaris mine was worked in 1940.

Jackson district.—A. L. Nelson and lessees worked the War Eagle and Lookout mines and shipped 196 tons of ore to a custom cyanide plant; 106 ounces of gold and 720 ounces of silver were recovered.

Manhattan district.—A lessee operated the Jumbo mine in 1940 and recovered 689 ounces of gold and 296 ounces of silver from 3,985 tons of ore amalgamated. The Manhattan Gold Mines Co. operated the Manhattan mine. The Reliance Mining Co. worked the Verden mine; 7,517 tons of ore were treated in a 90-ton flotation mill, and the resulting concentrates (101 tons) shipped to a smelter contained 1,957 ounces of gold, 1,080 ounces of silver, and 184 pounds of copper. The White Caps Gold Mining Co. and lessees shipped a substantial quantity of gold ore from the White Caps mine. The Manhattan Gold Dredging Co. (largest producer of placer gold in Nevada in 1940) operated a connected-bucket dredge, with 108 9½-cubic foot buckets, in Manhattan Gulch throughout the year. Lessees washed 392 ounces of gold and 159 ounces of silver from 7,165 cubic yards of gravel produced at the Orphant drift mine.

Morey district.—A lessee on the Morey mine shipped 774 tons of direct-smelting ore containing 43 ounces of gold and 16,859 ounces of silver during 1940.

Northumberland district.—The Northumberland Mining Co. operated a 280-ton cyanide plant at the Northumberland mine throughout 1940; 76,466 tons of ore yielded 11,918 ounces of gold and 8,646 ounces of silver.

Phonolite district.—The Penelas Mining Co. ceased operations at the Penelas mine during 1940 after known ore bodies were exhausted.

Quartz Mountain district.—A lessee shipped lead ore from the San Rafael mine to a smelter in 1940.

Round Mountain district.—Morrin & Steigmeyer operated the Gold Hill mine during 1940. Dodge Construction, Inc., a lessee, operated a power shovel and washing plant on the Hillside placer of the Nevada Porphyry Mining Co. from April to June.

Tonopah district.—The Tonopah Belmont Development Co. operated the Tonopah Belmont mine on the leasing system during 1940; the fire that broke out October 31, 1939, however, has made most of the mine workings inaccessible. The Tonopah Mining Co. of Nevada also worked its property on the leasing system; all ore was shipped crude to smelters.

Tybo district.—Hall Bros. and lessees shipped 10,368 tons of gold-silver ore and 740 tons of silver ore from the 2–G mine dump in 1940; in all, the ores contained 890 ounces of gold, 100,424 ounces of silver, 194 pounds of copper, and 48,420 pounds of lead.

PERSHING COUNTY

Imlay district.—The Standard Cyaniding Co. operated a 600-ton cyanide plant at the Gold Standard mine throughout 1940. Eavey, Swank & Van Galder produced a substantial quantity of placer gold from a drift mine in Willow Creek.

Rosebud district.—The Rio Seco Mining Co. washed 35,000 cubic yards of gravel in a nonfloating washing plant, to which gravel was delivered by a ¾-cubic yard power shovel; 295 ounces of gold and 33 ounces of silver were recovered between January 1 and June 15. The company passed into receivership May 16.

Seven Troughs district.—Leases operated the Portland mine in 1940.

STOREY COUNTY

Comstock district.—Several groups of lessees on the Chollar-Potosi mine shipped 1,642 tons of ore to a custom cyanide plant during 1940; 604 ounces of gold and 12,368 ounces of silver were recovered. The Consolidated Virginia Mining Co. worked the Consolidated Virginia mine; 17,479 tons of ore treated at the Sierra Nevada and Dayton cyanide mills yielded 1,497 ounces of gold and 5,000 ounces of silver. Sutro Tunnel Coalition, Inc., operated the Crown Point mine during the year; the output of gold-silver ore was treated in the company cyanide plant. The Hartford Mining Co. worked the Hartford mine; in addition, some custom ore was treated in the company cyanide plant. Several groups of lessees shipped 1,892 tons of gold-silver ore from the Justice mine to the Dayton Consolidated custom cyanide plant; 448 ounces of gold and 7,407 ounces of silver were recovered. The Dayton Consolidated Mines Co. produced 46,363 tons of ore at the Keystone mine; 16,408 ounces of gold and 41,205 ounces of silver were recovered by cyanidation at the company mill. The Nevada

Securities Co. worked the Overland mine in 1940. The Consolidated Chollar Gould & Savage Mining Co. operated the Overman mine; 132,064 tons of ore treated in the company 400-ton cyanide plant yielded 7,320 ounces of gold and 152,151 ounces of silver; during the year the company stripped a section of the Comstock Lode preparatory to mining it by the open-pit method. Sierra Nevada, Ltd., worked the Sierra Nevada mine. The Silver Hill and Succor mines were productive in 1940.

WASHOE COUNTY

Granite Range district.—The Burm Ball Mining Co. worked the Mountain View mine 20 miles northeast of Gerlach from January 1 to December 15, 1940; gold ore was shipped to a smelter.

White Horse district.—G. F. Dallimore operated the Renegade mine throughout 1940; 80 tons of ore treated by amalgamation yielded 191 ounces of gold and 62 ounces of silver, and 57 tons of ore shipped to a custom cyanide mill yielded 119 ounces of gold and 31 ounces of silver.

WHITE PINE COUNTY

Aurum district.—Grand Deposit Consolidated Mines, Inc., shipped zinc, copper, and lead ores from the Grand Deposit mine in 1940.

Cherry Creek district.—A number of lessees operated the Egan mine during 1940; 4,325 tons of fluxing ore containing 568 ounces of gold and 12,250 ounces of silver were shipped to the McGill smelter. The Imperial Leasing Co. operated the Exchequer mine and shipped silver ore to a smelter. The Nevada Standard Mining Corporation shipped gold-silver ore from the Goodman Tunnel to a smelter. Lessees worked the Mary Ann mine and shipped 2,181 tons of ore containing 36 ounces of gold and 14,289 ounces of silver to a smelter.

Osceola district.—The Gilded Age Mining Co. operated the Gilded Age mine throughout 1940; gold ore was shipped to a smelter. Operators of the Golden Eagle mine also shipped gold ore to a smelter. W. M. Stout worked the Sunshine mine from July 15 to October 10; 300 tons of ore containing 344 ounces of gold and 120 ounces of silver were shipped to a smelter.

Robinson district.—C. Caviglia shipped siliceous ore from the Chainman mine to a smelter during 1940. Farnsworth-Ely Combination Metals worked the Cuba mine; 6,347 tons of ore shipped to a smelter contained 938 ounces of gold and 38,784 ounces of silver. The Consolidated Coppermines Corporation, second-largest copper producer in the State in 1940, was active throughout the year; copper ore mined on company account was shipped to McGill for concentration and smelting. Lessees on company properties produced a small quantity of both zinc carbonate ore and siliceous ore; the zinc carbonate ore was shipped to a zinc smelter and the siliceous ore to the McGill smelter for flux. According to the company printed annual report for the year ended December 31, 1940, 2,769,084 tons of ore yielded (on the basis of smelter settlements) 52,976,621 pounds of copper, 29,340 ounces of gold, 74,453 ounces of silver, 966 pounds of lead, and 214,410 pounds of zinc. During 1940 dividends of $794,-087.55 were declared and paid, bringing the total dividend disbursements to the end of 1940 to $1,866,069.36. D. F. Paine worked the Hayes mine. L. Piombo shipped 2,536 tons of siliceous ore containing 430 ounces of gold and 2,880 ounces of silver from the Jupiter mine during 1940. The Ely Gold Mining Co. worked the Revenue mine. The Nevada Consolidated Copper Corporation (operating subsidiary of the Kennecott Copper Corporation and largest industrial company in Nevada) operated the Ruth mine at Ruth and the open pit at Copper Flat throughout the year; it handled more ore and produced more copper than any other operation in the State. In addition to its mining activities, the company operated the McGill copper smelter (only smelter in the State) and the McGill flotation concentrator (18,000 tons daily capacity); both of these plants did some custom work. C. Luther operated the Sophie mine during the year.

Taylor district.—In 1940 the Ely Gold Mining Co. operated the Monitor mine and shipped silver ore to a smelter.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEW MEXICO

(MINE REPORT)

By CHAS. W. HENDERSON AND A. J. MARTIN

SUMMARY OUTLINE

Production of copper in New Mexico in 1940 was much larger in quantity than in any other year on record, and that of zinc was the highest since 1933; the increases over 1939 were 51 and 3 percent, respectively. The output of silver was about the same as in 1939, gold decreased 3 percent, and lead decreased 29 percent. The total value of the recovered output of the five metals in 1940 (see fig. 1) was $22,246,421 (the highest since 1929) and compares with $15,402,572 in 1939. Although the increase in copper output accounted for the largest part of the gain in total value, a substantial part also was due to the moderate advance in average prices of silver and the base metals. New mills placed in operation during the year were the 150-ton flotation mill at the San Pedro copper-gold-silver mine in Santa Fe County and the 50-ton cyanidation mill at the East Camp gold-silver mine in Grant County. All the large mines and mills that were active in 1939, except the Pecos in San Miguel County (permanently closed May 31, 1939), continued operations throughout 1940.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1936–40

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1936	$35.00	$0.7745	$0.092	$0.046	$0.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052
1940	35.00	[6] .711+	.113	.050	.063

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] 1936–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–40: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464.
[5] $0.67878787.
[6] $0.71111111.

The following table shows the number of mines in New Mexico producing gold, silver, copper, lead, and zinc and their annual output of ore and metals from 1936 to 1940; also the total production from 1848 to 1940. The report of this series for 1929 (chapter of Mineral Resources of the United States, 1929, pt. 1, pp. 729–759) gives the yearly production of each important metal-producing district in New Mexico from 1904 to 1929, inclusive. Subsequent records year by year may be found in annual issues of Mineral Resources and Minerals Yearbook.

Mine production of gold, silver, copper, lead, and zinc in New Mexico, 1936–40, and total, 1848–1940, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1936	136	169	514,966	33,037	$1,156,295	1,163,255	$900,941
1937	159	160	4,191,092	41,171	1,440,985	1,243,766	962,053
1938	166	164	2,414,857	43,050	1,506,750	1,229,860	795,061
1939	214	168	4,977,375	36,979	1,294,265	1,400,878	950,899
1940	164	179	7,089,903	35,943	1,258,005	1,407,839	1,001,130
1848–1940			(1)	2,120,935	47,566,918	63,948,259	50,205,625

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1936	6,332,000	$582,544	13,252,000	$609,592	41,336,000	$2,066,800	$5,316,172
1937	64,106,000	7,756,826	13,024,000	768,416	47,854,000	3,110,510	14,038,790
1938	40,878,000	4,006,044	9,898,000	455,308	56,472,000	2,710,656	9,473,819
1939	92,284,000	9,597,536	10,784,000	506,848	58,712,000	3,053,024	15,402,572
1940	139,696,000	15,785,648	7,644,000	382,200	60,626,000	3,819,438	22,246,421
1848–1940	[2] 943,966	291,538,175	[2] 240,016	22,999,579	[2] 573,968	69,207,224	481,517,521

[1] Figures not available.
[2] Short tons.

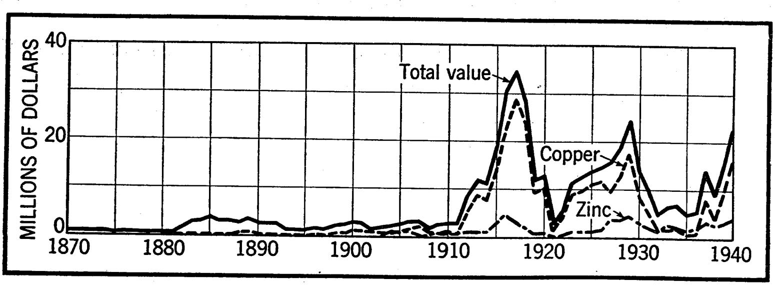

FIGURE 1.—Value of mine production of copper and zinc and total value of gold, silver, copper, lead, and zinc in New Mexico, 1870–1940. The value of gold, silver, and lead produced annually has been relatively small.

Gold and silver produced at placer mines in New Mexico, 1936–40, 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	
1936	3,378	$118,230	235	$182	$118,412	1939	3,474	$121,590	209	$142	$121,732
1937	3,027	105,945	203	157	106,102	1940	2,928	102,480	263	187	102,667
1938	2,626	91,910	167	108	92,018						

Gold.—The principal gold-producing districts in New Mexico in 1940 were: Mogollon, Catron County, which contributed 27 percent of the State total recoverable output of gold; Central, Grant County, 24 percent; Steeple Rock, Grant County, 15 percent; San Pedro, Santa Fe County, 8 percent; Las Animas, Sierra County (mostly from placers), 7 percent; and Lordsburg, Hidalgo County, 6 percent. Dry and siliceous ores yielded 53 percent of the State total gold in 1940; copper ore, 37 percent; lead and zinc-lead ores, 2 percent; and placers 8 percent.

Silver.—Silver production in New Mexico in 1940 varied little (0.5-percent increase) from that in 1939. The Mogollon district contributed 39 percent of the State total silver, Central 34 percent, Steeple Rock 15 percent, Lordsburg 5 percent, and San Pedro 2 percent. Dry and siliceous ores yielded 57 percent of the total silver; copper ore, 26 percent; zinc-lead ore, 16 percent: and lead ore, together with a small quantity of silver from placers, 1 percent.

Copper.—The output of recoverable copper from New Mexico mines in 1940 (139,696,000 pounds) was the highest in the history of mining in the State, surpassing the former record annual output of 1917 by 34,128,000 pounds and representing a 51-percent increase over 1939. The Chino open-pit mine of the Nevada Consolidated Copper Corporation at Santa Rita, Grant County, was by far the largest producer. Other sizable producers were the Bonney mine near Lordsburg, Hidalgo County; the San Pedro near Golden, Santa Fe County; and the Ground Hog-San Jose group near Hanover, Grant County. Copper ore and mine-water precipitates yielded 99 percent of the total copper; most of the remainder was recovered from concentrates produced from the milling of zinc-lead ore.

Lead.—The 29-percent decrease in 1940 from 1939 in the New Mexico output of lead reflected the effect of the closing in May 1939 of the Pecos mine in the Willow Creek district, San Miguel County, formerly the largest producer of lead (as well as of gold, silver, and zinc) in the State. Zinc-lead ore (mostly from the Central district, Grant County) yielded 76 percent of the State total output of lead, copper ore 14 percent, lead ore 7 percent, and other types of ore 3 percent.

Zinc.—The output of recoverable zinc from New Mexico increased 3 percent in 1940 over 1939. The Central district contributed 98 percent of the State total in 1940. Other producing districts were the Pinos Altos and Swartz, Grant County; San Simon, Hidalgo County; Cooks Peak, Luna County; and Magdalena, Socorro County. Zinc-lead ore yielded 69 percent and zinc ore 31 percent of the total.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1940, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Bernalillo	1		7	$245	7	$5
Catron	12		9,761	341,635	547,020	388,992
Colfax	3	7	1,273	44,555	280	199
Dona Ana	6		111	3,885	509	362
Grant	56	40	15,676	548,660	716,376	509,423
Guadalupe	1				111	79
Hidalgo	26		2,502	87,570	81,945	58,272
Lincoln	4	54	331	11,585	675	480
Luna	4		113	3,955	4,175	2,969
Otero	3		29	1,015	211	150
Rio Arriba	1		25	875	211	150
Santa Fe	5	12	3,116	109,060	32,597	23,180
Sierra	32	66	2,977	104,195	22,649	16,106
Socorro	7		20	700	962	684
Taos	1		2	70	83	59
Valencia	2				28	20
Total	164	179	35,943	1,258,005	1,407,839	1,001,130
1939	214	168	36,979	1,294,265	1,400,878	950,899

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Bernalillo	200	$23	100	$5			$278
Catron	1,700	192	300	15			730,834
Colfax	1,200	136					44,890
Dona Ana	2,800	316	2,300	115			4,678
Grant	130,050,000	14,695,650	7,188,000	359,400	60,157,000	$3,789,891	19,903,024
Guadalupe	230,800	26,080					26,159
Hidalgo	6,561,000	741,393	157,000	7,850	9,000	567	895,652
Lincoln	100	11	200	10			12,086
Luna	2,600	294	107,000	5,350	49,000	3,087	15,655
Otero	16,000	1,808	1,700	85			3,058
Rio Arriba			2,000	100			1,125
Santa Fe	2,789,000	315,157					447,397
Sierra	35,300	3,989	56,400	2,820			127,110
Socorro	2,600	294	129,000	6,450	411,000	25,893	34,021
Taos							129
Valencia	2,700	305					325
Total	139,696,000	15,785,648	7,644,000	382,200	60,626,000	3,819,438	22,246,421
1939	92,284,000	9,597,536	10,784,000	506,848	58,712,000	3,053,024	15,402,572

Gold and silver produced at lode mines in New Mexico in 1940, by counties, in terms of recovered metals

County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
Bernalillo	30	7	7
Catron	69,342	9,761	547,020
Colfax	26,761	1,254	277
Dona Ana	237	111	509
Grant	6,820,523	15,198	716,258
Guadalupe	2,604		111
Hidalgo	128,289	2,502	81,945
Lincoln	503	153	661
Luna	1,061	113	4,175
Otero	106	29	211
Rio Arriba	428	25	211
Santa Fe	35.225	2,706	32,580
Sierra	3,537	1,134	22,538
Socorro	1,239	20	962
Taos	6	2	83
Valencia	12		28
Total	7,089,903	33,015	1,407,576
1939	4,977,375	33,505	1,400,669

Gold and silver produced at placer mines in New Mexico in 1940, 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	19	3	-------	-------	19	3
Grant	113	28	365	90	478	118
Lincoln	178	14	-------	-------	178	14
Santa Fe	132	4	278	13	410	17
Sierra	209	9	1, 634	102	1, 843	111
Total	651	58	2, 277	205	2, 928	263
1939	534	44	2, 940	165	3, 474	209

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

MINING INDUSTRY

The greater part of the 7,089,903 tons of ore produced in New Mexico in 1940 was copper ore, mined with power shovels, from the Chino open-pit mine at Santa Rita, Grant County. Underground mining was done at the other principal mines of the State. The quantity of each type of ore produced, with its content in terms of recovered metals, is shown in the table that follows. Operating details at both lode and placer mines are given in the following review by counties and districts.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in New Mexico in 1940, with content in terms of recovered metals

Source	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	33, 490	4, 895	15, 951	59, 975	67, 710	-----------
Dry and siliceous gold-silver ore	91, 965	14, 245	775, 228	10, 048	78, 867	-----------
Dry and siliceous silver ore	1, 559	12	13, 156	5, 226	50, 000	-----------
	127, 014	19, 152	804, 335	75, 249	196, 577	-----------
Copper ore	6, 606, 471	13, 202	369, 968	[1] 137, 851, 531	1, 099, 534	-----------
Lead ore	1, 901	505	13, 404	26, 517	517, 192	-----------
Zinc ore	123, 126	---------	-----------	-----------	3, 108	18, 900, 506
Zinc-lead ore	231, 391	156	219, 869	1, 742, 703	5, 827, 589	41, 725, 494
	6, 962, 889	13, 863	603, 241	[1] 139, 620, 751	7, 447, 423	60, 626, 000
Total, lode mines	7, 089, 903	33, 015	1, 407, 576	[1] 139, 696, 000	7, 644, 000	60, 626, 000
Total, placers	----------	2, 928	263	-----------	-----------	-----------
	7, 089, 903	35, 943	1, 407, 839	[1] 139, 696, 000	7, 644, 000	60, 626, 000
Total, 1939	4, 977, 375	36, 979	1, 400, 878	[2] 92, 284, 000	10, 784, 000	58, 712, 000

[1] Includes 8,258,984 pounds of copper recovered from mine-water precipitates.
[2] Includes 3,237.257 pounds of copper recovered from mine-water precipitates.

METALLURGIC INDUSTRY

All the principal flotation mills operating in New Mexico in 1940 treated ores containing all or a large part of their value in copper, lead, and zinc; they comprised the Chino at Hurley, Empire Zinc at Hanover, Banner near Lordsburg, Peru near Deming, Combination near Hanover, and San Pedro near Golden. Most of the gold and gold-silver ores were treated in the Little Fanney cyanidation mill at Mogollon, the East Camp cyanidation mill in the Steeple Rock district (Grant County), and the Aztec amalgamation-flotation mill in Colfax County. The Chino reverberatory copper smelter of the Nevada Consolidated Copper Corporation at Hurley (first blown in early in May 1939) was operated throughout 1940 on company concentrates, ore, and mine-water precipitates. Concentrates and ore produced by other operators in the State were shipped to smelters in other States, mentioned in the following review by counties and districts. About 448,645 cubic yards of gravel were treated at four placer mines using dry-land dredges, and considerable gravel for which figures are not obtainable was handled at small placers worked by hand methods.

Mine production of metals in New Mexico in 1940, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore amalgamated	20,264	314	325			
Ore cyanided [1]	92,520	12,384	680,426			
Concentrates smelted	276,738	12,804	426,184	[2] 134,580,984	5,879,669	60,120,764
Ore smelted	99,670	7,513	300,641	5,115,016	1,764,331	505,236
Placer		2,928	263			
		35,943	1,407,839	139,696,000	•7,644,000	60,626,000
Total, 1939		36,979	1,400,878	92,284,000	10,784,000	58,712,000

[1] Cyanide used was approximately 292,000 pounds of Aero Brand calcium cyanide (approximately 48 to 49 percent NaCN) and 6,272 pounds of sodium cyanide (91 percent).
[2] Includes 8,258,984 pounds of copper recovered from smelting of mine-water precipitates.

Mine production of metals from amalgamation and cyanidation mills (with or withou concentration equipment) in New Mexico in 1940, by counties, in terms of recovered metals

County	Ore treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Catron	68,702	9,336	536,369					
Colfax	26,546	318	116	128	850	141	864	
Grant	16,831	2,965	144,247					
Santa Fe	225	75	17					
Sierra	480	4	2	48	10	559	228	
	112,784	12,698	680,751	176	860	700	1,092	
Total, 1939	88,453	8,305	377,995	423	2,103	2,122	28,891	52

Mine production of metals from concentrating mills in New Mexico in 1940, by counties, in terms of recovered metals

County	Ore treated (short tons)	Concentrates smelted and recovered metal					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Grant	6,717,165	260,668	8,381	328,481	[1] 126,244,776	5,744,714	60,111,764
Hidalgo	127,307	12,755	2,203	76,136	6,550,090	86,347	9,000
Lincoln	162	11	2	623	----------	200	----------
Rio Arriba	425	17	19	152	----------	1,498	----------
Santa Fe	31,690	3,052	1,338	19,739	1,783,670	----------	----------
Sierra	700	59	1	353	1,356	46,910	----------
	6,877,449	276,562	11,944	425,484	[1] 134,579,892	5,879,669	60,120,764
Total, 1939	4,801,902	215,524	14,511	517,494	[2] 88,045,534	7,798,069	57,178,000

[1] Includes 8,258,984 pounds of copper recovered from mine-water precipitates.
[2] Includes 3,237,257 pounds of copper recovered from mine-water precipitates.

Gross metal content of concentrates produced from ores mined in New Mexico in 1940, by classes of concentrates smelted

Class of concentrates	Concentrates produced (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (wet assay) (pounds)	Lead (wet assay) (pounds)	Zinc (pounds)
Dry gold	159	877	349	1,006	2,069	----------
Dry gold-silver	48	10	559	238	----------	----------
Dry silver	7	----------	620	61	262	14
Copper	207,151	11,764	204,487	[1] 135,141,749	117,641	----------
Lead	104	35	1,346	2,973	89,695	----------
Lead-copper	7,574	80	198,229	1,701,654	6,369,265	1,572,146
Zinc	61,695	58	31,711	474,083	552,892	67,523,020
	276,738	12,824	437,301	[1] 137,321,764	7,131,824	69,095,180
Total, 1939	215,947	16,767	543,586	[2] 91,025,344	9,271,007	65,818,015

[1] Includes 8,384,755 pounds of copper contained in mine-water precipitates.
[2] Includes 3,287,100 pounds of copper contained in mine-water precipitates.

Mine production of metals from New Mexico concentrates shipped to smelters in 1940, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Colfax	128	850	141	864	----------	----------
Grant	260,668	8,381	328,481	[1] 126,244,776	5,744,714	60,111,764
Hidalgo	12,755	2,203	76,136	6,550,090	86,347	9,000
Lincoln	11	2	623	----------	200	----------
Rio Arriba	17	19	152	----------	1,498	----------
Santa Fe	3,052	1,338	19,739	1,783,670	----------	----------
Sierra	107	11	912	1,584	46,910	----------
	276,738	12,804	426,184	[1] 134,580,984	5,879,669	60,120,764
Total, 1939	215,947	16,614	519,616	[2] 88,074,425	7,798,121	57,178,000

BY CLASSES OF CONCENTRATES SMELTED

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	159	877	349	965	1,757	----------
Dry gold-silver	48	10	559	228	----------	----------
Dry silver	7	----------	620	----------	200	----------
Copper	207,151	11,764	204,487	[1] 132,835,833	64,703	----------
Lead	104	35	1,346	2,481	80,735	----------
Lead-copper	7,574	80	198,229	1,362,322	5,732,274	----------
Zinc	61,695	38	20,594	379,155	----------	60,120,764
	276,738	12,804	426,184	[1] 134,580,984	5,879,669	60,1207,64

[1] Includes 8,258,984 pounds of copper recovered from mine-water precipitates.
[2] Includes 3,237,257 pounds of copper recovered from mine-water precipitates.

Gross metal content of New Mexico crude ore shipped to smelters in 1940, by classes of ore

Class of ore	Ore		Gross metal content				
	Short tons	Percent of total	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	6,191	6.21	3,513	15,483	63,092	120,482	25,514
Dry and siliceous gold-silver	5,952	5.97	2,046	94,090	10,776	87,809	----------
Dry and siliceous silver	781	.78	11	12,183	4,443	4,823	----------
Copper	83,568	83.85	1,438	165,481	5,196,564	1,881,792	----------
Lead	1,901	1.91	505	13,404	33,309	574,933	4,115
Zinc	111	.11	----------	----------	----------	4,440	62,160
Zinc-lead	1,166	1.17	----------	----------	----------	103,289	570,845
	99,670	100.00	7,513	300,641	5,308,184	2,777,568	662,634
Total, 1939	87,020	100.00	8,587	503,155	4,391,586	4,572,346	2,101,073

Mine production of metals from New Mexico crude ore shipped to smelters in 1940, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Bernalillo	30	7	7	200	100	----------
Catron	640	425	10,651	1,700	300	----------
Colfax	215	86	20	336	----------	----------
Dona Ana	237	111	509	2,800	2,300	----------
Grant	86,527	3,852	243,530	3,805,224	1,443,286	45,236
Guadalupe	2,604	----------	111	230,800	----------	----------
Hidalgo	982	299	5,809	10,910	70,653	----------
Lincoln	341	151	38	100	----------	----------
Luna	1,061	113	4,175	2,600	107,000	49,000
Otero	106	29	211	16,000	1,700	----------
Rio Arriba	3	6	59	----------	502	----------
Santa Fe	3,310	1,293	12,824	1,005,330	----------	----------
Sierra	2,357	1,119	21,624	33,716	9,490	----------
Socorro	1,239	20	962	2,600	129,000	411,000
Taos	6	2	83	----------	----------	----------
Valencia	12	----------	28	2,700	----------	----------
	99,670	7,513	300,641	5,115,016	1,764,331	505,236
Total, 1939	87,020	8,586	503,058	4,209,575	2,985,879	1,534,000

BY CLASSES OF ORE

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	6,191	3,513	15,483	59,111	66,212	----------
Dry and siliceous gold-silver	5,952	2,046	94,090	9,820	78,867	----------
Dry and siliceous silver	781	11	12,183	3,870	2,890	----------
Copper	83,568	1,438	165,481	5,015,698	1,034,831	----------
Lead	1,901	505	13,404	26,517	517,192	----------
Total to copper and lead plants	98,393	7,513	300,641	5,115,016	1,699,992	----------
Zinc	111	----------	----------	----------	3,108	49,000
Zinc-lead	1,166	----------	----------	----------	61,231	456,236
	99,670	7,513	300,641	5,115,016	1,764,331	505,236

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1940, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Bernalillo County: Coyote	1		30	7		7	7		7	200	100		$278
Catron County: Mogollon	12		69, 342	9, 761		9, 761	547, 020		547, 020	1, 700	300		730, 834
Colfax County: Mount Baldy	3	7	26, 761	1, 254	19	1, 273	277	3	280	1, 200			44, 890
Dona Ana County: Organ	6		237	111		111	509		509	2, 800	2, 300		4, 678
Grant County:													
Bullards Peak	1		292	5		5	4, 095		4, 095	1, 000	200		3, 210
Burro Mountain	1		3	5		5	118		118				259
Central	9	2	6, 789, 683	8, 624	6	8, 630	481, 095		481, 095	129, 981, 600	6, 489, 000	59, 145, 000	19, 382, 668
Chloride Flat	1		16				1, 305		1, 305	400	1, 800		1, 063
Eureka [1]	4		98	1		1	1, 163		1, 163	300	4, 400		1, 116
Gold Hill [1]	2		143	53		53	121		121	700			2, 020
Pinos Altos	21	36	4, 122	1, 058	470	1, 528	8, 834	118	8, 952	24, 400	117, 700	410, 000	94, 318
Red Rock	2		62	1		1	571		571	600	28, 200		1, 919
Steeple Rock	11		22, 915	5, 414		5, 414	216, 374		216, 374	20, 900	74, 000		349, 418
Swartz	1		3, 159	6		6	2, 492		2, 492	20, 100	472, 700	602, 000	65, 814
White Signal	3	2	30	31	2	33	90		90				1, 219
Guadalupe County	1		2, 604				111		111	230, 800			26, 159
Hidalgo County:													
Eureka [1] (Sylvanite)	5		515	210		210	3, 524		3, 524	4, 200	1, 200		10, 391
Gold Hill [1]	6		74	65		65	76		76	800	1, 300		2, 484
Lordsburg	12		126, 670	2, 225		2, 225	76, 770		76, 770	6, 555, 300	77, 900		877, 111
San Simon	3		1, 030	2		2	1, 575		1, 575	700	76, 600	9, 000	5, 666
Lincoln County:													
Cedar Creek	1		78				620		620		200		451
Jicarilla		54			178	178		14	14				6, 240
Nogal	1		84	2		2	3		3				72
White Oaks	2		341	151		151	38		38	100			5, 323

[1] District lies in both Grant and Hidalgo Counties.

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1940, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Luna County:													
Cooks Peak	2		152				152		152		27,000	49,000	$4,545
Tres Hermanas	1		6				42		42		1,300		95
Victorio	1		903	113		113	3,981		3,981	2,600	78,700		11,015
Otero County:													
Orogrande	2		86	29		29	173		173	13,900	1,700		2,794
Sacramento	1		20				38		38	2,100			264
Rio Arriba County: Headstone	1		428	25		25	211		211		2,000		1,125
Santa Fe County:													
Ortiz Mountains (Cerrillos)	1	7	13	18	363	381	1	17	18	100			13,359
San Pedro	4	5	35,212	2,688	47	2,735	32,579		32,579	2,788,900			434,038
Sierra County:													
Chloride	14		2,248	448		448	17,709		17,709	10,200	52,200		32,036
Kingston	2		63	2		2	1,111		1,111		100		865
Lake Valley	2		132				1,499		1,499	100	800		1,117
Las Animas (Hillsboro)	13	13	1,084	684	1,688	2,372	2,115	104	2,219	25,000	3,300		87,588
Pittsburg and Caballos Mountains		53			155	155		7	7				5,430
Tierra Blanca	1		10				104		104				74
Socorro County:													
Magdalena	6		1,237	15		15	959		959	2,600	129,000	411,000	33,844
San Mateo Mountains	1		2	5		5	3		3				177
Taos County: Red River	1		6	2		2	83		83				129
Valencia County: Grants	2		12				28		28	2,700			325
Total New Mexico	164	179	7,089,903	33,015	2,928	35,943	1,407,576	263	1,407,839	139,696,000	7,644,000	60,626,000	22,246,421

BERNALILLO COUNTY

Coyote district.—A lessee at the Franklin claim 14 miles east of Albuquerque shipped a car of gold-silver-copper-lead ore to the El Paso smelter in 1940.

CATRON COUNTY

Mogollon district.—Production of gold and silver in the Mogollon district in 1940 increased 27 and 44 percent, respectively, over 1939. Most of the output in both years was contained in gold-silver bullion shipped to the Denver Mint by the Black Hawk Consolidated Mines Co., which operated the Little Fanney cyanide mill and the Consolidated group (comprising the Andrew Jackson Consolidated, Lexington Contention, and Lexington Gunboat claims on the Queen vein) under lease from the Lehigh Metals Co. Besides ore from the Consolidated group, the mill in 1940 treated custom ore from the Ann Arbor, Champion, Eberle, Gold Bullion group, Golden Eagle, Little Fanney, Lone Star No. 2, Last Chance group, Maud S, and Pacific; all operated on a small scale. Company and custom ore treated in 1940 totaled 68,549 tons, from which 9,336 fine ounces of gold and 536,350 fine ounces of silver were recovered.

COLFAX COUNTY

Mount Baldy district (Baldy, Elizabethtown, Eagle Nest).—In 1940 the Maxwell Land Grant Co. operated its 140-ton Aztec mill from April 1 to September 15 and treated 1,698 tons of ore from the Aztec mine and 17,648 tons from the dump. Treatment was by jigging in the ball mill-classifier circuit, followed by flotation; the jig concentrates were amalgamated in an amalgam barrel, and the flotation concentrates (containing gold, silver, and copper) were shipped to the El Paso smelter. The Deep Tunnel Mining Co. operated its 40-ton cyanide plant at the Moreno-Red Bandana group part of the year and shipped gold-silver bullion to the Denver Mint. A lessee at the Golden Ajax mine shipped 215 tons of gold-silver-copper ore to the El Paso smelter. Sluicing on Ute and Willow Creeks and Big Nigger and Hamburg Gulches recovered small lots of placer gold. Late in the year Fullroe, Inc., moved a caterpillar bulldozer, 1¼-cubic yard dragline, and portable screening and sluicing plant to the Lynch Homestead placer near Elizabethtown and had them ready to operate in December.

DONA ANA COUNTY

Organ district.—The Donalco Mining Co. operated the Mormon mine on a small scale from January 1 to October 4, 1940, and shipped several cars of gold-silver ore to the El Paso smelter. The mine was idle the rest of the year, and the company was being liquidated in in March 1941. At the leased Torpedo-Bennett Stephenson-Memphis group the Willett Mining Co. retimbered a 400-foot vertical shaft and drove 300 feet of drifts, encountering a high-grade shoot of zinc-silver-copper-lead ore on the 200-foot level of the Memphis claim 638 feet north of the Memphis shaft. The company ceased operations in October soon after reaching the ore but planned to do some diamond drilling on the property in the near future; output from the mine in 1940 was 31 tons of silver-lead-copper ore, shipped to the El Paso smelter.

GRANT COUNTY

Bullards Peak district.—The Cora Miller mine about 15 miles northwest of Silver City was worked by the owner and lessees during November and December 1940 and yielded 292 tons of silver-copper-gold-lead ore, part of which was shipped to the El Paso smelter and part to the Ira L. Wright assay office at Silver City.

Burro Mountain district (Tyrone).—Development work was done at the Calcutta claim in 1940, and a test lot of gold-silver ore was shipped to Hawley & Hawley at Douglas, Ariz.

Central district (Bayard, Fierro, Georgetown, Hanover, Santa Rita).—The Nevada Consolidated Copper Corporation, Chino Mines Division, largest producer of copper in New Mexico, operated its open-pit mine at Santa Rita and flotation mill and reverberatory copper smelter at Hurley continuously through 1940. The output of copper increased 57 percent over 1939 and was the highest in any year on record. The ore is mined with electric shovels and transported 10 miles over the Atchison, Topeka & Santa Fe Railway to the mill, which has a daily capacity of 17,500 tons. The copper concentrates carry a low content of gold and silver to the ton. Molybdenite concentrates are recovered in the mill as a byproduct. The material smelted in 1940 included, besides concentrates from the mill, a considerable tonnage of carbonate copper ore (used as a flux) and copper precipitates recovered from leaching operations. The Twenty-sixth Annual Report of the Kennecott Copper Corporation, dated March 15, 1941, contains the following paragraphs regarding operations at the Chino property in 1940:

A total of 37,649,967 tons of ore having a calculated average assay of 1.06 percent copper was treated at the properties in Utah, Nevada, Arizona, and New Mexico whose copper production aggregated 721,766,162 pounds, equivalent to an average of slightly over 30,000 tons per month. During the last quarter output averaged in excess of 32,000 tons monthly.

In addition to ore, approximately 46,000,000 tons of noncommercial overburden were handled at the open-pit shovel mines in Utah, Nevada, and New Mexico.

The Chino property also showed a large increase in production, the copper output exceeding that of any prior year. Capital expenditures, which were comparatively large, were devoted primarily to installations to effect reductions in cost. At the mine the shovel pit was equipped for electric haulage and partially double-tracked, with operating results fully justifying the expenditures. Thirteen 30-yard dump cars and a 5-yard electric shovel were added to mine equipment, and the shops serving the mine were moved to the pit entrance and greatly improved. A larger high-tension transmission line was installed between the power plant at Hurley and the mine. At the power plant the installation of a high-pressure boiler and of a turbo-generator was completed, and the modernized plant is now operating with marked economies.

The Empire Zinc Co., operating its Hanover mine group and 300-ton selective-flotation mill, was again the largest producer of zinc in New Mexico. The zinc concentrates produced were shipped to the American Zinc Co. plant at East St. Louis, Ill. (for roasting in transit) and the New Jersey Zinc Co. plants at Depue, Ill. (Mineral Point Zinc Division), and Palmerton, Pa.; the byproduct lead-copper concentrates made were shipped to the El Paso smelter. The Peru Mining Co. operated its Pewabic mine at Hanover and 500-ton mill near Deming throughout 1940. Besides ore from the Pewabic mine, the mill handled some zinc tailings from the Cleveland mine near Pinos Altos and a few lots of zinc ore from properties at Vanadium and Central. The concentrates produced were shipped to retort plants at Dumas, Tex., and Fort Smith, Ark.

The principal producer of lead in the Central district and the State in 1940 was the Ground Hog-San Jose group which, with the Lucky Bill group, was operated by the American Smelting & Refining Co. The greater part of the ore produced was mill-grade zinc-lead-copper-silver ore, which was treated by selective flotation in the leased Combination (Black Hawk) mill near Hanover; the rest was copper-lead-silver-gold and lead-copper-silver ores, shipped crude to the El Paso smelter. The zinc concentrates produced were shipped to the Amarillo (Tex.) smelter and the lead-copper concentrates to El Paso. The mill feed in 1940 included some custom ore from the Grandview mine in the Swartz district and Bull Frog, Gran Kibira, and September in the Central district. Zinc-lead ore from the Peerless group was shipped to the Ozark pigment plant at Coffeyville, Kans.

Chloride Flat district.—Prospecting in the Chloride Flat district yielded a few lots of silver-lead-copper ore in 1940.

Eureka district (see also Hidalgo County).—Intermittent small-scale operations at the King 400 and other properties resulted in the shipment of a few cars of smelting ore from Hachita.

Gold Hill district (see also Hidalgo County).—Lessees on the Reservation claim in the Standard group shipped 132 tons of gold-silver-copper ore in 1940, part of which was sold to Hawley & Hawley, Douglas, Ariz., and part to the International Smelting & Refining Co., Miami, Ariz.

Pinos Altos district.—Most of the ores produced from mines in the Pinos Altos district in 1940 were gold-silver and gold-silver-lead-copper ores and were shipped crude to the El Paso smelter, the Ira L. Wright assay office at Silver City, and Hawley & Hawley at Douglas, Ariz. About 175 tons of zinc-lead-gold-silver-copper ore from the Silver Hill mine were treated in the Calumet 20-ton custom mill and yielded zinc concentrates (containing gold, silver, copper, and lead), sold to the Amarillo (Tex.) smelter, and lead concentrates (containing gold, silver, copper, and some zinc), sold to the El Paso smelter. Old zinc-bearing tailings from the mill dump on the Cleveland property were shipped to the Peru mill at Deming.

The Bear Creek Mining Co., which late in 1939 took over operations at the Sunny Spot placer on Bear Creek 3 miles north of Pinos Altos, continued producing until February 3, 1940, and then closed down. The property was idle from February 4 to May 1, when it was taken over by the Momex Mining Co., which operated intermittently (owing to lack of water) during the rest of the year. The equipment used included a ¾-cubic yard dragline, washer, and sluices.

Red Rock district.—Lead-silver-copper-gold ore totaling 62 tons was shipped in 1940 from the Colard and another property in the Red Rock district.

Steeple Rock district.—The East Camp group, operated in 1940 by The Exploration Syndicate, Inc. (formerly East Camp Exploration Syndicate, a partnership), was again the leading producer of gold and silver in the Steeple Rock district; the output of ore totaled 16,126 tons, of which 2,175 tons containing 852 ounces of gold and 53,360 ounces of silver were shipped crude to the International Smelting & Refining Co., Miami, Ariz., and 13,951 tons were treated in the company new cyanide mill, yielding 2,442 fine ounces of gold and 132,125 fine ounces of silver in bullion sold to the Denver Mint. The mill, which was completed in April and operated steadily from May through December, has a capacity of 50 tons daily and is powered by two 240-hp. Diesel motors. Mine development and exploratory work done during the year totaled about 2,600 feet. Lessees at the Carlisle group shipped 2,460 tons of gold-silver and gold-silver-lead-copper ores and 172 tons of lead-gold-silver-copper ore to smelters in Arizona and Texas. The Willmont Mining Co. continued to work the Laura mine; part of the ore was treated in the 30-ton cyanide plant on the property, and part was shipped direct to smelters.

Swartz (or Carpenter or Camp Monarch) district.—The Black Range Development Co. worked throughout 1940 on development and mining at the Grandview group; the ore produced (3,159 tons averaging about 13 percent zinc and 9 percent lead and 0.75 ounce of silver to the ton) was sold to the Combination mill near Hanover.

White Signal district.—Small lots of gold ore from the Apache Trail and Reward claims and 18 tons of gold-silver ore from the Combination claim were shipped to the Ira L. Wright assay office at Silver City in 1940.

GUADALUPE COUNTY

The Stauber copper mine in the "Red Beds" 2½ miles north of Pastura was worked on a small scale under lease by Alex Bonnyman, Jr., about 10 months in 1940. The ore is oxidized and contains a little silver; shipments during the year totaled 2,604 tons, all sold to the El Paso smelter.

HIDALGO COUNTY

Eureka (Sylvanite) district (see also Grant County).—Lessees operated the Buckhorn-Barney-Woods group 16 miles southwest of Hachita 3 months in 1940 and shipped gold-silver-copper-lead ore to the El Paso smelter. A lessee on the Hardscrabble group shipped 48 tons of ore containing 64.13 ounces of gold, 33 ounces of silver, and 200 pounds of copper. Lewis Croom worked the Rincon mine from September through December and shipped 60 tons of ore containing 3,161 ounces of silver and a little lead and copper.

Gold Hill district (see also Grant County).—Most of the output from mines and prospects in the Hidalgo County part of the Gold Hill district in 1940 was gold-silver-lead and gold-silver-copper ore sold in small lots to Hawley & Hawley at Douglas, Ariz.

Lordsburg district.—The Banner Mining Co. operated the Bonney mine and the company flotation mill 6 miles south of Lordsburg continuously in 1940. The vertical main shaft (formerly 1,213 feet deep) was sunk to a depth of 1,300 feet, 4,663 feet of development drifts were driven, and 1,093 feet of diamond drilling were done. The product of the mill is copper-gold-silver-[iron] concentrates, which are sold to the El Paso smelter. A lessee at the "85" mine shipped 75 tons of copper-gold-silver ore to the Copper Queen branch of the Phelps Dodge Corporation at Douglas, Ariz.

San Simon district (Steins).—The Carbon Hill Mines group 6 miles south of Steins was operated from September 1 to 27, 1940, by the New Mexico Western Mining Corporation, which reconditioned the 50-ton mill and treated some zinc-lead-silver ore, recovering a small tonnage of zinc and lead concentrates; the zinc concentrates were shipped to the Amarillo (Tex.) smelter, and the lead concentrates and some crude ore were sold to the El Paso smelter. R. A. Custer shipped 67 tons of lead-silver-copper ore from the Bob Montgomery mine, and lessees at the "66" mine shipped some gold-silver ore.

LINCOLN COUNTY

Cedar Creek district.—A lessee installed a 10-ton gravity- and flotation-concentration mill at the Silver Cap No. 2 mine and treated about 78 tons of ore, from which were produced 7 tons of silver-lead concentrates that were trucked 145 miles to the El Paso smelter.

Jicarilla district.—Placer miners continued to recover gold in 1940 by rocking and sluicing in the Jicarilla Mountains southeast of Ancho.

Nogal district.—A lessee on the Great Western property milled 84 tons of ore in 1940 and produced 4 tons of gold-silver concentrates, sold to the El Paso smelter.

White Oaks district.—Gold-silver-copper ore was shipped to the El Paso smelter from two properties in the White Oaks district in 1940.

LUNA COUNTY

Cooks Peak district.—A lessee on the Ethel-"85" group in the Cooks Peak district shipped lead-silver ore through the Ira L. Wright assay office at Silver City in 1940, and another operator in the district shipped a few cars of zinc-lead ore to the Ozark pigment plant at Coffeyville, Kans.

Deming.—In 1940 the Peru Mining Co. operated continuously its 500-ton selective-flotation mill at Wemple near Deming and treated mostly company zinc ore from the Pewabic mine in the Central district, Grant County, with some custom ore from other districts in Grant County.

Tres Hermanas district.—C. R. Morrill shipped 4 tons of silver ore and 2 tons of lead-silver ore from the Red Bird Nos. 1 and 2 group to the El Paso smelter in 1940.

Victorio district.—Shanks Carpenter continued to ship gold-silver-lead-copper-[zinc]-iron-lime ore to the El Paso smelter from the Victorio group until May 10, 1940, when he ceased operations and canceled his lease; the property was idle the rest of the year.

OTERO COUNTY

Orogrande district.—About 2 cars of copper-gold-silver ore and 8 tons of lead-silver-gold ore were shipped to the El Paso smelter from Orogrande in 1940.

Sacramento district.—A 20-ton lot of copper-silver ore was shipped in 1940 from the Sacramento district.

RIO ARRIBA COUNTY

Headstone district.—The small mill on the property of the Amarillo Gold Mining Co. near Tres Piedras was operated for a short period in 1940.

SANTA FE COUNTY

Ortiz Mountains district (Cerrillos).—On old placer ground about 6 miles south of Cerrillos in the Old Placers district of the Ortiz Grant, the Universal Placer Mining Corporation continued operations (begun March 27, 1939) to April 22, 1940, when activity ceased. The excavating unit began with a 1-cubic yard dragline which in December 1939 was replaced by a 2½-cubic yard dragline. The plant included a dry-separation machine at the property and a two-bowl amalgamator at Santa Fe where the highly concentrated gold-bearing material underwent wet treatment.

San Pedro or New Placers district.—Raskob Mining Interests, Inc., operated its San Pedro mine continuously in 1940. The company 150-ton flotation mill completed at the mine about the first of the year treated 31,671 tons of ore, which yielded 3,049 tons of concentrates containing 1,336 ounces of gold, 19,739 ounces of silver, and 1,823,543 pounds of copper; additional output from the mine was 3,297 tons of smelting ore containing 1,275 ounces of gold, 12,823 ounces of silver, and 1,044,463 pounds of copper. Both the ore and concentrates were shipped to the El Paso smelter. A lessee at the Candelari mine did some retimbering, cleaned out the 435-foot tunnel, and installed track and air lines; he produced 225 tons of ore and amalgamated it in a 10-ton mill, recovering bullion containing 74 fine ounces of gold and 19 fine ounces of silver. A lessee at the Shamrock claim concentrated 19 tons of ore in a 5-ton mill and produced 2½ tons of concentrates containing 1.90 ounces of gold.

SIERRA COUNTY

Chloride (Apache, Cuchillo Negro) district.—The Empire Mines & Metals Co., which built a mill and did development work at the Bald Eagle mine in 1939, ran its mill in 1940 for a period and shipped a car of lead-silver-copper-gold concentrates. A. B. Stewart operated the Great Republic through January to December 4 and shipped 762 tons of gold-silver ore to the El Paso smelter.

Kingston district.—A car of silver ore sorted from the Southern Cross-Independence group and a small lot of silver ore from the Norris property were shipped to the El Paso smelter.

Lake Valley district.—Several cars of silver ore were shipped to the El Paso smelter from the Lake Valley district in 1940.

Las Animas district (*Hillsboro*).—Drunzer and Everheart, lessees, operated the Wicks mine steadily in 1940 and shipped several hundred tons of gold-silver-copper ore to the El Paso smelter.

The John I. Hallett Construction Co. continued throughout 1940 to operate its movable dry-land Coulter-Ainlay four-bowl gold-recovery plant on placer ground 6 miles northeast of Hillsboro. A very considerable yardage of overburden was removed before the gold-bearing gravel was dug and washed. The excavating unit consists of two butane-powered draglines of 1 and 1¼ cubic yards capacity, respectively.

Pittsburg and Caballos Mountains district.—Many individuals, local and itinerant, panned for gold in 1940 on placer ground in the Pittsburg and Caballos Mountains district; the yield was sold through the Myers Co. store at Hatch.

Tierra Blanca district.—In 1940, L. E. Cleveland shipped 10 tons of silver smelting ore from his Silver Bell claim through the Ira L. Wright sampling plant at Silver City.

SOCORRO COUNTY

Magdalena district.—The Waldo mine of the Ozark Smelting & Mining Co. was operated by the company for 2 months in 1940, resulting in the shipment of several hundred tons of zinc-lead sulfide ore to the company pigment plant at Coffeyville, Kans. A lessee on the Kelly group shipped lead-silver ore to El Paso and zinc-lead ore to Coffeyville.

San Mateo Mountains district.—Cleaning of tailings at the mill of the San Mateo Gold Mines resulted in a 2-ton shipment, containing gold, to El Paso.

TAOS COUNTY

Red River district.—A 6-ton lot of gold-silver ore was shipped to the El Paso smelter from the Lipton property.

The Molybdenum Corporation of America continued to produce molybdenum ore from the Phyllis group on Sulphur Creek. The ore is treated in the company 40-ton (per 24 hours) flotation mill at the junction of Sulphur Creek and Red River above Questa.

VALENCIA COUNTY

Grants district.—Two small lots of copper-silver smelting ore were shipped from Grants in 1940.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN OREGON

(MINE REPORT)

By Charles White Merrill and H. M. Gaylord

SUMMARY OUTLINE

The total value (in terms of recovered metals) of the gold, silver, copper, and lead produced in Oregon in 1940—$4,148,271—exceeded that in each year since mining was begun in 1852 and represents a 24-percent increase over 1939. It was divided among the metals as follows: Gold, almost 96 percent; silver, almost 4 percent; and copper and lead combined, less than 0.6 percent. No recovery of zinc was reported for the year. Baker County continued to be the leading metal producer and contributed 43 percent of the State total value; Grant County yielded 29 percent, Jackson County 15 percent, Josephine County 9 percent, and the other 15 producing counties only 4 percent. Despite small increases in the total value of production in Baker and Grant Counties (leading producers in the State) compared with 1939, their percentages of total State production dropped, largely because Jackson County nearly doubled its output during the year.

Cornucopia Gold Mines, which worked the Cornucopia mine in the Cornucopia district of Baker County, not only continued as the largest producer of lode gold in Oregon in 1940 but also led again in output of total gold, silver, and copper.

Another feature in the mining industry of the State in 1940 was the record output of gold by dragline dredges, which accounted for nearly half of the placer total. Production by nonfloating washing plants, to which gravel was delivered by mechanical means, almost doubled; but the output of placer gold by each of the other methods, except hydraulic and dry small-scale hand-operated methods, declined.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

Yardage figures used in measuring material treated in placer operations are bank measure; that is, the material is measured in the ground before treatment.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1936–40

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1936	$35.00	$0.7745	$0.092	$0.046	$0.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052
1940	35.00	[6] .711+	.113	.050	.063

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] 1936–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–40: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787. [6] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Oregon, 1936–40, and total, 1852–1940, in terms of recovered metals

Year	Mines producing [1]		Ore, old tailings, etc. (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1936	93	166	136,338	60,753	$2,126,355	85,061	$65,880
1937	104	150	77,230	52,662	1,843,170	60,564	46,846
1938	84	157	74,936	81,729	2,860,515	100,507	64,974
1939	116	201	69,025	93,372	3,268,020	105,388	71,536
1940	112	192	105,469	113,402	3,969,070	219,112	155,813
1852–1940			(2)	5,524,223	121,310,848	4,813,624	4,501,008

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1936	574,000	$52,808	158,000	$7,268	122,000	$6,100	$2,258,411
1937	820,000	99,220	218,000	12,862	48,000	3,120	2,005,218
1938	76,000	7,448	46,000	2,116			2,935,053
1939	96,000	9,984	30,000	1,410			3,350,950
1940	176,000	19,888	70,000	3,500			4,148,271
1852–1940	[3] 12,140	4,591,141	[3] 655	65,125	[3] 140	13,846	130,481,968

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Figures not available.
[3] Short tons.

Gold produced at placer mines in Oregon, 1936–40, by classes of mines and by methods of recovery

Class and method	Mines producing [1]	Material treated (cubic yards)	Gold recovered: Fine ounces	Gold recovered: Value	Gold recovered: Average per cubic yard
Surface placers:					
Gravel mechanically handled:					
Connected-bucket dredges:					
1936	5	5,148,000	17,067.26	$597,354	$0.116
1937	4	5,017,000	17,178.00	601,230	.120
1938	5	7,258,000	29,006.00	1,015,210	.140
1939	5	6,267,000	25,028.00	875,980	.140
1940	6	7,580,000	24,951.00	873,285	.115
Dragline dredges: [2]					
1936	4	2,066,000	12,989.42	454,630	.220
1937	4	2,085,000	9,126.00	319,410	.153
1938	11	2,891,000	15,939.00	557,865	.193
1939	10	5,964,000	26,257.00	918,995	.154
1940	23	7,361,000	35,216.00	1,232,560	.167
Nonfloating washing plants: [3]					
1936	6	136,000	1,479.21	51,772	.381
1937	9	186,000	2,017.00	70,595	.380
1938	5	136,000	1,768.00	61,880	.455
1939	13	346,000	2,169.00	75,915	.219
1940	29	638,000	4,092.00	143,220	.224
Gravel hydraulically handled:					
Hydraulic:					
1936	52	1,051,000	2,677.05	93,697	.089
1937	48	366,000	2,344.00	82,040	.224
1938	66	731,000	3,261.00	114,135	.156
1939	76	440,000	2,585.00	90,475	.206
1940	82	599,000	2,731.00	95,585	.160
Small-scale hand methods: [4]					
Wet:					
1936	79	455,580	4,785.85	167,505	.368
1937	71	173,892	3,197.00	111,895	.643
1938	57	332,800	3,874.00	135,590	.407
1939	83	299,200	4,398.00	153,930	.514
1940	44	499,300	4,279.00	149,765	.300
Dry: [5]					
1938	2	800	16.00	560	.700
1939	1	400	13.00	455	1.138
1940	1	500	21.00	735	1.470
Underground placers:					
Drift:					
1936	20	5,420	422.21	14,777	2.726
1937	15	3,108	357.00	12,495	4.020
1938	11	5,400	467.00	16,345	3.027
1939	13	5,400	329.00	11,515	2.132
1940	10	6,200	287.00	10,045	1.620
Grand total placer:					
1936	166	8,862,000	39,421.00	1,379,735	.156
1937	[6] 150	7,831,000	34,219.00	1,197,665	.153
1938	157	11,355,000	54,331.00	1,901,585	.167
1939	201	13,322,000	60,779.00	2,127,265	.160
1940	[6] 192	16,684,000	71,577.00	2,505,195	.150

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

[2] Includes all placer operations using dragline excavator for delivering gravel to floating washing plant.

[3] Includes all placer operations using power excavator and washing plant, both on dry land; when washing plant is movable, outfit is termed "dry-land dredge."

[4] Includes all operations in which hand labor is principal factor in delivering gravel to sluices, long toms, dip boxes, pans, etc.

[5] None reported for 1936–37, inclusive.

[6] A mine using more than 1 method of recovery is counted but once in arriving at total for all methods.

Gold.—Production of gold in Oregon in 1940 increased 21 percent over 1939; the output from placers increased 18 percent and that from lode mines 28 percent. Of the total placer gold, 49 percent was recovered by dragline dredges, 35 percent by connected-bucket dredges, 6 percent each by wet small-scale hand methods and nonfloating washing plants with mechanical excavators, and 4 percent by hydraulicking, drift mining, and dry small-scale hand methods combined. Virtually all the lode gold was derived from dry ores and most (97 percent) of it from dry gold ore. Although 304 properties produced in 1940, the bulk of the gold came from relatively few mines; the following 10 properties, listed in order of output, supplied 62 percent of the State total: Cornucopia Gold Mines (gold ore), Sumpter Valley Dredging Co. (connected-bucket dredge), Northwest Development Co. (dragline dredge), Porter & Co. (connected-bucket dredge), Cougar-Independence Lessees (gold ore), Murphy-Murray Dredging Co. (connected-bucket dredge), Ferris Mining Co. (Grant County operation) (dragline dredge), Lewis Investment Co. (gold ore), Timms Gold Dredging Co. (connected-bucket dredge), and The B-H Co. (dragline dredge).

Silver.—Silver production in Oregon in 1940 increased 108 percent in quantity and 118 percent in value over 1939. Of the State total Baker County contributed 61 percent (55 percent coming from the Cornucopia mine), Grant County 26 percent, and Jefferson County 9 percent; dry gold ore yielded 64 percent, dry gold-silver ore 29 percent, placer gravel 6 percent, and base-metal ores 1 percent. Nearly 81 percent of the total lode silver was recovered by concentration followed by smelting of the resulting concentrates; virtually all the rest of the output came from smelting of ore.

Copper, lead, and zinc.—Nearly 68 percent of the copper output of Oregon in 1940 was a byproduct of gold production at the Cornucopia mine. The lead output of the State totaled only 70,000 pounds. No zinc was reported recovered.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, and lead in Oregon in 1940, by counties, in terms of recovered metals

County	Mines producing [1]		Gold						Silver (lode and placer) [2]	
			Lode		Placer		Total			
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Baker	26	36	26,446	$925,610	21,206	$742,210	47,652	$1,667,820	132,977	$94,561
Coos		3			85	2,975	85	2,975	14	10
Curry	2	5	92	3,220	121	4,235	213	7,455	35	25
Douglas	1	13	4	140	1,467	51,345	1,471	51,485	107	76
Grant	17	24	8,112	283,920	24,541	858,935	32,653	1,142,855	57,618	40,973
Harney		1			2	70	2	70		
Jackson	38	48	1,530	53,550	15,729	550,515	17,259	604,065	3,506	2,493
Jefferson	1		329	11,515			329	11,515	20,313	14,445
Josephine	19	51	5,256	183,960	5,813	203,455	11,069	387,415	1,441	1,025
Lane	4	(3)	12	420	1	35	13	455	2,638	1,876
Lincoln		(3)			2	70	2	70		
Malheur	1	6	34	1,190	1,624	56,840	1,658	58,030	311	221
Morrow		2			12	420	12	420	1	1
Umatilla		1			17	595	17	595	3	2
Union		2			954	33,390	954	33,390	142	101
Wallowa		(3)			3	105	3	105		
Other counties [4]	3		10	350			10	350	6	4
	112	192	41,825	1,463,875	71,577	2,505,195	113,402	3,969,070	219,112	155,813
Total, 1939	116	201	32,593	1,140,755	60,779	2,127,265	93,372	3,268,020	105,388	71,536

See footnotes at end of table.

Mine production of gold, silver, copper, and lead in Oregon in 1940, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Total value
	Pounds	Value	Pounds	Value	
Baker	132,000	$14,916	16,000	$800	$1,778,097
Coos					2,985
Curry					7,480
Douglas					51,561
Grant	10,000	1,130	28,000	1,400	1,186,358
Harney					70
Jackson			8,000	400	606,958
Jefferson	6,000	678	18,000	900	27,538
Josephine	26,000	2,938			391,378
Lane	2,000	226			2,557
Lincoln					70
Malheur					58,251
Morrow					421
Umatilla					597
Union					33,491
Wallowa					105
Other counties [4]					354
	176,000	19,888	70,000	3,500	4,148,271
Total, 1939	96,000	9,984	30,000	1,410	3,350,950

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Sources of total silver as follows: 1940, 206,317 ounces from lode mines and 12,795 ounces from placers; 1939, 94,794 ounces from lode mines and 10,594 ounces from placers.
[3] Output from property not classed as a "mine."
[4] Lake, Linn, and Marion.

MINING INDUSTRY

Of the 105,469 tons of ore (including 3,219 tons of old tailings) sold or treated in Oregon in 1940 Baker County produced 55,941 tons or 53 percent, Grant County 23,889 tons (including 60 tons of old tailings) or 23 percent, and Josephine County 20,623 tons (including 2,175 tons of old tailings) or 20 percent. Nearly 94 percent of the ore was dry gold ore, and virtually all the remainder was dry gold-silver ore. In addition to the ore 3,219 tons of old tailings, of value principally in gold, were treated.

The six properties worked by connected-bucket dredges had one dredge each, none of which was moved elsewhere during 1940. Among the properties worked by dragline dredges, however, one had two dredges and a number of the dredges worked more than one property; in consequence, 16 dragline outfits worked 23 properties during the year. The dragline excavators were equipped as follows: 6 with 1½-cubic yard buckets, 5 with 1¼-cubic yard buckets, and 1 each with a 5-, 4-, 3-, 2½-, and 2-cubic yard bucket. Twenty-three nonfloating mechanical outfits worked 29 placer properties, indicating some movement of plants from one property to another.

Reports on the use of quicksilver at Oregon placer mines indicate that 1,317 pounds were consumed during 1940. The four connected-bucket dredges reporting consumption of quicksilver in 1940 recovered 61 ounces of gold for each pound used, compared with an average recovery of 53 ounces in 1939. For the nine properties worked by dragline dredges reporting consumption of quicksilver, a recovery of 51 ounces of gold per pound was recorded, compared with a recovery of 42 ounces in 1939. The quantities of gold recovered per pound of quicksilver used at other types of placer operations were as follows: Nonfloating washing plants with mechanical excavators, 13 ounces; hydraulic mines, 22 ounces; and small-scale hand operations, 5 ounces.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore and old tailings sold or treated in Oregon in 1940, with content in terms of recovered metals

Source	Material sold or treated		Gold	Silver	Copper	Lead
	Ore	Old tailings				
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry and siliceous gold ore	96,076	3,219	40,620	140,487	131,800	25,700
Dry and siliceous gold-silver ore	6,023		1,193	62,965	14,000	43,000
Copper ore	146		6	2,696	30,100	
Lead ore	5		6	169	100	1,300
Total, lode mines	102,250	3,219	41,825	206,317	176,000	70,000
Total, placers			71,577	12,795		
	102,250	3,219	113,402	219,112	176,000	70,000
Total, 1939	65,261	3,764	93,372	105,388	96,000	30,000

METALLURGIC INDUSTRY

Of the State total ore and old tailings (105,469 tons), 69 percent was treated in concentrating mills, most of which used flotation; 23 percent was treated in amalgamation and cyanidation mills, with or without concentration equipment; and 8 percent was shipped crude to smelters. Ultimate recovery of 71 percent of the total lode gold was from the smelting of concentrates; 12 percent from direct smelting of ore and old tailings; 10 percent as bullion from cyanidation of ore and old tailings; and 7 percent as bullion from amalgamation of ore and old tailings. All material requiring smelting was shipped out of the State, as Oregon has no smelters.

Data furnished by operators of gold and silver mills show that 11,139 pounds of 91-percent sodium cyanide were consumed in recovering 3,811 ounces of gold and 305 ounces of silver from 16,420 tons of ore and 579 tons of old tailings, and that 34 pounds of quicksilver were used in recovering 1,007 ounces of gold and 242 ounces of silver from 659 tons of ore and 250 tons of old tailings.

Mine production of metals in Oregon in 1940, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Ore and old tailings amalgamated	4,721	2,819	556		
Ore and old tailings cyanided	19,639	4,001	403		
Concentrates smelted:					
Flotation	5,345	29,595	166,090	127,900	39,700
Gravity	97	300	925		8,000
Ore and old tailings smelted	8,270	5,110	38,343	48,100	22,300
Total, lode mines		41,825	206,317	176,000	70,000
Total, placers		71,577	12,795		
		113,402	219,112	176,000	70,000
Total, 1939		93,372	105,388	96,000	30,000

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Oregon in 1940, by types of mills and by counties, in terms of recovered metals

County	Material treated		Recovered in bullion		Concentrates smelted and recovered metal				
	Ore [1]	Old tailings	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
AMALGAMATION MILLS									
Baker	896		341	79	1	10	21		
Curry	1	250	81	15					
Douglas	300		4						
Grant	176		88	23	5	3	84		
Jackson	961	30	1,128	307					
Josephine	1,924	25	1,157	120	25	111	34		
Lane	15		10	6					
Other counties [2]	143		10	6					
	4,416	305	2,819	556	31	124	139		
Total, 1939	4,422	325	2,048	516	44	150	125		700
CYANIDATION MILLS									
Curry		250	11	3					
Grant		60	7	8					
Jackson		659	36	24					
Josephine	16,520	2,150	3,947	368					
	16,520	3,119	4,001	403					
Total, 1939	14,029	3,439	3,087	400					
Grand total: 1940	20,936	3,424	6,820	959	31	124	139		
1939	18,451	3,764	5,135	916	44	150	125		700

[1] Figures under "Ore" for cyanidation mills include both raw ore and concentrates cyanided, but not raw ore concentrated before cyanidation of concentrates.
[2] Lake, Linn, and Marion.

Mine production of metals from concentrating mills in Oregon in 1940, by counties, in terms of recovered metals

County	Ore	Concentrates smelted and recovered metal				
		Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Baker	49,180	2,271	22,625	120,943	118,900	14,700
Grant	22,613	3,074	6,970	45,147	9,000	25,000
Jackson	1,496	66	176	786		8,000
	73,289	5,411	29,771	166,876	127,900	47,700
Total, 1939	38,760	2,077	20,659	82,915	88,400	15,700

Gross metal content of concentrates produced from ores mined in Oregon in 1940, by classes of concentrates

Class of concentrates	Concentrates	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	2,105	6,337	4,961	1,618	200	
Dry gold-silver	1,005	812	40,525	8,258	33,754	
Copper	2,266	22,570	120,743	122,448	24,650	
Lead	66	176	786	11	8,819	
	5,442	29,895	167,015	132,335	67,423	
Total, 1939	2,121	20,809	83,040	91,176	25,608	1,664

Mine production of metals from Oregon concentrates shipped to smelters in 1940, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Baker	2,272	22,635	120,964	118,900	14,700
Grant	3,079	6,973	45,231	9,000	25,000
Jackson	66	176	786		8,000
Josephine	25	111	34		
	5,442	29,895	167,015	127,900	47,700
Total, 1939	2,121	20,809	83,040	88,400	16,400

BY CLASSES OF CONCENTRATES

Dry gold	2,105	6,337	4,961	1,000	
Dry gold-silver	1,005	812	40,525	8,000	25,000
Copper	2,266	22,570	120,743	118,900	14,700
Lead	66	176	786		8,000
	5,442	29,895	167,015	127,900	47,700

Gross metal content of Oregon crude ore shipped to smelters in 1940, by classes of ore

Class of ore	Ore	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold	6,851	4,703	12,872	13,872	4,404	
Dry and siliceous gold-silver	1,223	382	22,521	7,086	29,474	
Copper	146	6	2,696	31,696	402	
Lead	5	6	169	156	1,355	
	8,225	5,097	38,258	52,810	35,635	
Total, 1939	8,060	6,649	10,838	10,093	20,703	3,684

Mine production of metals from Oregon crude ore shipped to smelters in 1940, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Baker	5,865	3,470	7,086	13,100	1,300
Grant	1,040	1,044	7,935	1,000	3,000
Jackson	13	190	35		
Jefferson	1,062	329	20,313	6,000	18,000
Josephine	204	41	222	26,000	
Lane	27	2	2,632	2,000	
Malheur	14	21	35		
	8,225	5,097	38,258	48,100	22,300
Total, 1939	8,060	6,649	10,838	7,600	13,600

BY CLASSES OF ORE

Dry and siliceous gold	6,851	4,703	12,872	11,900	3,000
Dry and siliceous gold-silver	1,223	382	22,521	6,000	18,000
Copper	146	6	2,696	30,100	
Lead	5	6	169	100	1,300
	8,225	5,097	38,258	48,100	22,300

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, and lead in Oregon in 1940, by counties and districts, in terms of recovered metals [1]

County and district [1]	Mines producing [2]		Ore and old tailings	Gold			Silver (lode and placer) [3]	Copper	Lead	Total value
	Lode	Placer		Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	
Baker County:										
Baker	3	3	255	88	464	552	336	500		$19,616
Bull Run	2	1	14	28	529	557	59			19,537
Connor Creek		4			329	329	49			11,550
Cornucopia	3	3	49,216	22,660	206	22,866	121,029	119,000	14,700	900,557
Cracker Creek	2	2	4,457	2,816	1,839	4,655	6,670	7,600		168,527
Eagle Creek	(4)	(5)	(4)	(4)	7	[6] 7	[6] 3			[6] 247
Greenhorn [7]		4			1,606	1,606	360			56,466
Homestead		2			20	20	3			702
Mormon Basin [8]	2	6	93	17	397	414	93	2,100		14,793
Rock Creek	2	(5)	6	9	27	36	177	100	1,300	1,462
Sparta	3	(5)	416	173	36	209	363	1,100		7,697
Sumpter		4			15,002	15,002	3,555			527,598
Upper Burnt River		5			608	608	90			21,344
Virtue	4	(5)	1,108	483	13	496	127	1,600		17,631
Weatherby	4	2	286	152	123	275	60			9,668
Coos County:										
Coos Bay		(5)			7	7				245
Johnson Creek		3			78	78	14			2,740
Curry County:										
China Diggings	2	(5)	251	92	4	96	18			3,373
Gold Beach		(5)			55	55	7			1,930
Sixes		4			57	57	10			2,002
Douglas County:										
Green Mountain		2			39	39	9			1,371
Riddle	1	9	300	4	1,392	1,396	96			48,928
Grant County:										
Canyon	2	9	6	23	6,435	6,458	713			226,537
Granite	4	4	23,484	7,933	11,111	19,044	53,300	10,000	28,000	706,972
Greenhorn [7]	5	2	271	103	21	124	2,317			5,988
North Fork John Day		3			22	22	4			773
Quartzburg	4	3	124	48	3,185	3,233	564			113,556
Susanville	2	3	4	5	3,767	3,772	720			132,532
Harney County: Idol City		1			2	2				70
Jackson County:										
Ashland	5	(5)	178	70	18	88	25			3,098
Elk Creek	1	(5)	1,496	176	15	191	789		8,000	7,646
Gold Hill	13	22	561	295	6,629	6,924	1,131			243,144

See footnotes at end of table.

Mine production of gold, silver, copper, and lead in Oregon in 1940, by counties and districts, in terms of recovered metals [1]—Continued

County and district [1]	Mines producing [2]		Ore and old tailings	Gold			Silver (lode and placer) [3]	Copper	Lead	Total value
	Lode	Placer		Lode	Placer	Total				
Jackson County—Continued.			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	
Greenback [9]	1		10	189		189	35			$6,640
Jacksonville	6	4	543	49	395	444	93			15,606
Upper Applegate	12	22	371	751	8,672	9,423	1,433			330,824
Jefferson County: Ashwood	1		1,062	329		329	20,313	6,000	18,000	27,538
Josephine County:										
Galice	4	10	18,143	4,992	740	5,732	423			200,921
Grants Pass	1	8	525	35	555	590	84			20,710
Greenback [9]	8	10	1,417	164	657	821	389			29,012
Illinois River	1	8	28	7	285	292	34			10,244
Lower Applegate	1	1	24	16	18	34	6			1,194
Waldo	4	14	486	42	3,558	3,600	505	26,000		129,297
Lane County:										
Blue River	2		28	1		1	2,631	2,000		2,132
Bohemia	2	(5)	14	11	1	12	7			425
Lincoln County: Otter Rock		(5)			2	2				70
Malheur County:										
Malheur		3			1,178	1,178	153			41,339
Mormon Basin [8]	1	2	59	34	107	141	137			5,032
Snake River		1			339	339	21			11,880
Morrow County: Columbia River		2			12	12	1			421
Umatilla County: Desolation		1			17	17	3			597
Union County: Camp Carson		2			954	954	142			33,491
Wallowa County: Snake River		(5)			3	3				105
Combined counties and districts [10]	4	3	233	30	41	71	11			2,493
Total Oregon	112	192	105,469	41,825	71,577	113,402	219,112	176,000	70,000	4,148,271

[1] Only those counties and districts shown separately for which Bureau of Mines is at liberty to publish figures; others producing listed in footnote 10 and their output included under "Combined counties and districts."
[2] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[3] Source of total silver as follows: 206,317 ounces from lode mines and 12,795 ounces from placers.
[4] Included under "Combined counties and districts."
[5] Output from a property not classed as a "mine."
[6] Exclusive of lode output, which is included under "Combined counties and districts."
[7] Greenhorn district lies in both Baker and Grant Counties.
[8] Mormon Basin district lies in both Baker and Malheur Counties.
[9] Greenback district lies in both Jackson and Josephine Counties.
[10] Includes following districts: Eagle Creek (lode) in Baker County, Mule Creek (all placer) in Curry County, Canyonville (all placer) and Myrtle Creek (all placer) in Douglas County, High Grade (all lode) in Lake County, Quartzville (all lode) in Linn County, and Gold Butte (all lode) in Marion County.

BAKER COUNTY

Baker district.—The Midas mine in the Pocahontas section of the Baker district was worked by hydraulic mining during 1940; 304 ounces of gold and 22 ounces of silver were recovered from 20,000 cubic yards of gravel.

Bull Run district.—The Ferris Mining Co. operated a dragline dredge with a 3-cubic yard dragline excavator on Bull Run Creek 6 miles southwest of Unity from October 3 until the end of 1940; 124,820 cubic yards of gravel yielded 529 ounces of gold and 56 ounces of silver.

Cornucopia district.—The Cornucopia mine, operated by Cornucopia Gold Mines, continued to be the outstanding producer of lode gold and of total gold, silver, and copper in Oregon in 1940. The flotation of 49,060 tons of gold ore yielded 2,266 tons of copper concentrates containing 22,570 ounces of gold, 120,743 ounces of silver, 122,448 pounds of copper, and 24,650 pounds of lead; the concentrates were shipped to a smelter. In terms of recovered metals, the mine supplied 54 percent of the lode gold produced in the State, 20 percent of the total gold, 55 percent of the total silver, 68 percent of the copper, and 21 percent of the lead. The company paid its first dividend—$28,725—during the year.

Cracker Creek district.—The dragline dredge of Consuelo Oregon Mines was the larger of the two placer-gold producers in the Cracker Creek district in 1940. Oregon-Argonaut Gold, Inc., operated the Argonaut mine 10 months and produced 509 tons of smelting ore containing 643 ounces of gold, 128 ounces of silver, and 630 pounds of copper; the property was deeded back to its former owners late in the year. A group of lessees and sublessees shipped 3,948 tons of ore containing 2,173 ounces of gold, 5,992 ounces of silver, and 7,211 pounds of copper from the Cracker Creek group of mines near Bourne; the group included the North Pole, Columbia, Tabor Fraction, and E and E properties.

Greenhorn district.—From June 15 to December 1, 1940, the Triangle Construction Co. operated a dragline dredge with a Diesel-electric washing plant and a Diesel dragline excavator with a 1½-cubic yard bucket.

Mormon Basin district.—The Ancient Channel Syndicate operated a nonfloating washing plant on Burnt River 2 miles southeast of Bridgeport during 1940.

Sumpter district.—The Sumpter Valley Dredging Co., largest producer of placer gold in Oregon in 1940, washed 3,311,112 cubic yards of gravel and recovered 7,697 ounces of gold and 1,663 ounces of silver; the dredge was of the connected-bucket electric-power type, with seventy-two 9-cubic foot buckets. Consuelo Gold Mines operated a dragline dredge on McCully Fork a short time. The Northwest Development Co. operated two dragline dredges in the Sumpter Valley section of Powder River throughout the year; 1,210,080 cubic yards of gravel yielded 6,934 ounces of gold and 1,776 ounces of silver. On November 1, 1940, a general copartnership by K. R. Nutting, J. E. Little, Louis L. Harris, and Harry F. Wolfinger acquired the assets of the Northwest Development Co., the Nutting Dredging Co., and Little, Harris & Wolfinger.

Virtue district.—Work at the Columbian mine in 1940 yielded 822 tons of smelting ore containing 320 ounces of gold, 74 ounces of silver, and 1,363 pounds of copper.

DOUGLAS COUNTY [1]

Riddle district.—Lobicasa Co. operated a dragline dredge using a dragline excavator with a 1½-cubic yard bucket on the Weaver and Benton property from May 24 until October 14, 1940; a substantial quantity of gold was recovered from 220,586 cubic yards of gravel washed.

GRANT COUNTY

Canyon district.—The Ferris Mining Co. operated a dragline dredge from January 1 until September 21, 1940; 1,152,210 cubic yards of gravel yielded 4,065 ounces of gold, 416 ounces of silver, and 14 ounces of platinum-group metals; the dragline excavator used a 4-cubic yard bucket. The Western Dredging Co. operated a connected-bucket dredge with seventy-two 6-cubic foot buckets on the John Day River near John Day during 1940.

Granite district.—Porter & Co. operated a connected-bucket dredge with sixty-one 4½-cubic foot buckets on Granite, Clear, Olive, and Crane Creeks during 1940. The Oroplata Mining Co. moved its dragline dredge from the Granite district, Grant County, to the Camp Carson district in Union County August 20, 1940. The Intermountain Mining Co. washed 110,000 cubic yards of gravel by dragline dredging from May 10 to the end of the year and recovered 1,719 ounces of gold and 403 ounces of silver. Operations at the Bellevue mine yielded 4,800 tons of ore, which was treated in the company 50-ton flotation plant; 1,001 tons of gold-silver concentrates containing 811 ounces of gold, 40,444 ounces of silver, 8,243 pounds of copper, and 33,732 pounds of lead were shipped to a smelter. The Constitution Gold Mining Co. shipped a small quantity of high-grade gold ore. Cougar-Independence Lessees produced 18,427 tons of gold ore, of which 664 tons were shipped for direct smelting and 17,763 tons were treated at the 75-ton flotation mill on the property; the shipping ore contained 414 ounces of gold, 3,473 ounces of silver, 1,907 pounds of copper, and 630 pounds of lead, and the 2,066 tons of concentrates contained 6,146 ounces of gold, 4,696 ounces of silver, 1,564 pounds of copper, and 187 pounds of lead.

Quartzburg district.—H. F. England Co. operated a dragline dredge on Dixie Creek 2 miles from Prairie City during 1940; 650,000 cubic yards of gravel yielded 3,119 ounces of gold and 525 ounces of silver; the dragline excavator had a 1½-cubic yard bucket.

Susanville district.—The Timms Gold Dredging Co. operated a connected-bucket dredge with sixty 4-cubic foot buckets at its new location on the Middle Fork of John Day River.

JACKSON COUNTY [2]

Elk Creek district.—Al Sarena Mines, Inc., operated the Buzzard or Al Sarena mine from January 1 to 26, 1940, and shipped lead concentrates to a smelter.

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[1] *See also* State of Oregon Department of Geology and Mineral Industries, Oregon Metal Mines Handbook: Bull. 14-C, 1940, 133 pp.

[2] *See also* Wells, Francis G., Preliminary Geologic Map of the Medford Quadrangle, Oregon: State of Oregon Department of Geology and Mineral Industries, 1939.

See also State of Oregon Department of Geology and Mineral Industries, Reconnaissance Geologic Map of the Butte Falls Quadrangle: 1941 (to accompany Bull. 22, Geology of the Butte Falls Quadrangle).

Gold Hill district.—Gold Hill Placers operated a nonfloating washing plant to which gravel was delivered by a 1¼-cubic yard power shovel on the E. C. Fiene, Ralph Dusenberry, G. L. Smith, Perry L. Waite, and W. L. Wright properties during 1940. The Lance mine was operated by hydraulicking early in the year; later a nonfloating washing plant, to which gravel was delivered by a 1¼-cubic yard bucket Diesel-electric dragline, was installed. The Murphy-Murray Dredging Co. operated a connected-bucket dredge with seventy 3½-cubic foot buckets from February 12 until the end of the year; 627,261 cubic yards of gravel yielded 4,253 ounces of gold and 616 ounces of silver. The Pleasant Creek Mining Corporation operated a dredge of the connected-bucket type on Pleasant Creek for a short period. The Lucky Eagle Mining Co. suspended operations at the Lucky Bart mine May 10 and opened the property to leasing.

Upper Applegate district.—Charles C. Stearns operated a dragline dredge on the Alaska of Oregon, Belle, Holzgang, and Mee properties in 1940. The B-H Co. worked the B-H (Sturgis) mine on Forest Creek with a dragline dredge; the dragline excavator had a 1½-cubic yard bucket. The Crescent Pacific Mining Co. operated a dragline dredge using a dragline excavator with a 1¼-cubic yard bucket on the Matney ranch intermittently in 1940; the company also used the same equipment on the Offenbacher and Smith ranches. The Sterling Mines, Inc., hydraulicked a substantial quantity of gravel at the Sterling mine. The Southern Oregon Mining Co. worked the Taylor property with a dragline dredge from November 14 until the end of the year. D. A. Wright recovered 678 ounces of gold and 170 ounces of silver from 50 tons of ore mined at the Steamboat group in the Steamboat section of the Upper Applegate district during the early months of the year.

JEFFERSON COUNTY

Ashwood district.—The Oregon King Mines, Inc., started operations at the Oregon King mine September 1, 1940, and shipped 1,062 tons of ore containing 329 ounces of gold, 20,313 ounces of silver, 6,169 pounds of copper, and 29,474 pounds of lead to a smelter before the end of the year.

JOSEPHINE COUNTY [3]

Galice district.—The Lewis Investment Co. worked the Benton mine throughout 1940 and was again the third-largest producer of lode gold in the State; the ore was treated in a cyanide plant with a 60-ton daily capacity. W. S. Robertson amalgamated a small quantity of very rich ore at the Bunker Hill mine and cyanided old tailings; the mine ranked fifth in production of lode gold in the State.

Greenback district.—The Blue Channel mine was operated by hydraulicking from January 1 to May 20, 1940. P. B. Wickham operated the Greenback mine from January 1 until September 10, after which the lease was suspended.

Waldo district.—The Esterly mine was worked by hydraulicking from the first of the year until July 1 and from October 20 until the end of 1940. The Atlas Gold Dredging Co. operated a dragline dredge on the Leonard property on Althouse Creek.

[3] *See also* Wells, Francis G., Preliminary Geologic Map of the Grants Pass Quadrangle, Oregon: State of Oregon Department of Geology and Mineral Industries, 1940.

MALHEUR COUNTY

Malheur district.—The Pacific Placers Engineering Co. operated a nonfloating washing plant on the State Veterans Aid property during May and June; the operation was taken over by Pacific Placers late in 1940.

Snake River district.—J. M. Rhodes washed 36,039 cubic yards of gravel in a nonfloating washing plant from April 28 to August 3; gravel was excavated with a ⅜-cubic yard power shovel and delivered to the washing plant in 1½-ton dump trucks.

UNION COUNTY

Camp Carson district.—The Oroplata Mining Co. moved its dragline dredge from Grant County to the Golden West Placers and resumed production September 23, 1940; the dragline excavator had a 2½-cubic yard bucket. Hydraulicking was also carried on at this property by F. M. Cronkhite.

OTHER COUNTIES

Small outputs in 1940 were reported also from Coos, Curry, Harney, Lake, Lane, Lincoln, Linn, Marion, Morrow, Umatilla, and Wallowa Counties.

Details of production by counties and districts are given in the preceding table.

GOLD, SILVER, COPPER, AND LEAD IN SOUTH DAKOTA

(MINE REPORT)

By Chas. W. Henderson

SUMMARY OUTLINE

Lode gold mining is the principal mineral industry of South Dakota. The placer gold output is small. Silver is produced annually as a by-product, and copper and lead are produced occasionally. There is also production of minor metals such as columbo-tantalite, minor non-metals such as lithium minerals, and a little tin. The mineralized area of the State is included in Custer, Lawrence, and Pennington Counties in the mountain group known as the Black Hills. At Lead, Lawrence County, is the Homestake mine, largest producer of gold in the United States; it was operated steadily during 1940. Details of producing mines are given in the review by counties. The output of recovered gold in South Dakota in 1940 was 586,662 fine ounces valued at $20,533,170, a 5-percent decrease from the peak output of 618,536 ounces and $21,648,760 in 1939. Recovered silver in 1940 was 175,514 ounces, copper 12,000 pounds, and lead 14,000 pounds.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1936–40

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1936	$35.00	$0.7745	$0.092	$0.046	$0.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052
1940	35.00	[6] .711+	.113	.050	.063

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] 1936–37: Yearly average weighted Treasury buying price for newly mined silver; 1939–40: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464.
[5] $0.67878787.
[6] $0.71111111.

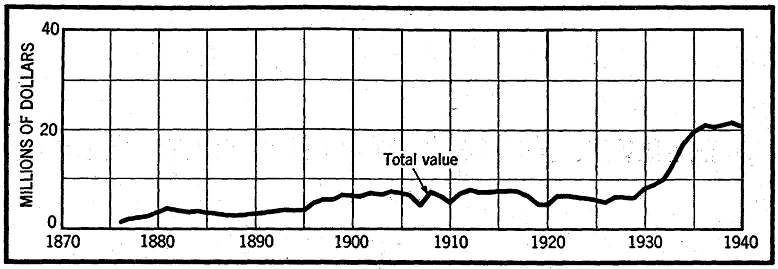

FIGURE 1.—Total value of mine production of gold and silver in South Dakota, 1876–1940.

Mine production of gold, silver, copper, and lead in South Dakota, 1936–40, and total, 1876–1940, in terms of recovered metals [1]

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1936	12	130	1,549,146	586,353.40	$20,522,369	144,448	$111,875
1937	14	73	1,597,178	581,544.00	20,354,040	139,638	108,010
1938	11	71	1,586,181	594,847.00	20,819,645	162,295	104,918
1939	18	80	1,632,778	618,536.00	21,648,760	167,584	113,754
1940	11	81	1,667,370	586,662.00	20,533,170	175,514	124,810
1876–1940			(2)	19,437,306.00	461,902,919	9,175,505	6,527,191

Year	Copper		Lead		Total value
	Pounds	Value	Pounds	Value	
1936					$20,634,244
1937					20,462,050
1938					20,924,563
1939					21,762,514
1940	12,000	$1,356	14,000	$700	20,660,036
1876–1940	[3] 104	35,954	[3] 295	35,520	468,501,584

[1] For total production of gold and silver in South Dakota, by years, see Mineral Resources, 1913, pt. 1, p. 42; Mineral Resources, 1922, pt. 1, p. 194; and subsequent volumes of Mineral Resources and Minerals Yearbook.
[2] Figures not available.
[3] Short tons.

Gold and silver produced at placer mines in South Dakota, 1936–40, in terms of recovered metals

Year	Gold		Silver		Total value
	Fine ounces	Value	Fine ounces	Value	
1936	346.80	$12,138	31	$24	$12,162
1937	1,010.60	35,371	75	58	35,429
1938	1,069.00	37,415	82	53	37,468
1939	622.00	21,770	47	32	21,802
1940	229.00	8,015	21	15	8,030

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, and lead in South Dakota in 1940, by counties, in terms of recovered metals

County	Gold (lode and placer)		Silver (lode and placer)		Copper		Lead		Total value
	Fine ounces	Value	Fine ounces	Value	Pounds	Value	Pounds	Value	
Custer	26	$910	273	$194			14,000	$700	$1,804
Lawrence	584,853	20,469,855	174,881	124,360	12,000	$1,356			20,595,571
Pennington	1,783	62,405	360	256					62,661
	586,662	20,533,170	175,514	124,810	12,000	1,356	14,000	700	20,660,036

MINING AND METALLURGIC INDUSTRY

The total ore mined and sold or treated by producers of lode gold and silver in South Dakota in 1940 was 1,667,370 tons yielding in recovered metals 586,433 fine ounces of gold, 175,493 ounces of silver, 12,000 pounds of copper, and 14,000 pounds of lead. By methods of treatment, 1,433,737 tons were treated by amalgamation followed by cyanidation of sands and slimes; 176,072 tons by cyanidation only (36,708 tons of which were first roasted, and part of 130,643 tons was also first roasted); 45,168 tons by jigging, amalgamation of the jig concentrates, and flotation of the remaining pulp (concentrates carrying gold, silver, and some copper were shipped to smelters); 200 tons by amalgamation only; 800 tons by amalgamation with flotation of tailing; 11,288 tons by countercurrent-decantation cyanidation with jig in ball-mill circuit (gold concentrates to smelter); and 105 tons (containing 220.84 ounces of gold, 1,004 ounces of silver, and 15,557 pounds of lead) shipped crude to smelters. Operating details at both lode and placer mines are given in the following review by counties.

METALLURGIC RECOVERY

Gold and silver bullion produced at mills in South Dakota by amalgamation, 1936–40

Year	Ore treated	Gold in bullion	Silver in bullion	Quicksilver used
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*
1936	1,393,450	330,052.08	66,585	15,093
1937	1,414,772	329,975.10	66,640	10,178
1938	1,430,391	328,044.50	62,602	7,744
1939	1,461,283	336,424.93	64,710	9,221
1940	1,479,905	313,964.15	60,254	4,997

Gold and silver bullion produced at mills in South Dakota by cyanidation, 1936–40

Year	Material treated				Gold in bullion product	Silver in bullion product	Sodium cyanide used [1]
	Crude ore	Concentrates	Sands and slimes	Total			
	Short tons	*Short tons*	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*
1936	155,652		1,382,676	1,538,328	255,849.83	77,811	749,923
1937	182,406		1,394,252	1,576,658	249,980.70	72,883	786,072
1938	155,667		1,416,899	1,572,566	262,913.21	98,777	860,762
1939	170,270	[2] 61	1,443,548	1,613,879	279,889.77	102,317	887,888
1940	187,360		1,432,244	1,619,604	269,518.82	111,607	[3] 883,849

[1] In terms of 96- to 98-percent strength.
[2] From 1,143 tons of ore treated by flotation.
[3] Actually 1,753,137 pounds of calcium cyanide (48- to 49-percent strength) and 8,000 pounds of sodium cyanide (91-percent strength); all reduced to equivalent of 96- to 98-percent strength to conform with earlier use of figures for high-strength NaCN and KCN.

REVIEW BY COUNTIES

CUSTER COUNTY

Small hand-method placering was done on French Creek. Development work at the Spokane lode mine resulted in the shipment of 81 tons of lead-silver-gold ore to the Helena (Mont.) smelter.

LAWRENCE COUNTY

Homestake mine.—The Homestake mine includes a large acreage of consolidated lode claims at Lead, operated by the Homestake Mining Co. The Homestake Mining Co. in 1877 acquired original discoveries of the year 1876 known as the Homestake and Golden Star claims but continued subsequently to add to its acreage by purchase and consolidation of other companies. Development of the mine from the 3,200- to the 5,000-foot level has been under way since 1932. One new shaft, the Ross, has been in operation since 1934 and had been completed to the 4,100-foot level at the end of 1938. Another new shaft, the Yates, was begun in 1938; in 1939 pilot raises were completed 3,426 feet, and a winze from the 4,100-foot level was sunk to the 4,550-foot level; in 1940 all pilot raises from the 4,100-foot level were completed, the winze from the 4,100-foot level was continued to the 4,700-foot level, and drifting on the 4,700-foot level was begun. The annual report of the general manager of the Homestake Mining Co. for the year ended December 31, 1940, says—

Operations during 1940 were normal in all departments. Ore production from the mine was 1,433,737 tons. This is 2.41 percent higher than in 1939. The gross income for gold and silver produced was 4.56 percent lower than in 1939. It is expected that production for 1941 will be approximately the same as in 1940.

Operating expenses exclusive of taxes were slightly lower than in 1939. Total taxes were $3,589,344.32, which is $456,832.21 more than in 1939.

There are 397,603 tons of broken ore remaining in shrinkage stopes.

The reserve of developed ore is 18,636,797 tons. As in previous reports this includes the broken ore. Of the total reserve 7,974,600 tons are in the new ledge referred to in recent reports. This ore is materially lower in grade than that in the main ledges. Production from this ledge gradually increased and reached an average of 848 tons per day in December. It is expected that the average grade of all ore produced in 1941 will be substantially the same as that for 1940.

Yates shaft construction has continued to make good progress. Pilot raises have all been completed to the 4,100-foot level, and the shaft is stripped to size and timbered from the surface to 50 feet below the 3,350-foot level. The hoists were placed in operation in May and have since been continuously operated for shaft construction work. The shaft has not yet been used for production because hoisting at the Ellison shaft is still possible. The winze from the 4,100-foot level was sunk to the 4,700-foot level and drifting on the 4,700-foot level was begun.

Ore milled, receipts, and dividends, Homestake mine, 1936–40 [1]

Year	Ore milled (short tons)	Receipts for bullion product		Dividends
		Total	Per ton	
1936	1,383,929	$19,506,534.78	$14.0950	$9,041,760
1937	1,394,773	19,304,076.45	13.8403	9,041,760
1938	1,377,314	19,284,459.67	14.0015	9,041,760
1939	1,400,015	19,922,964.60	14.2300	9,041,760
1940	1,433,737	19,014,767.73	13.2624	9,041,760

[1] From 1876 to 1940, inclusive, this mine yielded bullion and concentrates that brought a net return of $399,012,747 and paid $133,229,242 in dividends.

In the course of mining and development in 1940 the company sank 1,711 feet of shaft, drove 29,155 feet of drifts and 12,238 feet of raises, and did 46,481 feet of diamond drilling. Surface treatment plants operated (besides the primary crushing plants at the hoists) comprised the South mill, which includes the main secondary crushing (including 180 stamps), grinding, and amalgamating plant, with a capacity of 3,900 tons per 24 hours, cyanide sand plant No. 1, cyanide sand plant No. 3, and the refinery—all at Lead; and the slime plant at Deadwood. At the refinery silver is parted from the gold and virtually pure metals are shipped to the Denver Mint.

Other mines.—The Bald Mountain Mining Co., second-largest producer of gold and silver in South Dakota in 1940, continued to operate its consolidated group of mines and 350-ton all-sliming countercurrent-cyanidation plant at Trojan. Much of the ore of the Bald Mountain group is oxide, but in 1938 the company installed a 110-ton gas-fired rotary hearth furnace to treat refractory sulfide or "blue ores" and continued in 1940 to mine both sulfide and oxide ores. The yield in recovered metals from 130,643 tons of ore treated in the mill and 10 tons of high-grade ore shipped to the Omaha (Nebr.) smelter was 25,849 fine ounces of gold and 50,077 fine ounces of silver. The ore is brought to the mill by rail tramway and trucks. The company did 4,485 feet of development work in the mine during the year.

At the Maitland group 5½ miles northwest of Deadwood the Canyon Corporation continued to operate steadily its 100-ton roast-cyanide mill on its refractory sulfide ores. Besides gold and silver the ores contain pyrite, silica, dolomite, and some undetermined arsenic mineral. The yield in recovered metals from 36,708 tons was 12,503 fine ounces of gold and 1,730 fine ounces of silver. Lime-hydrating equipment and a diaphragm pump were added to the mill equipment. The mine is opened by a vertical shaft 600 feet deep. Drifts driven in 1940 totaled 3,260 feet of prospecting work and 3,627 feet of mine development work; 2,540 feet of diamond drilling were done.

Gilt Edge Mines, Inc., continued operation at the Gilt Edge-Dakota Maid-Oro Fino-Rattlesnake Jack group in the Bear Butte district. The ores are both oxide and sulfide and contain gold, silver, and iron, and enough copper to be troublesome in the cyanide circuit. So, in February–March 1940 flotation cells were installed, and the larger part of the production in 1940 was in gold-silver concentrates, containing some copper, sold to Montana smelters. Amalgamation also continued by amalgamating jig concentrates; and a small quantity of slimes was cyanided. Development work in 1940 consisted of 100 feet of shaft, 1,900 feet of drifts, and 2,700 feet of diamond drilling. The Oro-Fino shaft was unwatered. At the end of 1940 development of the property was reported as three shafts 100, 450, and 335 feet deep and 10,000 feet of drifts and crosscuts.

The Frerichs Mining Co. operated a group of claims in Whistler Gulch 1½ miles from Deadwood and ran its 30- to 50-ton all-sliming cyanidation plant for 10 months. In 1940 a flotation unit and a thickener were added to the mill equipment. The object of the flotation unit was to remove graphite, a cyanicide.

The Black Hills Tin Co. mined a few hundred tons of gold ore from part of its property at Tinton and produced a small gold-silver bar. Within its mill building in 1940 experiments were made in working out a flow sheet for treating tin ore, and several hundred tons of tin ore were treated; some tin concentrate was sold.

Sluicing at small placers near Deadwood and Tinton yielded some gold.

PENNINGTON COUNTY

The receiver for Empire Gold Mines, Inc., former operator of the Golden Slipper mine and amalgamation-flotation mill 5 miles east of Hill City, made a small clean-up of material around the mill. The Bald Mountain Mining Co. of Trojan took a lease on this property and began work January 15, 1941.

The Gold Lode mine and mill 5 miles northwest of Hill City were operated for 10 weeks. The 25-ton mill was enlarged to 75-ton capacity. Flotation cells were added to the jigs, amalgamating plates, and tables. James A. Murphy operated a small amalgamation mill for 60 days, when water was available, on ore from the Western Bell, 6 miles from Hill City.

The once famous Holy Terror-Keystone mine at Keystone was reopened in 1940; the 100-ton cyanide plant was rebuilt in July and was operated the remainder of the year. The mill process is countercurrent-decantation cyanidation, with a jig in the ball-mill circuit. Gold-silver bullion was shipped to the Denver Mint and gold-silver concentrates to Montana. The mine is opened by a 500-foot shaft, which first had to be retimbered. The ore carries pyrite and arsenopyrite.

Individuals sluicing, rocking, and panning, principally on Battle, Rapid, and Spring Creeks, continued to recover small lots of gold dust, most of which was sold to dealers or traded for groceries at stores in the vicinity.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN TEXAS

(MINE REPORT)

By Chas. W. Henderson

SUMMARY OUTLINE

Silver was found in Texas in 1880 at the Presidio mine at Shafter, Presidio County, but it was not until 1885 that shipments were begun. From 1885 through 1940 this mine has been by far the principal producer of the State—chiefly of silver but also of gold and lead. Another early producer was the Hazel mine in Culberson County. The American Metal Co. of Texas continued to operate the Shafter mine and 400-ton cyanidation mill in 1940 and made a slightly increased tonnage output containing less silver to the ton than in 1939. About 1,000 tons of silver smelting ore, carrying some copper, were shipped from the Hazel mine to the El Paso smelter. Of interest in 1940 was the shipment of 3 tons of copper ore from an open-cut on the Bob Cat location 10 miles south and 6 miles east of Quanah, Hardeman County, where copper ore has been reported for many years. About 600 tons of silver smelting ore, carrying some copper, were shipped from the Sancho Panza mine near Allamoore, Hudspeth County, to the El Paso smelter. About 600 tons of silver smelting ore, carrying copper and lead, were shipped from the Plata Verde mine in Hudspeth County, southwest of Van Horn, to the El Paso smelter. Smelting lead-silver ore, carrying some copper, was shipped from the Black Hill mine near Sierra Blanca, Hudspeth County, to El Paso.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1936–40

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1936	$35.00	$0.7745	$0.092	$0.046	$0.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052
1940	35.00	[6] .711+	.113	.050	.063

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] 1936–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–40: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787. [6] $0.71111111.

MINE PRODUCTION

The following table shows the annual output of ore and the quantity and value of the metals recovered from Texas mines from 1936 to 1940, as well as the total metal production from 1885 to 1940.

Mine production of gold, silver, copper, lead, and zinc in Texas, 1936–40, and total, 1885–1940, in terms of recovered metals

Year	Ore (short tons)	Gold		Silver	
		Fine ounces	Value	Fine ounces	Value
1936	104,990	613	$21,455	1,361,459	$1,054,450
1937	120,145	562	19,670	1,325,660	1,025,398
1938	131,002	439	15,365	1,433,008	926,389
1939	141,795	324	11,340	1,341,945	910,896
1940	146,936	312	10,920	1,326,150	943,040
1885–1940	(1)	7,735	204,670	31,417,729	22,094,896

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1936	53,000	$4,876	935,000	$43,010			$1,123,791
1937	320,000	38,720	790,000	46,610			1,130,398
1938	32,000	3,136	684,000	31,464			976,354
1939	68,000	7,072	454,000	21,338			950,646
1940	60,000	6,780	410,000	20,500			981,240
1885–1940	[2] 950	276,737	[2] 4,408	442,041	[2] 744	$106,491	23,124,835

[1] Figures not available.
[2] Short tons.

Mine production of gold, silver, copper, and lead in Texas in 1940, by counties, in terms of recovered metals

County	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Culberson	1	1,055		18,903	33,000	
Hardeman	1	3			300	
Hudspeth	3	1,320	3	12,444	26,700	28,000
Presidio	1	144,558	309	1,294,803		382,000
	6	146,936	312	1,326,150	60,000	410,000
Total, 1939	7	141,795	324	1,341,945	68,000	454,000

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Texas in 1940, with content in terms of recovered metals

Source	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Dry and siliceous silver ore	4	146,811	309	1,322,364	59,308	386,703
Copper ore	1	3			300	
Lead ore	1	122	3	3,786	392	23,297
	6	146,936	312	1,326,150	60,000	410,000
Total, 1939	7	141,795	324	1,341,945	68,000	454,000

SMELTING AND REFINING PLANTS IN TEXAS

In 1940 the American Smelting & Refining Co. continued to purchase gold, silver, copper, and lead ores and concentrates from operators in Arizona, California, New Mexico, and Texas for reduction in its lead and copper smelters at El Paso. The smelters were not operated at full capacity because of decreasing receipts from Mexico; termination on March 22, 1939, of the company's contract under which it had treated the copper concentrates from the 15,000-ton Chino concentrator at Hurley, N. Mex.; and the closing on May 31, 1939, of the Pecos zinc-lead-copper-silver-gold mine and 600-ton flotation mill in San Miguel County, N. Mex., for 13 years an important shipper of lead-copper-silver-gold concentrates to the El Paso smelter. In addition to the lead and copper furnaces the plant contains a unit for the recovery of arsenic. The Nichols electrolytic copper refinery at El Paso, a unit of the Phelps Dodge Corporation, continued to refine copper anodes produced at corporation smelters in Arizona. The Illinois Zinc Co. gas-retort zinc smelter at Dumas (idle from March 25, 1939, through the remainder of that year) was leased by the American Zinc Co. of Illinois and was reopened in February 1940 to treat zinc concentrates from the Peru mill at Wemple near Deming, N. Mex., and concentrates from Mexico. Additions to the roasting and smelting works of the Dumas plant, which will increase the capacity 50 percent, were completed by February 1941. Additions in March and April will increase the capacity 100 percent over that of 1939. The American Smelting & Refining Co. gas-retort zinc smelter at Amarillo was operated continuously on zinc ores and concentrates purchased from operators in Arizona, Colorado, Nevada, New Mexico, Utah, and Mexico.

MINES REVIEW BY COUNTIES

Culberson County.—Silver ore totaling 1,055 tons, containing 18,903 ounces of silver, 34,945 pounds of copper, and 1,984 pounds of zinc, was shipped from the Hazel mine 14 miles northwest of Van Horn to the El Paso smelter by A. P. Williams, lessee. The mine is opened by a vertical shaft 320 feet deep. Only 60 feet of development work were done in 1940.

Hardeman County.—From an open-cut near Quanah, 3 tons of copper ore containing 320 pounds of copper were shipped to the El Paso smelter.

Hudspeth County.—Sancho Panza Mines and Garren Lease together shipped 577 tons of silver smelting ore containing 1,102 ounces of silver and 24,778 pounds of copper to the El Paso smelter from the Sancho Panza mine, northeast of Allamoore. The Yodina Mining Co., prospecting in Culberson and Hudspeth Counties, shipped several lots of lead-silver-gold ore by truck to El Paso. Lessees on the Plata Verde mine southwest of Van Horn shipped several hundred tons of silver smelting ore containing copper and lead.

Presidio County.—The American Metal Co. of Texas, by maintaining its mill at capacity and by reducing mining costs, was able to operate continuously in 1940 on lower heads into the mill than in 1939. The quantity treated in 1940 was 144,558 tons compared with 138,934 in 1939. The mine is developed by two vertical shafts, one 400 and one 600 feet deep; three underground subshafts, one 100, one 250, and one 450 feet deep; and other openings totaling about 52 miles of underground workings. Development work in 1940 totaled 47 feet of shaft, 7,957 feet of drifts, and 37,395 feet of diamond drilling. The minerals contained in the ore are argentite, cerargyrite, galena, anglesite, and cerussite. The ore is transported 1¼ miles by rail and aerial tramways from the shafts to the mill. The crushing plant operates an average of 14 hours a day. The discharge from the gyratory crusher is elevated over a 15-inch Dings magnetic pulley onto a ⅝- by ½-inch-mesh stationary screen. The oversize goes to a 3-foot Symons cone crusher set at ¼ inch. From storage tanks the ore is elevated to fall over a 3- by 5-foot 10-mesh Hum-mer screen. The oversize from the Hum-mer screen goes to a conical ball mill with 10-mesh discharge screen. The oversize from the ball mill goes to a Dorr Duplex classifier. The fines from the discharge screen of the ball mill and the undersize from the Hum-mer screen go to 11 Wilfley tables. The table tails go to tube mills where they are ground to between 80 to 90 percent minus-200-mesh. Six Pachuca tanks connected in series make up the agitation unit; the average agitation is 20 hours. The clarified solution passes to a Merrill-Crowe zinc-dust precipitation plant. In 1940 the mill produced 1,113,806 ounces of silver and 291 ounces of gold, in cyanide precipitates, and 469 tons of table concentrates containing 180,997 ounces of silver, 18 ounces of gold, and 381,783 pounds of lead. The cyanide precipitates carried 27,458 pounds of lead dissolved by the cyanide, an unusual phenomenon. The concentrates and precipitates were shipped to the Carteret (N. J.) smelter. Electric power for the mine and mill is obtained from a 1,300-horsepower Diesel plant.

Production of silver from the Presidio mine,[1] *1885–1940*[2]

Period	Mill heads treated (short tons)	Silver content of mill heads (ounces)		Recovery of silver	
		Per ton	Total	Percent	Ounces
1885–1912	450,000	25.84	11,628,000	81.68	9,497,750
1913–26	720,000	12.00	8,640,000	83.66	7,228,224
1927	48,190	22.87	1,102,105	91.41	1,007,434
1928	57,475	23.17	1,331,696	91.04	1,212,340
1929	54,644	19.74	1,078,673	90.30	974,049
Total, 1885–1929	1,330,309	17.88	23,780,474	83.77	19,919,797
1930	24,985	16.09	401,926	88.79	356,854
1934	46,653	19.70	919,064	91.39	839,936
1935	70,166	15.87	1,113,686	87.84	978,303
1936	98,499	14.41	1,419,371	87.48	1,241,605
1937	110,220	12.76	1,406,825	86.79	1,220,921
1938	127,574	12.76	1,627,844	84.72	1,379,187
1939	138,934	11.24	1,561,618	83.49	1,303,748
1940	144,558	10.55	1,525,087	84.90	1,294,803
Total, 1885–1940	2,091,898	16.14	33,755,895	84.53	28,535,154

[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, 20 pp.
Howbert, Van Dyne, and Bosustow, Richard, Mining Methods and Costs at Presidio Mine of the American Metal Co. of Texas: Am. Inst. Min. and Met. Eng. Tech. Pub. 334, 1930, 15 pp.
Stem, D. E., Milling Methods and Costs at the Presidio Mine: Arizona Min. Jour., vol. 24, No. 22, April 15, 1941, pp. 3–5.
[2] No production in 1931, 1932, and 1933.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN UTAH

(MINE REPORT)

By G. E. Woodward and Paul Luff

SUMMARY OUTLINE

Utah led all the States in value of combined production of gold, silver, copper, lead, and zinc in 1940; the total value for the State—in terms of recovered metals—was $86,585,499. This output, compared with $62,725,551 in 1939, represents a 38-percent gain. Greater production of all five metals (including an all-time high for gold and copper) was stimulated by moderately higher prices for silver and the base metals. Most of the gains in gold and copper and much of that in silver were in the Bingham district and resulted chiefly from the high rate of operations by the Utah Copper Co. The Park City region showed the greatest gain in silver, marked gains in gold and copper, and nearly doubled its 1939 production of lead and zinc. The output of each of the five metals in the Tintic district decreased. Tooele County showed a slight gain in total value of metal output.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1936–40

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1936	$35.00	$0.7745	$0.092	$0.046	$0.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052
1940	35.00	[6] .711+	.113	.050	.063

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] 1936-37: Yearly average weighted Treasury buying price for newly mined silver; 1939-40: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464.
[5] $0.67878787.
[6] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Utah, 1936–40, and total, 1864–1940, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1936	171	28	14,997,892	223,444	$7,820,540	9,997,645	$7,743,176
1937	189	14	24,578,275	322,759	11,296,565	12,869,117	9,954,262
1938	183	22	13,248,660	200,630	7,022,050	9,682,732	6,259,544
1939	175	11	21,094,097	277,751	9,721,285	10,758,657	7,302,846
1940	191	21	27,939,346	355,494	12,442,290	12,172,299	8,655,857
1864–1940			(1)	8,701,728	204,785,520	669,904,666	488,651,812

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1936	252,434,000	$23,223,928	139,772,000	$6,429,512	72,384,000	$3,619,200	$48,836,356
1937	411,988,000	49,850,548	178,916,000	10,556,044	96,002,000	6,240,130	87,897,549
1938	216,252,000	21,192,696	131,314,000	6,040,444	67,316,000	3,231,168	43,745,902
1939	343,780,000	35,753,120	135,268,000	6,357,596	69,052,000	3,590,704	62,725,551
1940	463,728,000	52,401,264	151,376,000	7,568,800	87,576,000	5,517,288	86,585,499
1864–1940	[2] 3,379,688	976,515,573	[2] 4,088,205	439,777,328	[2] 747,607	89,535,277	2,199,265,510

[1] 1864–1901: Figures not available; 1902–40: 389,413,166 tons produced.
[2] Short tons.

Gold.—The output of recoverable gold in Utah increased 77,743 ounces in 1940 compared with 1939. Copper ore yielded 63 percent of the total and siliceous ore 24 percent; the remainder was recovered from lead, lead-copper, zinc-lead, and zinc-lead-copper ore, and placers. Gold recovered from placer gravels was negligible. Ore of all classes treated at concentration mills yielded 74 percent of the total gold, ore shipped crude 21 percent, and ore cyanided and amalgamated and placers the remainder. The Bingham (West Mountain) district, which produced 72 percent of the State total gold, showed a gain of 66,005 ounces. There was a moderate decline in gold recovered from ore of the Tintic district because of decreases at the Centennial-Beck-Victoria group and the Eureka Standard mine. Gold recovered from ore of the Park City region nearly trebled, owing principally to a sharp increase from the New Park Mining Co. Gold recovered from ore of Tooele County gained, chiefly because of greater output from mines in the Camp Floyd district. The Utah Copper Co., which supplied over 60 percent of the total gold production of Utah, was followed by the Con Mercur, United States & Lark, Tintic Bullion, and Mayflower mines.

Silver.—The output of recoverable silver from Utah mines in 1940 increased 13 percent over 1939, owing to greater production of zinc-lead, zinc-lead-copper, and copper ore. Zinc-lead and zinc-lead-copper ore yielded 47 percent of the State total silver, siliceous ore 25 percent, copper ore nearly 18 percent, and lead and lead-copper ore 10 percent. The Bingham district was the largest producer (39 percent of the State total silver) followed by the Park City region, the Tintic district, and Tooele County. Concentrates yielded 67 percent of the silver output of the State and ore shipped crude to smelters virtually all the remainder. The Utah Copper Co. was the largest producer of silver in Utah in 1940; it was followed by the United States & Lark (first in silver production in Utah in 1939), Tintic Standard, Silver King

Coalition, and Park City Consolidated properties, the Judge group of the Park Utah Consolidated Mines Co., the Mayflower tunnel of the New Park Mining Co., and the Chief Consolidated property. These eight properties produced 76 percent of the silver output of Utah in 1940.

Copper.—The output of recoverable copper in Utah in 1940 set a new high mark and was 119,948,000 pounds greater than in 1939. The previous record was in 1937, when 411,988,000 pounds were produced. The Utah Copper Co. open-cut mine at Bingham and mills at Magna and Arthur operated at a high rate during 1940 and in December reached a record production rate of 42,000,000 pounds of

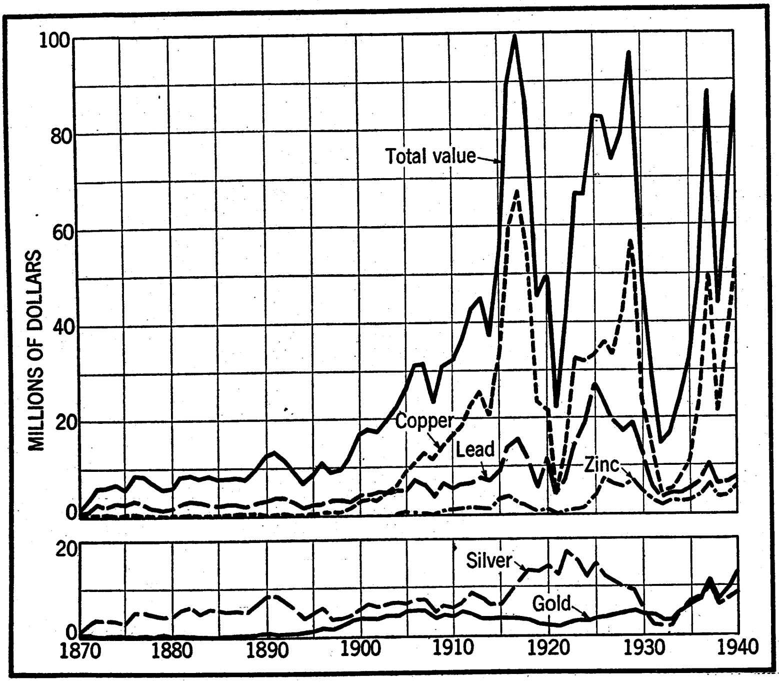

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value in Utah, 1870–1940.

copper a month; copper ore mined in 1940 totaled 25,950,500 tons, compared with 19,310,200 tons in 1939, and exceeded the previous high point of 23,119,800 tons in 1937. Copper ore and mine-water precipitates yielded 98 percent of the State total copper in 1940; the remainder came from zinc-lead, zinc-lead-copper, and lead-copper ore sent to flotation mills and siliceous ore shipped crude to smelters. Other important copper producers in Utah were the United States & Lark and Ohio Copper properties in the Bingham district, the Ophir Hill in Tooele County, and the Tintic Standard in the Tintic district.

Lead.—There was a 12-percent gain in output of recoverable lead in Utah in 1940 over 1939. The Bingham district continued to be the largest lead-producing area in the State, and the bulk of the output came from the United States & Lark property (operated by the United States Smelting, Refining & Mining Co.). The Park City region made the greatest increase in lead output, as the Silver King Coalition Mines

Co. and the Park Utah Consolidated Mines Co. properties were operated at an increased rate in 1940 and produced over 33,000,000 pounds of recovered lead—a sharp gain over 1939. The output of lead from the Tintic district decreased, owing chiefly to the drop in production at the Eureka Standard mine. The Calumet and Hidden Treasure mines in Tooele County showed increases. The principal lead-producing properties in Utah in 1940 were the United States & Lark, Silver King Coalition, Park Utah Consolidated, Calumet, Hidden Treasure, and Tintic Standard; these six properties produced 77 percent of the State total.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Utah in 1940, by counties, in terms of recovered metals

County	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
Beaver	18		15,405	1,468	$51,380	105,196	$74,806
Box Elder	6		569	73	2,555	25,266	17,967
Emery	2		2			14	10
Garfield		1		1	35		
Grand		9		82	2,870	17	12
Iron	7		899	275	9,625	3,292	2,341
Juab	29		157,268	18,349	642,215	1,012,469	719,978
Millard	3	2	47	106	3,710	24	17
Morgan	1		5			7	5
Piute	7		4,240	1,941	67,935	13,109	9,322
Salt Lake	28		26,756,244	256,830	8,989,050	4,795,726	3,410,294
San Juan	1	4	37	35	1,225	21	15
Sevier	3		553	66	2,310	1,554	1,105
Summit	7		125,394	3,611	126,385	1,311,781	932,822
Tooele	49		561,882	38,353	1,342,355	904,164	642,961
Uintah	1	5	8	83	2,905	21	15
Utah	22		130,225	20,524	718,340	1,978,228	1,406,740
Wasatch	5		186,512	13,689	479,115	2,021,341	1,437,398
Washington	2		56	8	280	69	49
	191	21	27,939,346	[1] 355,494	12,442,290	12,172,299	8,655,857
Total, 1939	175	11	21,094,097	[2] 277,751	9,721,285	10,758,657	7,302,846

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaver	484,000	$54,692	1,032,200	$51,610	529,000	$33,327	$265,815
Box Elder	2,000	226	25,000	1,250	15,000	945	22,943
Emery							10
Garfield							35
Grand							2,882
Iron	425	48	9,200	460			12,474
Juab	943,000	106,559	5,544,700	277,235	301,000	18,963	1,764,950
Millard	575	65	1,300	65			3,857
Morgan			4,400	220			225
Piute	5,000	565	12,300	615			78,437
Salt Lake	457,094,000	51,651,622	75,973,500	3,798,675	43,663,000	2,750,769	70,600,410
San Juan	7,000	791					2,031
Sevier							3,415
Summit	521,000	58,873	20,646,200	1,032,310	17,085,000	1,076,355	3,226,745
Tooele	2,218,000	250,634	21,143,800	1,057,190	7,211,000	454,293	3,747,433
Uintah	1,000	113					3,033
Utah	1,665,000	188,145	8,132,200	406,610	662,000	41,706	2,761,541
Wasatch	775,000	87,575	18,851,200	942,560	18,110,000	1,140,930	4,087,578
Washington	12,000	1,356					1,685
	463,728,000	52,401,264	151,376,000	7,568,800	87,576,000	5,517,288	86,585,499
Total, 1939	343,780,000	35,753,120	135,268,000	6,357,596	69,052,000	3,590,704	62,725,551

[1] Includes 275 ounces of placer gold distributed as follows: Garfield County, 1 ounce; Grand County, 82 ounces; Millard County, 74 ounces; San Juan County, 35 ounces; and Uintah County, 83 ounces.

[2] Includes 145 ounces of placer gold distributed as follows: Garfield County, 7 ounces; Grand County, 70 ounces; Millard County, 19 ounces; San Juan County, 21 ounces; and Uintah County, 28 ounces.

Zinc.—The output of recoverable zinc in Utah in 1940 rose 27 percent over 1939. The Park City region showed the greatest gain, followed by the Bingham district; there were losses in the Tintic district and in Tooele County. The source of virtually all the zinc output was zinc-lead ore treated by selective flotation at four plants; all the zinc ore (only 26 tons containing 27,712 pounds of zinc) was shipped crude to a smelter. The United States & Lark property at Bingham was the chief producer of zinc, followed by the Park Utah Consolidated and Silver King Coalition in the Park City region and the Calumet in Tooele County; these four properties produced 82 percent of the State total.

MINING INDUSTRY

The output of copper ore in Utah in 1940 represented 94 percent of the total tonnage of ore of all classes. The Utah Copper Co. open-cut mine at Bingham, which began the year with a gross copper production of nearly 40,000,000 pounds a month, gradually increased its output until more than 42,000,000 pounds a month were being produced in December. This copper ore, carrying a low content of gold and silver, accounted for nearly all the gain in output of copper and much of the gain in gold and silver in the State. Production of zinc-lead ore from the Park City region was greatly increased, whereas that from Bingham showed a slight gain and that from Tintic declined. The value of the metal output of Tooele County increased in 1940, owing principally to the large production of siliceous ore at Mercur. The increase in the Rush Valley district in Tooele County was responsible for the gain in output of lead in that county. Production in the Ophir district declined, owing chiefly to completion of the treatment of Ophir Hill tailings by the International Smelting & Refining Co.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Utah in 1940, with content in terms of recovered metals

Source	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold ore	33	376,859	54,881	118,265	633,974	357,194	
Dry and siliceous gold-silver ore	36	176,369	23,961	1,057,672	1,304,653	3,864,286	
Dry and siliceous silver ore	36	241,895	4,996	1,856,848	2,544,605	7,775,175	
	105	795,123	83,838	3,032,785	4,483,232	11,996,655	
Copper ore	12	26,301,745	223,156	2,132,727	[1]453,767,607	38,743	
Lead ore	86	65,072	7,690	1,061,774	456,425	16,060,728	
Lead-copper ore	3	8,510	58	171,646	502,193	4,438,625	
Zinc ore	1	26					24,900
Zinc-lead ore; Zinc-lead-copper ore[2]	40	768,870	40,477	5,773,336	4,518,543	118,841,249	87,551,100
Total, lode mines	[3]191	27,939,346	355,219	12,172,268	[1]463,728,000	151,376,000	87,576,000
Total, placers	21		275	31			
	212	27,939,346	355,494	12,172,299	[1]463,728,000	151,376,000	87,576,000
Total, 1939	186	21,094,097	277,751	10,758,657	[4]343,780,000	135,268,000	69,052,000

[1] Includes 14,223,006 pounds recovered from mine-water precipitates.
[2] Zinc-lead-copper ore all from 1 mine; Bureau of Mines not at liberty to publish figures.
[3] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[4] Includes 7,923,790 pounds recovered from mine-water precipitates.

METALLURGIC INDUSTRY

In 1940 the largest tonnage on record of ore containing gold, silver, copper, lead, and zinc was mined in Utah. It was treated as follows: 27,215,217 tons at concentration mills compared with 20,393,488 tons in 1939; 297,567 tons at cyanidation mills compared with 230,224 tons in 1939; 520 tons at amalgamation plants compared with none in 1939; and 426,042 tons shipped crude to smelters compared with 470,385 tons in 1939.

All the ore cyanided was treated at plants of two companies at Mercur, each treating considerable custom ore. The 297,567 tons cyanided yielded 17,537 ounces of gold and 518 ounces of silver. These two plants reported the consumption of 96,069 pounds of sodium cyanide (91-percent grade), 39,800 pounds of calcium cyanide, 1,704,510 pounds of lime, and 26,589 pounds of zinc dust.

Ten concentration plants were operated in Utah in 1940. Three plants (Arthur, Magna, and Ohio Copper) treated 26,296,475 tons of copper ore and old tailings; four mills (Bauer, Midvale, Silver King, and Tooele) treated 768,652 tons of zinc-lead and zinc-lead-copper ore; one mill (Ophir Hill) treated 147,585 tons of silver tailings; and two gravity-concentration plants, one in Tooele County and one in Utah County, treated 2,505 tons of lead ore.

The following tables give details of treatment for all the ore produced in Utah in 1940.

Mine production of metals in Utah in 1940, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore amalgamated	520	25	14			
Ore cyanided	297,567	17,537	518			
Concentrates smelted	1,011,416	263,903	8,212,922	444,939,519	123,620,563	87,473,400
Ore smelted	426,042	73,754	3,958,814	4,565,475	27,755,437	102,600
Mine-water precipitates smelted[1]	8,851			14,223,006		
Placer		275	31			
		355,494	12,172,299	463,728,000	151,376,000	87,576,000
Total, 1939		277,751	10,758,657	343,780,000	135,268,000	69,052,000

[1] All from Salt Lake County.

Mine production of metals from concentrating mills in Utah in 1940, by counties, in terms of recovered metals

County	Ore milled	Concentrates smelted and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	1,330	670	9	9,353	28,001	71,021	529,000
Box Elder	180	60		120	186	20,941	15,000
Juab	1,399	571	28	8,627	3,032	187,855	230,400
Salt Lake	26,712,982	876,448	245,680	4,539,946	442,096,561	71,167,406	43,631,000
Summit	113,824	34,892	2,015	1,100,421	442,178	19,094,908	17,085,000
Tooele	201,575	42,930	2,986	679,903	1,659,456	14,287,582	7,211,000
Utah	5,178	1,933	101	57,670	19,954	699,966	662,000
Wasatch	178,749	53,732	12,902	1,816,882	690,151	18,090,884	18,110,000
	27,215,217	1,011,236	263,721	8,212,922	444,939,519	123,620,563	87,473,400
Total, 1939	20,393,488	774,106	186,796	6,712,712	330,323,150	101,862,708	68,860,496

Gross metal content of concentrates produced from ores mined in Utah in 1940, by classes of concentrates smelted

Class of concentrates	Concentrates produced	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	180	182	------	------	------	------
Copper	681,231	223,084	2,106,981	452,602,478	------	------
Lead	104,953	16,749	4,555,668	3,471,032	109,475,308	10,135,316
Lead-copper	17,127	179	363,535	1,835,698	5,770,606	4,611,941
Zinc	90,380	5,059	660,460	1,280,407	8,795,109	97,192,828
Dry iron (from zinc-lead ore)	117,545	18,650	526,278	849,331	6,484,905	5,337,937
	1,011,416	263,903	8,212,922	460,038,946	130,525,928	117,278,022
Total, 1939	774,106	186,796	6,712,712	341,383,470	107,079,317	90,495,778

Mine production of metals from Utah concentrates shipped to smelters in 1940, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	670	9	9,353	28,001	71,021	529,000
Box Elder	60	------	120	186	20,941	15,000
Juab	571	28	8,627	3,032	187,855	230,400
Salt Lake	876,448	245,680	4,539,946	442,096,561	71,167,406	43,631,000
Summit	34,892	2,015	1,100,421	442,178	19,094,908	17,085,000
Tooele	43,110	3,168	679,903	1,659,456	14,287,582	7,211,000
Utah	1,933	101	57,670	19,954	699,966	662,000
Wasatch	53,732	12,902	1,816,882	690,151	18,090,884	18,110,000
	1,011,416	263,903	8,212,922	444,939,519	123,620,563	87,473,400
Total, 1939	774,106	186,796	6,712,712	330,323,150	101,862,708	68,860,496

BY CLASSES OF CONCENTRATES SMELTED

	Concentrates	Gold	Silver	Copper	Lead	Zinc
Dry gold	180	182	------	------	------	------
Copper	681,231	223,084	2,106,981	439,023,871	------	------
Lead	104,953	16,749	4,555,668	2,382,937	105,096,159	------
Lead-copper	17,127	179	363,535	1,567,937	5,505,969	------
Zinc	90,380	5,059	660,460	1,195,086	8,249,098	87,473,400
Dry iron (from zinc-lead ore)	117,545	18,650	526,278	769,688	4,769,337	------
	1,011,416	263,903	8,212,922	444,939,519	123,620,563	87,473,400

Gross metal content of Utah crude ore shipped to smelters in 1940, by classes of ore

Class of ore	Ore	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold	78,772	37,079	117,731	654,381	583,938	------
Dry and siliceous gold-silver	176,369	23,961	1,057,672	1,345,618	6,403,877	------
Dry and siliceous silver	94,310	4,837	1,526,332	1,183,407	5,196,463	------
Copper	5,270	130	25,748	537,895	54,557	------
Lead	62,567	7,689	1,059,685	567,581	16,533,344	------
Lead-copper	8,510	58	171,646	626,561	4,625,996	------
Zinc	26	------	------	------	------	27,712
Zinc-lead	218	------	------	------	56,772	86,544
	426,042	73,754	3,958,814	4,915,443	33,454,947	114,256
Total, 1939	470,385	75,159	4,043,953	5,905,674	39,901,384	212,793

Mine production of metals from Utah crude ore shipped to smelters in 1940, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	14,070	1,458	95,842	455,999	961,179	----------
Box Elder	389	73	25,146	1,814	4,059	----------
Emery	2	----------	14	----------	----------	----------
Iron	899	275	3,292	425	9,200	----------
Juab	155,869	18,321	1,003,842	939,968	5,356,845	70,600
Millard	47	32	17	575	1,300	----------
Morgan	5	----------	7	----------	4,400	----------
Piute	4,240	1,941	13,109	5,000	12,300	----------
Salt Lake	43,262	11,150	255,780	774,433	4,806,094	32,000
San Juan	37	----------	21	7,000	----------	----------
Sevier	53	49	1,541	----------	----------	----------
Summit	11,570	1,596	211,360	78,822	1,551,292	----------
Tooele	62,740	17,648	223,743	558,544	6,856,218	----------
Uintah	8	----------	14	1,000	----------	----------
Utah	125,042	20,422	1,920,558	1,645,046	7,432,234	----------
Wasatch	7,763	787	204,459	84,849	760,316	----------
Washington	46	2	69	12,000	----------	----------
	426,042	73,754	3,958,814	4,565,475	27,755,437	102,600
Total, 1939	470,385	75,159	4,043,953	5,533,060	33,405,292	191,504

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous gold	78,772	37,079	117,731	633,974	357,194	----------
Dry and siliceous gold-silver	176,369	23,961	1,057,672	1,304,653	3,864,286	----------
Dry and siliceous silver	94,310	4,837	1,526,332	1,147,906	3,119,055	----------
Copper	5,270	130	25,748	520,730	38,743	----------
Lead	62,567	7,689	1,059,685	456,019	15,892,116	----------
Lead-copper	8,510	58	171,646	502,193	4,438,625	----------
Zinc	26	----------	----------	----------	----------	24,900
Zinc-lead	218	----------	----------	----------	45,418	77,700
	426,042	73,754	3,958,814	4,565,475	27,755,437	102,600

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Utah in 1940, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Beaver County:													
Beaver Lake	2		24				121		121	62	10,420		$614
Bradshaw	1		78	8		8	121		121	425	4,120	5,603	973
Granite	2		89	88		88	90		90	513	5,040		3,454
Newton	1		1	1		1							35
Rocky	1		4,385	117		117	12,728		12,728	433,000			62,075
San Francisco	6		9,504	1,246		1,246	81,741		81,741	17,000	927,200	21,746	151,388
Star and North Star	5		1,324	8		8	10,395		10,395	33,000	85,420	501,651	47,276
Box Elder County:													
Ashbrook	3		373	71		71	25,124		25,124	1,212	2,600		20,618
Crater Island	1		14	2		2	21		21	602			153
Lucin	2		182				121		121	186	22,400	15,000	2,172
Emery County: Emery	2		2				14		14				10
Garfield County: Imperial		1			1	1							35
Grand County: Colorado River		9			82	82		17	17				2,882
Iron County: Stateline	7		899	275		275	3,292		3,292	425	9,200		12,474
Juab County:													
Detroit [1]	1		66	25		25	90		90	1,478			1,106
Fish Springs	3		46				4,777		4,777	97	33,440		5,080
Mount Nebo	1		45				76		76		10,140		561
Tintic [2]	22		157,101	18,321		18,321	1,007,422		1,007,422	941,363	5,495,120	301,000	1,757,717
West Tintic	2		10	3		3	104		104	62	6,000		486
Millard County:													
Cricket Mountain	1		3								1,300		65
Detroit [1]	2		44	32		32	17		17	575			1,197
Sawtooth Mountains		2			74	74		7	7				2,595
Morgan County: Argenta	1		5				7		7		4,400		225
Piute County:													
Gold Mountain	1		2,912	1,291		1,291	5,961		5,961				49,424
Mount Baldy	1		1,082	584		584	5,469		5,469	2,310	4,800		24,830
Ohio	5		246	66		66	1,679		1,679	2,690	7,500		4,183
Salt Lake County:													
Big Cottonwood	6		881	88		88	18,606		18,606	42,000	72,700	32,000	26,708
Little Cottonwood	4		1,753	122		122	14,687		14,687	39,000	159,100	7,603	27,555
Smelter	4		228	62		62	2,181		2,181	2,469	28,600		5,430
West Mountain	14		26,753,382	256,558		256,558	4,760,252		4,760,252	457,010,531	75,713,100	43,623,397	70,540,717

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Utah in 1940, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
San Juan County:													
Bluff		1			13	13							$455
Colorado River		3			22	22							770
La Sal	1		37				21		21	7,000			806
Sevier County: Henry	3		553	66		66	1,554		1,554				3,415
Summit County: Uintah	7		125,394	3,611		3,611	1,311,781		1,311,781	521,000	20,646,200	17,085,000	3,226,745
Tooele County:													
Camp Floyd	12		342,223	33,860		33,860	696		696				1,185,595
Clifton	3		15	1		1	142		142		9,220		597
Columbia	2		39	1		1	256		256	71	5,100		480
Dugway	1		248	2		2	533		533	363	52,600	62,587	7,063
Free Coinage	2		13				194		194	44	5,640		425
Lakeside	3		3,034	1		1	2,160		2,160	3,000	665,080		35,164
North Tintic	1		51	1		1	69		69	168	23,600		1,283
Ophir	11		164,931	329		329	585,983		585,983	2,189,398	10,708,340	1,206,413	1,287,037
Rush Valley	11		50,641	3,221		3,221	310,351		310,351	23,133	9,520,540	5,942,000	1,186,416
Silver Island	1		2				142		142	53	620		138
Willow Springs	2		685	937		937	3,638		3,638	1,770	153,060		43,235
Uintah County:													
Carbonate	1		8				14		14	1,000			123
Green River		5			83	83		7	7				2,910
Utah County:													
American Fork	8		4,268	69		69	32,317		32,317	15,646	552,100	513,286	87,106
North Tintic	1		7				21		21		2,500		140
Santaquin	1		5	1		1							35
Tintic [2]	12		125,945	20,454		20,454	1,945,890		1,945,890	1,649,354	7,577,600	148,714	2,674,260
Wasatch County:													
Blue Ledge	3		118,208	12,473		12,473	1,617,307		1,617,307	616,416	6,023,700	6,069,000	2,339,827
Snake Creek	2		68,304	1,216		1,216	404,034		404,034	158,584	12,827,500	12,041,000	1,747,751
Washington County:													
Bull Valley	1		11	8		8							280
Tutsagubet	1		45				69		69	12,000			1,405
Total Utah	191	21	27,939,346	355,219	275	355,494	12,172,268	31	12,172,299	463,728,000	151,376,000	87,576,000	86,585,499

[1] Detroit district lies in both Juab and Millard Counties.

[2] Tintic district lies in both Juab and Utah Counties.

BEAVER COUNTY

Beaver Lake district.—Small shipments of crude silver-lead ore, principally from the Beaver Gold & Copper Co. property northwest of Milford, comprised the output in 1940.

Bradshaw district.—The Cave property produced 1 car of gold ore shipped crude to a smelter and 1 car of zinc-lead ore shipped to a custom mill in 1940.

Granite district.—Gold ore from the Hope Chest property at the mouth of Big Canyon Gulch and lead ore from the Beaver View property were shipped crude to a smelter.

Newton district.—A small lot of gold ore was shipped crude to a smelter from the Big 4 property.

Rocky district.—The Old Hickory group, incorporated as the Prospect Mining Co. in June 1940, was the only property operated in the Rocky district. In October the presence of scheelite was noted in the copper ore that had been shipped crude to smelters. Shipments were discontinued, and construction of a 25-ton concentration mill was begun.

San Francisco district.—The value of the metal output of the San Francisco district in 1940 was less than in 1939, owing largely to decreased output from the Horn Silver property. Other producers were the Quad Metals Corporation and the King David Mining Co.

Star and North Star district.—Regular shipments of lead-copper ore and zinc-lead ore were made in 1940 to Tooele from the Moscow Silver property. Most of the remaining production came from zinc-lead ore shipped to Tooele by the New Majestic Mining Co.

BOX ELDER COUNTY

Ashbrook district.—Silver ore shipped crude to a smelter yielded the entire metal output of the Ashbrook district in 1940. The Vipont mine was the largest producer.

Crater Island district.—Gold ore was shipped from the Copper Blossom mine in 1940.

Lucin district.—Four cars of zinc-lead ore shipped to Midvale from the Eldorado mine comprised the bulk of the output of the Lucin district in 1940.

EMERY COUNTY

Small test lots of silver ore were shipped crude from properties in the Cedar Mountains.

GARFIELD COUNTY

A little placer gold was recovered in the Imperial (Crescent Creek) district.

GRAND COUNTY

The entire output of Grand County came from placer gravels along the Colorado River.

IRON COUNTY

Stateline district.—The value of the metal output of Iron County (all from the Stateline district) decreased sharply in 1940, owing to the closing of the Creole property in August and the decrease in gold ore shipped crude to a smelter by Aetna Gold Mines, Inc. The company began to construct a 75-ton flotation mill in 1940. Other producers in the district were the Wonder, Ophir, Badger, Blue Rock, and New Arrow properties.

JUAB COUNTY

Detroit district.—Production in the Detroit district decreased sharply in 1940 owing to suspension of mining (after 3 months of work) at the Ibex property—only active mine in the Juab County section of the district.

Fish Springs district.—The Carnation, Galena, and Utah properties shipped lead ore rich in silver direct to smelters in 1940.

Mount Nebo district.—The Syndicate Oil Mineral Co. shipped 1 car of lead ore from the Earl No. 5 property.

Tintic district.—The Tintic district, which lies in both Juab and Utah Counties, is reviewed here. The table that follows gives the metal production in each section of the district for 1940, a comparison with the total output in 1939, and the grand total from 1869 to 1940.

Mine production of gold, silver, copper, lead, and zinc in Tintic district, Juab and Utah Counties, Utah, 1939–40, and total, 1869–1940, in terms of recovered metals

	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
1940		*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Juab County	22	157,101	18,321	1,007,422	941,363	5,495,120	301,000	$1,757,717
Utah County	12	125,945	20,454	1,945,890	1,649,354	7,577,600	148,714	2,674,260
	34	283,046	38,775	2,953,312	2,590,717	13,072,720	449,714	4,431,977
Total, 1939	35	294,628	41,080	3,227,808	2,825,433	17,236,618	1,702,904	4,821,314
Total, 1869-1940		(1)	2,474,382	250,713,384	234,838,164	1,779,164,079	39,151,738	372,387,082

[1] Figures not available.

In 1940 the Chief Consolidated Mining Co. operated at the Chief No. 1, Gemini, Eureka Hill, and Plutus mines in Juab County and continued development work at the Apex Standard property in Utah County. Large tonnages of tailings were shipped direct to a smelter from the Chief No. 1 and the Eureka Hill dumps. According to the company printed annual report, production of gold and silver increased, but that of lead, copper, and zinc decreased. The total output in 1940 comprised 27,780 tons of siliceous ore, 1,445 tons of lead ore, and 1,843 tons of zinc-lead ore from the Chief No. 1 mine; 5,844 tons of siliceous ore and 237 tons of lead ore from the Gemini mine; 6,596 tons of siliceous ore and 174 tons of lead ore from the Eureka Hill mine; and 2,609 tons of siliceous ore from the Plutus mine—an aggregate of 46,528 tons of ore of all classes, which contained 4,684 ounces of gold, 392,116 ounces of silver, 100,162 pounds of copper, 776,294 pounds of lead, and 341,550 pounds of zinc. In addition, the company reported shipments of manganese ore that contained 527,984 pounds of manganese. The United States Smelting, Refining & Mining Co. operated the Centennial-Beck, Victoria, and Eagle & Blue Bell properties; lessees worked the American Star mine from May

6 to the end of the year. Production from these properties comprised about 37,000 tons of siliceous ore and 2,500 tons of lead ore shipped crude to a smelter. The Empire-Star, Dragon, Martha Washington, and Treasure groups, all owned or controlled by the International Smelting & Refining Co., shipped crude ore to smelters; the bulk of the ore (siliceous gold-silver) came from the Dragon property. The Mammoth Mining Co. operated throughout the year and shipped 39,319 tons of crude ore (chiefly siliceous gold ore) direct to a smelter. The Grand Central mine of the American Smelting & Refining Co. was operated by lessees and shipped about 500 tons of siliceous ore direct to smelters. The Godiva mine, operated by a lessee during 1940, produced 2,564 tons of silver, lead, and zinc-lead ore which contained 1,098,672 pounds of lead, 53,350 ounces of silver, 50,840 pounds of zinc, and 42 ounces of gold The remainder of the output from the Juab County section of the Tintic district came from the Undine (Windrige), Hope, and Alaska mines.

The Tintic Standard Mining Co. and its subsidiary companies were the largest producers in the Utah County section of the Tintic district. The printed annual report of these companies gives the following operating details for 1940. Ore production at the Tintic Standard mines (including the Iron Blossom) increased 17,588 tons over the 86,757 tons produced in 1939 and resulted in an increase in output of gold but a decrease in silver, copper, and lead. The bulk of the ore was company-mined. Development work at the Eureka Standard mine was discontinued about September 1, 1940. The Eureka Lilly Consolidated mines were operated largely by lessees, incident to further development of the property. At the Colorado Consolidated and Sioux mines all operations were carried on by lessees. The 112,012 tons of ore of all classes mined from properties of the Tintic Standard Mining Co. in 1940 contained 6,437 ounces of gold, 1,872,227 ounces of silver, 1,292,095 pounds of copper, 9,442,054 pounds of lead, and 190,686 pounds of zinc. Active mines in the Utah County section of the Tintic district, owned or controlled by the International Smelting & Refining Co. and its subsidiaries, were the Eureka Bullion, May Day (Mountain View), North Lily, Tintic Bullion, and Yankee.

West Tintic district.—Crude lead ore shipped to smelters, principally from the Scotia dump, comprised the output of the West Tintic district in 1940.

MILLARD COUNTY

Cricket Mountain district.—A small lot of lead ore was shipped crude to a smelter from the Galena mine in 1940.

Detroit district.—Virtually all the production in the Millard County section of the Detroit district came from gold ore shipped crude from the property of the Charm Mining Co.

Sawtooth Mountains district.—Gold was recovered at two placer operations in Granite Canyon about 50 miles southwest of Delta.

MORGAN COUNTY

Argenta district.—A small lot of lead ore from the Dan Heiners mine was shipped crude to a smelter in 1940.

PIUTE COUNTY

Gold Mountain district.—The production from the Gold Mountain district in 1940—all from lessee operations on the Annie Laurie property—totaled 2,912 tons of gold ore shipped crude to smelters.

Mount Baldy district.—Shipments of crude gold ore were made by lessees on the Deer Trail mine until November 23, 1940, when operations were suspended.

Ohio district.—Gold-silver ore from the Bully Boy mine and the Shamrock claim of the Tushar Mines group was shipped crude to smelters in 1940 by lessees. Other active properties were the Copper Belt, Gold Strike, and Great Western.

SALT LAKE COUNTY

Big and Little Cottonwood districts.—Lessees operated the Cardiff property in the Big Cottonwood district during 1940 and shipped 538 tons of ore of all classes direct to smelters. The Mountain Mines Co. operated the Lake Blanch property from June 1 to the end of the year and shipped gold and silver ore crude to smelters. The rest of the output from the district comprised several small lots of lead ore shipped crude to smelters.

Most of the production from the Little Cottonwood district came from silver and lead ore shipped crude to smelters by the Wasatch Mines Co. and the Alta United Mines Co.

Smelter district.—Most of the output from the Smelter district in 1940 comprised shipments from the Mingo dump near Sandy.

West Mountain (Bingham) district.—The Bingham district is by far the most important mining region in Utah. The total value of the district output of gold, silver, copper, lead, and zinc has doubled since 1938, owing principally to doubling of the output of gold and copper. In 1940 the district produced these five metals valued at $70,540,717, or 81 percent of the State total. The following table gives the output from mines at Bingham in 1939 and 1940 and the total for the district from 1865 to 1940.

Mine production of gold, silver, copper, lead, and zinc in Bingham or West Mountain district, Salt Lake County, Utah, 1939–40, and total, 1865–1940, in terms of recovered metals

Year	Mines producing	Ore	Gold (lode and placer)	Silver (lode and placer)	Copper	Lead	Zinc	Total value
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1939	14	20,039,432	190,553	4,120,296	335,712,875	73,684,979	41,721,903	$50,013,034
1940	14	26,753,382	256,558	4,760,252	457,010,531	75,713,100	43,623,397	70,540,717
Total, 1865–1940	--------	(1)	4,195,808	117,138,653	[2] 3,161,215	[2] 1,385,850	[2] 371,749	1,285,177,699

[1] Figures not available.
[2] Short tons.

Virtually all the gain in output of gold, silver, and copper in 1940 can be ascribed to the increased rate of operations at the Utah Copper properties. According to the printed annual report of the Kennecott Copper Corporation, more than 42,000,000 pounds of copper were produced in December, when the mills treated an average of about 80,000 tons of ore a day, with high recoveries. The Arthur and Magna mills have a combined rated capacity of 80,000 tons daily. In addition to the copper recovered from the copper concentrates, several million pounds of cement copper were recovered from the mine-water precipitation plant at Copperton. The output of molybdenum concentrates in 1940 showed a marked increase, although somewhat less than 60 percent of the 1940 output was sold. The Boston Consolidated property of the Utah Copper Co. was operated the entire year by the American Smelting & Refining Co.

Most of the lead and zinc produced in the Bingham district in 1940 came from the United States & Lark property, which was operated continously by the United States Smelting, Refining & Mining Co. The tonnage of gold-silver ore and lead ore shipped for smelting decreased. The tonnnage of zinc-lead ore concentrated at Midvale was more than 44,000 tons greater than in 1939 and accounted for much of the increase in lead and zinc output. The production of gold increased, but that of silver decreased, chiefly because of the lower silver content of milling ores. The Montana-Bingham Consolidated shipped over 7,500 tons of ore of all classes. Other active properties in the Bingham district, operated or controlled by the United States Smelting, Refining & Mining Co., were the Bingham Metals, Niagara, and Utah Metal & Tunnel.

The National Tunnel & Mines Co. operated the Apex Delaware group throughout 1940 on company and lessee account. The output of zinc-lead mill ore increased about 8,000 tons over 1939, but a corresponding decrease was noted in shipments of gold ore; the result was an increase in lead and zinc output but a decrease in gold. The Elton tunnel, being driven by the National Tunnel & Mines Co., was reported in May 1941 to have reached 23,475 feet of the projected length of 24,100 feet; completion is expected about the middle of 1941.

The Ohio Copper Co. treated 345,975 tons of old tailings in its 1,000-ton flotation mill during 1940 and made a larger output of copper. In addition, an underground precipitation plant began to operate in July 1940, and 204 tons of copper precipitates were recovered.

Over 38,000 tons of zinc-lead ore from the Bingham (Lavagnino) group of the Combined Metals Reduction Co. were shipped to Bauer for milling in 1940; this was nearly double the output of milling ore from this property in 1939.

The remainder of the output from the Bingham district came principally from gold ore shipped crude from the Ophir group.

SAN JUAN COUNTY

Bluff district.—A little placer gold was recovered from the I-Hope property in 1940.

Colorado River district.—Placers near Hanksville in the Colorado River district produced some gold.

La Sal district.—The Lisbon Copper group south of Moab shipped a test lot of 37 tons of copper ore in 1940.

SEVIER COUNTY

Henry district.—Gold ore from the Patsey H. mine was amalgamated in 1940. Small lots of gold-silver ore principally from the B. W. & H. property were shipped crude to smelters.

SUMMIT AND WASATCH COUNTIES

PARK CITY REGION

The Park City region, which includes the Uintah district in Summit County and the Blue Ledge and Snake Creek districts in Wasatch County, produced gold, silver, copper, lead, and zinc valued at $7,314,323 in 1940, or nearly double the total value in 1939. The following table gives the production from the Park City region in 1939 and 1940 and the total since 1870.

Mine production of gold, silver, copper, lead, and zinc in Park City region, Summit and Wasatch Counties, Utah, 1939–40, and total, 1870–1940, in terms of recovered metals

Year	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1939	11	182,344	6,548	2,229,645	824,673	23,262,127	18,107,866	$3,863,331
1940	12	311,906	17,300	3,333,122	1,296,000	39,497,400	35,195,000	7,314,323
Total, 1870–1940		(1)	453,638	223,396,935	61,820,513	2,249,758,834	552,699,911	329,081,220

[1] Figures not available.

The Silver King mine and 800-ton selective-flotation mill operated throughout 1940. According to the company printed annual report production in 1940 comprised 98,891 tons of milling ore and 2,345 tons of crude lead ore. In addition, 5,732 tons of 62-percent zinc concentrates held in storage were sold to smelters. The gross metal content of ore and concentrates (produced and stored) sold to smelters in 1940 was 1,975 ounces of gold, 1,132,850 ounces of silver, 572,566 pounds of copper, 17,058,797 pounds of lead, and 21,632,294 pounds of zinc. On January 1, 1941, 1,092 tons of zinc concentrates remained in storage. Dividends declared in 1940 totaled $488,187.

The Park Utah Consolidated Mines Co. operated the Judge (City Unit) property continuously in 1940. All the ore was sent to the International smelter and mill for treatment. According to the company printed annual report the 84,625 tons of ore produced contained 2,094 ounces of gold, 559,623 ounces of silver, 22,194 pounds of copper, 19,627,980 pounds of lead, and 21,385,160 pounds of zinc. Development was carried on regularly in 1940. Operations were also carried on at the Liberty property near Keetley by the Park City Utah Mines Co. (affiliate of the Park Utah Consolidated Mines Co.).

The Park City Consolidated Mines Co. produced from the Roosevelt group 65,625 tons of zinc-lead ore, which contained 2,462 ounces of gold, 1,035,610 ounces of silver, 190,228 pounds of copper, 1,505,550 pounds of lead, and 2,875,918 pounds of zinc; all the ore was shipped to the Midvale concentrator for treatment. Operations at the Park Galena and Mayflower mines of the New Park Mining Co. were continuous in 1940, and the output of zinc-lead ore shipped to Midvale was about 42,500 tons—nearly triple the quantity in 1939. The company was by far the largest gold producer in the region. During 1940 all operations were transferred to the Mayflower tunnel, which intersects the Park Galena fissure at depth. The Mayflower tunnel and the Park Galena mine are now connected by raises. Lessees operated the American Flag property of the Park Flag Mines Co. and shipped about 6,600 tons of gold-silver ore crude to smelters.

The remainder of the production from the Park City region in 1940 comprised shipments of zinc-lead ore to custom mills and crude silver ore to smelters from the New Quincy property and old tailings, principally from Silver Creek.

TOOELE COUNTY

Mines in Tooele County produced metals valued at $3,747,433 in 1940 compared with $3,609,803 in 1939. Gains in value of output from the Camp Floyd and Rush Valley districts more than offset the sharp drop in value of production from the Ophir district.

Camp Floyd district.—Gold output from Mercur increased moderately in 1940 compared with 1939. The bulk of the gold ore mined in the Camp Floyd district was treated in the cyanidation mills of Snyder Mines, Inc., and the Geyser Marion Gold Mining Co. The Snyder properties again were the largest producers of gold in the district, their output (company and lessee) being exceeded in the State only by that of the Utah Copper property at Bingham. About 43,000 tons of gold ore were shipped crude to smelters from the Snyder properties and about 1,300 tons from the Geyser Marion properties. Other producers at Mercur in 1940 included the Boston Sunshine, Herschel, Silver Lode, Omaha, and Rover.

Clifton (Gold Hill) district.—Nearly all the output from the Clifton district in 1940 was lead ore shipped crude to a smelter from the Rube mine and silver ore from the Success mine.

Columbia district.—Two shipments of crude lead ore from prospects near Vernon were made in 1940.

Dugway district.—Zinc-lead ore from the Four Metals mine was shipped to Tooele in 1940 for milling.

Free Coinage district.—The output from the Free Coinage district in 1940 consisted of silver ore from the Humdinger group and lead ore from the Golden Globe Consolidated Mines (Ltd.) property (formerly the Utah-Bunker Hill Mining Co.).

Lakeside district.—The Lakeside Monarch Mining Co. made most of the output in the Lakeside district in 1940. Lead concentrates were shipped from the Georgia Lyn property, which is equipped with a 100-ton gravity-concentration plant.

North Tintic district.—A small lot of lead ore was shipped direct to a smelter from the Scranton property in 1940.

Ophir district.—The total value of the metal output from the Ophir district decreased sharply in 1940, owing principally to completion of the treatment of Ophir Hill tailings by the International Smelting & Refining Co. The 700-ton flotation plant of this company was operated until August 1940, when the mill was closed and dismantling was begun. In 1940, 147,585 tons of old tailings were treated, and the lead-copper concentrates produced were sent to Tooele. Operations of the United States Smelting, Refining & Mining Co. at the Hidden Treasure mine were regular, but there was a sharp drop in tonnage of zinc-lead ore shipped to Midvale. The tonnage of lead-copper ore shipped for smelting was twice that in 1939. The complex milling ore was treated in a separate circuit at the Midvale mill, making lead, copper, zinc, and iron concentrates. Gains were noted at the Ophir Hill and Ophir Coalition Mines Co. properties, both operated by the Ophir Development Co. Other producers included the Kearsarge, Mono, Ophir, Zella, Wandering Jew, Northern Light, and Queen of the Hills.

Rush Valley district.—The value of the metal output from the Rush Valley district was $1,186,416 in 1940—a 47-percent gain compared with 1939. The operation of the Combined Metals Reduction Co. at the Calumet property, which produced 46,255 tons of zinc-lead mill ore compared with 32,738 tons in 1939, was responsible for most of the increase. Other producing mines in the district in 1940 were the Commodore group, Cyclone (Bluestone), Honerine, Muirbrook, and Salvation-Hercules.

Silver Island district.—A small test lot of lead ore from a prospect was shipped crude to a smelter in 1940.

Willow Springs district.—In 1940, as in 1939, almost all the output from the Willow Springs district came from lessee operations at the Oro Del Rey mine. A small lot of ore from the Depression property was shipped direct to a smelter.

UINTAH COUNTY

A little copper ore from the dump of the Dyer mine was sent to a smelter in 1940. The rest of the output from Uintah County was placer gold from the Big Ben, Big Lizard, and Utah State Lease No. 788, all on Green River.

UTAH COUNTY

American Fork district.—There was a marked gain in output from the American Fork district in 1940 compared with 1939. The Pacific Consolidated Mining Co. shipped about 130 tons of lead concentrates. High-grade zinc-lead ore was shipped to Midvale from the Dutchman mine. Other mines active in 1940 included the Yankee, Globe, Silver Bell, Silver Dipper, and Red Cloud.

North Tintic district.—A trial lot of lead ore from the Lehi Tintic mine was shipped to a smelter in 1940.

Santaquin district.—A little gold ore from the Golden Leaf property was amalgamated in 1940.

Tintic district.—Mines in the Utah County section of the Tintic district are reviewed under Juab County.

WASHINGTON COUNTY

A small amount of gold ore from the Bull Run mine in the Bull Valley district was amalgamated in 1940. Some copper ore was shipped direct to a smelter from the Dixie property of the Utah Southern Mining Co. in the Tutsagubet district.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN WASHINGTON

(MINE REPORT)

By G. E. Woodward and Paul Luff

SUMMARY OUTLINE

Mines in Washington produced gold, silver, copper, lead, and zinc valued at $7,018,812 in 1940, a 4-percent gain compared with $6,739,467 in 1939. This increase in total value resulted from greater output of copper and zinc, which was stimulated by moderately higher prices; the output of gold, silver, and lead decreased. The chief factor in maintaining the production of gold and silver at a level comparable with that of 1939 was the increased output of copper-gold-silver ore from the Holden property of the Howe Sound Co. in Chelan County; the company operated its 2,000-ton flotation concentrator throughout 1940. The output of gold and silver declined sharply in Ferry, Okanogan, and Whatcom Counties; there was a slight gain in gold output from Stevens County, but a decrease in silver. The output of lead from Pend Oreille County was less, but there was a substantial increase in output of zinc. All the State output of zinc and nearly all the lead came from zinc-lead ore from Pend Oreille County. The decline in lead production resulted chiefly from the smaller tonnage of zinc-lead ore and lower lead content of ores treated by the Pend Oreille Mines & Metals Co. The Metaline Mining & Leasing Co. treated a larger tonnage of zinc-lead ore of slightly higher grade than in 1939.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1936–40

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1936	$35.00	$0.7745	$0.092	$0.046	$0.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4].646+	.098	.046	.048
1939	35.00	[5].678+	.104	.047	.052
1940	35.00	[6].711+	.113	.050	.063

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+ ($20.671835) per fine ounce.
[2] 1936–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–40: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787. [6] $0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Washington, 1936–40, and total, 1860–1940, in terms of recovered metals

Year	Mines producing: Lode	Mines producing: Placer	Ore (short tons)	Gold (lode and placer): Fine ounces	Gold (lode and placer): Value	Silver (lode and placer): Fine ounces	Silver (lode and placer): Value
1936	44	106	133,435	12,217.40	$427,609	66,900	$51,814
1937	65	90	294,826	36,310.00	1,270,850	126,304	97,696
1938	77	80	901,689	74,175.00	2,596,125	380,938	246,263
1939	88	84	1,124,564	90,420.00	3,164,700	442,063	300,067
1940	83	88	1,166,798	82,136.00	2,874,760	365,175	259,680
1860–1940			(1)	1,797,549.00	41,669,538	10,820,860	7,655,259

Year	Copper: Pounds	Copper: Value	Lead: Pounds	Lead: Value	Zinc: Pounds	Zinc: Value	Total value
1936	204,000	$18,768	1,680,000	$77,280	8,806,000	$440,300	$1,015,771
1937	128,000	15,488	5,660,000	333,940	8,232,000	535,080	2,253,054
1938	12,034,000	1,179,332	8,568,000	394,128	22,804,000	1,094,592	5,510,440
1939	17,996,000	1,871,584	7,436,000	349,492	20,262,000	1,053,624	6,739,467
1940	19,224,000	2,172,312	5,110,000	255,500	23,120,000	1,456,560	7,018,812
1860–1940	38,378	10,101,405	[2] 49,373	6,061,638	[2] 61,968	6,748,994	72,236,834

[1] 1860–1903: Figures not available; 1904–40: 5,925,764 tons produced. [2] Short tons.

Gold and silver produced at placer mines in Washington, 1936–40, in terms of recovered metals

Year	Gold: Fine ounces	Gold: Value	Silver: Fine ounces	Silver: Value	Total value
1936	657.20	$23,002	133	$103	$23,105
1937	371.00	12,985	48	37	13,022
1938	1,575.00	55,125	218	141	55,266
1939	2,261.00	79,135	358	243	79,378
1940	2,747.00	96,145	720	512	96,657

Gold.—The output of recoverable gold in Washington in 1940 declined 9 percent from 1939, owing chiefly to a smaller tonnage of gold ore cyanided and a sharp decrease in gold ore shipped crude to smelters. Gold from copper ore increased 3,465 ounces, but that from gold ores declined 12,297 ounces. Gold from ores treated in cyanidation plants (with or without concentration) decreased 1,468 ounces in Ferry County and 2,652 ounces in Whatcom County, but 769 ounces of gold in 1940 came from ores treated in the First Thought cyanidation plant in Stevens County, which was idle in 1939. Gold from gold ores sent crude to smelters declined 4,907 ounces in Ferry County, 4,183 ounces in Okanogan, and 215 ounces in Chelan. Gold ores treated in amalgamation mills yielded 568 ounces, principally from ores of Whatcom and Okanogan Counties. Copper concentrates produced by the Howe Sound Co. from its Holden property in Chelan County yielded over 60 percent of the State output of gold. Other important gold producers were the Aurum, Knob Hill, Mountain Lion, and Republic properties in Ferry County; the Alder property in Okanogan County; and the Orient property in Stevens County. The total output of gold ore was 202,502 tons, compared with 261,651 in 1939; it comprised 145,582 tons cyanided, 1,418 amalgamated, 9,580 concentrated, and 45,922 tons of ore sent crude to smelters. Production of gold from placer mines increased from 2,261 fine ounces in 1939 to 2,747 in 1940.

Silver.—The production of recoverable silver in Washington in 1940 decreased 17 percent in quantity from 1939. The bulk of the silver came from copper ore of Chelan County and gold ore of Ferry County and the remainder principally from copper and silver ores of Stevens and Snohomish Counties and silver ore of Okanogan County. Of the total silver output, copper ore yielded 60 percent, gold ore 31, silver ore 5, and zinc-lead, lead, and gold-silver ores and placers combined 4 percent. The Holden mine in Chelan County was again the largest producer of silver; it was followed by the Aurum, Knob Hill, and Mountain Lion in Ferry County and the Amazon and Copper King in Stevens County. These six properties produced 85 percent of the State silver output. Placer gravels yielded 720 fine ounces of silver.

Copper.—The output of recoverable copper in Washington increased 7 percent in quantity and 16 percent in value over 1939. About 97 percent of the State total came from copper concentrates produced from copper ore of the Holden property of the Howe Sound Co. The value of the gold in the copper concentrates was equivalent to 86 percent of the value of the copper. Copper produced in Okanogan County during 1940 more than doubled the 1939 output.

Lead and zinc.—The production of recoverable lead in Washington decreased 31 percent in quantity in 1940, but that of zinc increased 14 percent. Three mines in Pend Oreille County were responsible for 97 percent of the lead and all the zinc output in 1940. The quantity of zinc-lead ore treated in the two flotation-concentration mills in Pend Oreille County was 13,907 tons greater than in 1939. The 700-ton flotation mill of the Pend Oreille Mines & Metals Co. was operated all year, and the 450-ton Grandview mill of the Metaline Mining & Leasing Co. operated from August 19 to the end of 1940. The Grandview mill also treated zinc-lead ore from the Grandview property of the American Zinc, Lead & Smelting Co. during the last quarter of 1940. Most of the remaining lead output came from the Electric Point and W. J. Bryan properties in the Northport district of Stevens County.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Washington in 1940, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Asotin	----------	14	115	$4,025	21	$15
Benton	----------	4	24	840	7	5
Chelan	9	7	51,721	1,810,235	199,343	141,755
Clallam	----------	3	8	280	----------	----------
Douglas	----------	4	36	1,260	7	5
Ferry	14	4	22,335	781,725	110,579	78,634
Grant	----------	2	46	1,610	10	7
King	3	----------	38	1,330	322	229
Kittitas	2	14	1,619	56,665	520	370
Okanogan	27	20	4,123	144,305	13,949	9,919
Pend Oreille	4	----------	----------	----------	8,609	6,122
Skamania	1	----------	6	210	----------	----------
Snohomish	7	2	198	6,930	9,187	6,533
Stevens	14	10	1,514	52,990	22,500	16,000
Whatcom	2	3	345	12,075	121	86
Whitman	----------	1	8	280	----------	----------
Total	83	88	82,136	2,874,760	365,175	259,680
1939	88	84	90,420	3,164,700	442,063	300,067

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Asotin	----------	----------	----------	----------	----------	----------	$4,040
Benton	----------	----------	----------	----------	----------	----------	845
Chelan	18,577,400	$2,099,246	----------	----------	----------	----------	4,051,236
Clallam	----------	----------	----------	----------	----------	----------	280
Douglas	----------	----------	----------	----------	----------	----------	1,265
Ferry	4,800	542	----------	----------	----------	----------	860,901
Grant	----------	----------	----------	----------	----------	----------	1,617
King	100	11	100	$5	----------	----------	1,575
Kittitas	----------	----------	----------	----------	----------	----------	57,035
Okanogan	355,000	40,115	18,000	900	----------	----------	195,239
Pend Oreille	----------	----------	4,989,500	249,475	23,120,000	$1,456,560	1,712,157
Skamania	----------	----------	----------	----------	----------	----------	210
Snohomish	217,300	24,555	600	30	----------	----------	38,048
Stevens	69,200	7,820	101,700	5,085	----------	----------	81,895
Whatcom	200	23	100	5	----------	----------	12,189
Whitman	----------	----------	----------	----------	----------	----------	280
Total	19,224,000	2,172,312	5,110,000	255,500	23,120,000	1,456,560	7,018,812
1939	17,996,000	1,871,584	7,436,000	349,492	20,262,000	1,053,624	6,739,467

Gold and silver produced at lode mines in Washington in 1940, by counties, in terms of recovered metals

County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
Chelan	687,717	51,707	199,343
Ferry	180,213	22,206	110,558
King	205	38	322
Kittitas	14	6	11
Okanogan	16,779	4,068	13,939
Pend Oreille	273,233	----------	8,609
Skamania	2	6	----------
Snohomish	1,501	172	9,180
Stevens	6,565	848	22,372
Whatcom	569	338	121
Total	1,166,798	79,389	364,455
1939	1,124,564	88,159	441,705

Gold and silver produced at placer mines in Washington in 1940, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Dragline and dry-land dredges [1]		Total	
	Gold	Silver	Gold	Silver	Gold	Silver
Asotin	70	13	45	8	115	21
Benton	24	7	----------	----------	24	7
Chelan	14	----------	----------	----------	14	----------
Clallam	8	----------	----------	----------	8	----------
Douglas	36	7	----------	----------	36	7
Ferry	7	----------	122	21	129	21
Grant	1	----------	45	10	46	10
Kittitas	30	6	1,583	503	1,613	509
Okanogan	55	10	----------	----------	55	10
Snohomish	26	7	----------	----------	26	7
Stevens	77	16	589	112	666	128
Whatcom	7	----------	----------	----------	7	----------
Whitman	8	----------	----------	----------	8	----------
	363	66	2,384	654	2,747	720
Total, 1939	385	42	1,876	316	2,261	358

[1] A floating washing plant supplied with gravel by a dragline excavator is called a "dragline dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."

MINING INDUSTRY

A total of 1,103,842 tons of ore (95 percent of the State output) was mined in 1940 from six properties. This total includes copper ore from the Holden property in Chelan County; zinc-lead ore from the Pend Oreille, Metaline, and Grandview properties in Pend Oreille County; and gold ore from the Knob Hill and Mountain Lion properties in Ferry County. Considerable development work was reported from these six properties, which included 89,916 feet of diamond drilling and 1,575 feet of churn drilling; development work was also reported at several smaller lode operations in the State.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Washington in 1940, with content in terms of recovered metals

Source	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	41	202,502	27,682	111,619	350,946	952	----------
Dry and siliceous gold-silver ore	8	677	158	6,239	1,381	3,093	----------
Dry and siliceous silver ore	14	967	20	18,946	6,934	22,613	----------
	63	204,146	27,860	136,804	359,261	26,658	----------
Copper ore	11	689,325	51,529	218,861	18,864,662	178	----------
Lead ore	6	100	----------	203	77	100,964	----------
Zinc-lead ore	3	273,227	----------	8,587	----------	4,982,200	23,120,000
Total, lode mines	83	1,166,798	79,389	364,455	19,224,000	5,110,000	23,120,000
Total, placers	88	----------	2,747	720	----------	----------	----------
	171	1,166,798	82,136	365,175	19,224,000	5,110,000	23,120,000
Total, 1939	172	1,124,564	90,420	442,063	17,996,000	7,436,000	20,262,000

METALLURGIC INDUSTRY

Lode mines in Washington produced 1,166,798 tons of ore in 1940; it was treated as follows: 972,848 tons in straight concentrating mills, 145,582 tons at cyanide plants, 1,418 tons at amalgamation plants, and 46,950 tons shipped crude to smelters.

Amalgamation plants.—Seven straight amalgamation plants treated 1,418 tons of dry gold ore in 1940. The Boundary Red Mountain property in Whatcom County was the chief producer.

Cyanidation mills.—The 400-ton cyanidation-concentration plant of Knob Hill Mines, Inc., at Republic, Ferry County, treated the bulk of the gold ore cyanided; flotation concentration was begun November 7, 1940, on ores from the Knob Hill and Mountain Lion groups. The First Thought Mine Corporation treated gold ore in its 50-ton plant from the First Thought mine in the Orient district, Stevens County. Together these two mills treated 145,582 tons of gold ore and reported the consumption of 5,391 pounds of sodium cyanide (91-percent grade), 200,200 pounds of calcium cyanide, 31,750 pounds of zinc dust, and 1,248,575 pounds of lime.

Concentration mills.—The 972,848 tons of ore treated at 16 flotation mills were divided as follows: 688,946 tons of copper ore treated at 4 plants, 273,227 tons of zinc-lead ore at 2 plants, 9,580 tons of gold ore at 3 plants, 625 tons of gold-silver ore at 3 plants, and 470 tons of silver ore at 4 plants.

Details of the treatment of all ore produced in Washington in 1940 are given in the following tables.

Mine production of metals in Washington in 1940, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore amalgamated	1,418	568	161			
Ore cyanided	145,582	12,154	39,676			
Concentrates smelted	65,371	53,834	245,428	18,958,139	4,993,708	23,120,000
Ore smelted	46,950	12,833	79,190	265,861	116,292	
Placer		2,747	720			
Total		82,136	365,175	19,224,000	5,110,000	23,120,000
1939		90,420	442,063	17,996,000	7,436,000	20,262,000

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Washington in 1940, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Ore treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Chelan	16	5	1					
Ferry	60	31	7					
Kittitas	10	4	1					
Okanogan	780	201	119					
Skamania	2	6						
Whatcom	550	321	33					
Total	1,418	568	161					
1939	6,421	961	344	173	286	462	282	1,018

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Washington in 1940, by types of mills and by countries, in terms of recovered metals—Continued

CYANIDATION MILLS

County	Ore treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Ferry	140, 393	11, 385	39, 216	515	670	6, 722	----------	----------
Stevens	5, 189	769	460	----------	----------	----------	----------	----------
	145, 582	12, 154	39, 676	515	670	6, 722	----------	----------
Total, 1939	161, 551	15, 481	56, 078	7	694	80	----------	----------
Grand total: 1940	147, 000	12, 722	39, 837	515	670	6, 772	----------	----------
1939	167, 972	16, 442	56, 422	180	980	542	282	1, 018

Mine production of metals from concentrating mills in Washington in 1940, by counties, in terms of recovered metals

County	Ore treated (short tons)	Concentrates smelted and recovered metal					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Chelan	687, 441	38, 530	51, 444	199, 237	18, 576, 940	----------	----------
King	200	33	37	210	----------	----------	----------
Okanogan	9, 660	1, 473	1, 500	8, 866	235, 567	9, 770	----------
Pend Oreille	273, 227	24, 444	----------	8, 587	----------	4, 982, 200	23, 120, 000
Snohomish	1, 180	240	145	6, 324	81, 981	600	----------
Stevens	1, 140	136	38	15, 482	63, 651	1, 138	----------
	972, 848	64, 856	53, 164	238, 706	18, 958, 139	4, 993, 708	23, 120, 000
Total, 1939	864, 151	63, 925	48, 462	256, 803	17, 618, 697	7, 085, 352	20, 262, 000

Gross metal content of concentrates produced from ores mined in Washington in 1940, by classes of concentrates smelted

Class of concentrates	Concentrates produced (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	669	800	7, 039	411	232	----------
Dry gold-silver	129	136	5, 263	962	1, 776	----------
Dry silver	19	1	1, 571	1, 073	769	----------
Copper	40, 074	52, 893	215, 719	19, 537, 700	----------	5, 101, 100
Lead	3, 337	----------	8, 587	----------	5, 189, 801	96, 441
Lead-copper	36	4	7, 249	4, 342	10, 116	----------
Zinc	21, 107	----------	----------	----------	418, 573	25, 687, 921
	65, 371	53, 834	245, 428	19, 544, 488	5, 621, 267	30, 885, 462
Total, 1939	64, 105	49, 442	257, 345	18, 164, 127	7, 419, 902	22, 622, 587

Mine production of metals from Washington concentrates shipped to smelters in 1940, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Chelan	38,530	51,444	199,237	18,576,940		
Ferry	515	670	6,722			
King	33	37	210			
Okanogan	1,473	1,500	8,866	235,567	9,770	
Pend Oreille	24,444		8,587		4,982,200	23,120,000
Snohomish	240	145	6,324	81,981	600	
Stevens	136	38	15,482	63,651	1,138	
	65,371	53,834	245,428	18,958,139	4,993,708	23,120,000
Total, 1939	64,105	49,442	257,345	17,618,979	7,086,370	20,262,000

BY CLASSES OF CONCENTRATES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	669	800	7,039	400	123	
Dry gold-silver	129	136	5,263	939	1,123	
Dry silver	19	1	1,571	871	738	
Copper	40,074	52,893	215,719	18,952,371		
Lead	3,337		8,587		4,982,200	
Lead-copper	36	4	7,249	3,558	9,524	
Zinc	21,107					23,120,000
	65,371	53,834	245,428	18,958,139	4,993,708	23,120,000

Gross metal content of Washington crude ore shipped to smelters in 1940, by classes of ore

Class of ore	Ore (short tons)	Gross metal content			
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Dry and siliceous gold	45,922	12,763	63,186	125,781	1,561
Dry and siliceous gold-silver	52	22	976	466	3,943
Dry and siliceous silver	497	15	10,126	2,760	14,084
Copper	379	33	4,699	148,599	355
Lead	100		203	91	105,368
	46,950	12,833	79,190	277,697	125,311
Total, 1939	92,441	22,275	127,938	388,817	368,824

Mine production of metals from Washington crude ore shipped to smelters in 1940, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Chelan	260	258	105	460	
Ferry	39,760	10,120	64,613	4,800	
King	5	1	112	100	100
Kittitas	4	2	10		
Okanogan	6,339	2,367	4,954	119,433	8,230
Pend Oreille	6		22		7,300
Snohomish	321	27	2,856	135,319	
Stevens	236	41	6,430	5,549	100,562
Whatcom	19	17	88	200	100
	46,950	12,833	79,190	265,861	116,292
Total, 1939	92,441	22,275	127,938	377,021	349,630

BY CLASSES OF ORE

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Dry and siliceous gold	45,922	12,763	63,186	119,146	829
Dry and siliceous gold-silver	52	22	976	442	1,970
Dry and siliceous silver	497	15	10,126	2,505	12,351
Copper	379	33	4,699	143,691	178
Lead	100		203	77	100,964
	46,950	12,833	79,190	265,861	116,292

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Washington in 1940, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)		Silver (fine ounces)		Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Lode	Placer				
Asotin County: Snake River		14			115		21				$4,040
Benton County: Columbia River		4			24		7				845
Chelan County:											
Chelan Lake	1		687,429	51,444		199,175		18,576,000			4,041,264
Entiat	1		11	1							35
Leavenworth	1		12			62		940			150
Peshastin Creek	6	1	265	262	8	106		460			9,577
Wenatchee River		6			6						210
Clallam County: Ozette		3			8						280
Douglas County: Columbia River		4			36		7				1,265
Ferry County:											
Columbia River		3			127		21				4,460
Danville	1		201	172		145		2,770			6,436
Enterprise	1		29	1		720		90			557
Republic	12	1	179,983	22,033	2	109,693		1,940			849,448
Grant County: Columbia River		2			46		10				1,617
King County: Miller River	3		205	38		322		100	100		1,575
Kittitas County:											
Columbia River		2			4						140
Swauk	2	12	14	6	1,609	11	509				56,895
Okanogan County:											
Cascade	1		94	134		239					4,860
Columbia River		8			21		10				742
Conconully	5		296	5		8,228		5,000	14,600		7,321
Loomis-Oroville	8	3	196	44	7	1,180		2,000	900		2,895
Methow	11	1	16,139	3,853	8	4,240		348,000	2,100		177,579
Myers Creek and Mary Ann Creek	2	3	54	32	6	52			400		1,387
Similkameen River		5			13						455
Pend Oreille County: Metaline	4		273,233			8,609			4,989,500	23,120,000	1,712,157
Skamania County: Niggerhead	1		2	6							210
Snohomish County:											
Index	2		868	38		4,268		199,300			26,886
Stilaguamish	3		583	133		4,770		2,200	600		8,326
Sultan	2	2	50	1	26	142	7	15,800			2,836
Stevens County:											
Chewelah	1		924	41		15,082		66,400			19,663
Columbia River		8			665		128				23,366
Colville	1		64	5		2,766			5,900		2,437
Deer Trail	2		219	1		3,240		1,000	2,000		2,552
Kettle Falls	2		68	16		668		600	400		1,123
Northport	4	2	92		1	128			93,300		4,791
Orient	3		5,192	785		485			100		27,825
Springdale	1		6			3		1,200			138
Whatcom County: Mount Baker	2	3	569	338	7	121		200	100		12,189
Whitman County: Snake River		1			8						280
Total Washington	83	88	1,166,798	79,389	2,747	364,455	720	19,224,000	5,110,000	23,120,000	7,018,812

ASOTIN COUNTY

The quantity of gold recovered from gravel bars along the Snake River by small dragline and washer plants declined in 1940. A slight increase was noted in gold from small-scale sluicing operations.

BENTON COUNTY

The placer gold output of Benton County came entirely from small-scale sluicing operations along the Columbia River near Paterson and Richland.

CHELAN COUNTY

Chelan Lake district.—The Holden property of the Howe Sound Co. was again the leading producer of gold, silver, and copper in Washington during 1940. Ore milled totaled 687,429 tons, averaging 0.09 ounce of gold and 0.344 ounce of silver to the ton, 1.45 percent copper, and 1.02 percent zinc. The copper concentrates produced averaged over 1.25 ounces of gold and over 5 ounces of silver to the ton and about 25 percent copper. The company reported that mine development in 1940 comprised sinking a 250-foot inclined shaft and driving 12,575 feet of drifts and 4,606 feet of raises, in addition to 37,785 feet of diamond drilling. The value of the gold, silver, and copper produced was $409,901 greater in 1940 than in 1939.

Entiat district.—A small lot of gold ore from the Rex property near Entiat was amalgamated in 1940.

Leavenworth district.—A few tons of copper concentrates were shipped to Tacoma from the property of the Royal Development Co. as mill clean-up in 1940.

Peshastin Creek district.—Several lots of crude gold ore were shipped to smelters in 1940; the Old Blewett mine was the largest shipper, followed by the Tip Top and Apex mines. A small amount of placer gold was reported recovered from gravels along Peshastin Creek.

Wenatchee River district.—A small amount of placer gold was recovered from bars along the Wenatchee River.

CLALLAM COUNTY

A few small-scale sluicing operations on beach sands near Ozette recovered some gold.

DOUGLAS COUNTY

The placer gold output from Douglas County decreased owing chiefly to completion of work by a bulldozer and sluicing plant on the Hopkins property near Alameda in 1940. A small amount of gold was recovered from other bars along the Columbia River.

FERRY COUNTY

Columbia River district.—The bulk of the placer gold produced in 1940 came from dragline operations at the Fish properties along the Columbia River; the remainder was recovered by small-scale sluicing.

Danville district.—The tonnage of gold ore shipped to the Tacoma, Trail, and Bunker Hill smelters from the Morning Star mine increased sharply in 1940.

Enterprise district.—A small lot of crude silver ore from the Silver Bell property was shipped to Tacoma in 1940 for smelting.

Republic district.—Mines of the Republic district produced gold, silver, and copper valued at $849,448 in 1940, a decrease of $257,274 from 1939. The entire output came from siliceous gold ore and siliceous silver ore. Gold ore was by far the more important and comprised 140,393 tons treated by cyanidation, 60 tons amalgamated, and 39,213 tons shipped crude to smelters; 317 tons of silver ore also were shipped to smelters. All the ore from the Knob Hill and Mountain Lion groups, operated by Knob Hill Mines, Inc., was treated in the 400-ton cyanide-flotation plant at the Knob Hill mine; in addition to the gold bullion, 515 tons of gold concentrates were recovered from these ores. Knob Hill Mines, Inc., reported that flotation units had been added to its cyanide plant in November 1940. Gold recovered by amalgamation in the district came from small experimental lots sent to Seattle for testing. Most of the crude ore shipped for smelting came from company and leasing operations on properties of the Aurum Mining Co. Other important shippers of crude ore were the Eureka Mining & Milling Co., operating its Republic and Quilp properties on company and leasing accounts; Golden Valley, Inc., operating the Valley claim; and operators of the Anecia property.

GRANT COUNTY

Virtually the entire output of placer gold from Grant County was recovered by Miller Bros., who washed gravels of the Columbia River about 4 miles east of Priest Rapids.

KING COUNTY

Most of the gold from King County in 1940 was contained in dry gold concentrates produced from gold ore at the Apex property. Most of the year was spent in development work, and it was not until December that the 75-ton flotation mill was operated. Small lots of siliceous gold-silver and siliceous silver ores were shipped from the Silver Dollar and Cleopatra properties, respectively, for smelting.

KITTITAS COUNTY

Columbia River district.—A little gold was recovered during 1940 from placer operations along the Columbia River near Priest Rapids.

Swauk district.—The Swauk district produced over half of the State output of placer gold in 1940. Virtually all the gold came from operations of Needham & Hinds on Swauk Creek; about 394,000 cubic yards of gravel, supplied by a 2¼-cubic yard Diesel-powered Northwest dragline excavator, were treated in a portable washing plant. Operations were begun May 1 and ended November 15. The remainder of the placer gold from the district was recovered by small sluicing operations. Gold was recovered by amalgamation from a few tons of siliceous gold ore from the Nellie and Sunshine properties.

OKANOGAN COUNTY

Cascade district.—The entire output of the Cascade district was gold ore from the Bodie group near Wauconda. Over half of the gold and silver from this property was contained in crude ore sent to smelters; the remainder was recovered by amalgamation.

Columbia River district.—All the placer gold from this district was recovered by sluicing the sands and gravels of the Columbia River.

Conconully district.—Lead-copper concentrates produced from silver ores of the Sonny Boy and Arlington properties comprised the bulk of the metal output from the Conconully district.

Loomis-Oroville district.—Gold ore shipped crude to the smelter yielded the bulk of the gold output from the Loomis-Oroville district. Nearly all the recovered silver was contained in silver concentrates and crude silver ore shipped to Tacoma for smelting. Placer gravels yielded a small amount of gold.

Methow district.—The value of the metal output from the Methow district was $177,579 in 1940, a decrease of $69,617 from 1939. The Methow Gold Corporation operated the Alder group near Twisp and was by far the largest producer of gold and copper in the district; over 9,000 tons of gold ore from the property were treated in the 40-ton Red Shirt mill about ½ mile south of Twisp. Other producers were the Hunter, Independence, Highland Light, Hidden Treasure, and Oriental properties.

Myers Creek and Mary Ann Creek district.—A little gold was recovered from gravels along Mary Ann Creek near Chesaw. Small lots of gold ore were shipped crude to the smelter from the Mother Lode and Morning Glory properties.

Similkameen River district.—Small-scale placer operations along the Similkameen River recovered a few ounces of gold in 1940.

PEND OREILLE COUNTY

Metaline district.—The value of the metal output from Pend Oreille County increased from $1,391,570 in 1939 to $1,712,157 in 1940, owing entirely to increased output of zinc, as production of both lead and silver declined. During 1940, 273,227 tons of zinc-lead ore were treated in two flotation mills compared with 259,320 tons in 1939. The Pend Oreille Mines & Metals Co. operated the Sullivan, Josephine, Hidden Falls, Open Cut, and Yellow Head groups and milled an average of 675 tons of ore a day in its 700-ton flotation mill, producing the bulk of the zinc and lead output of the Metaline district. The average content of the zinc-lead ore milled in 1940 was 1.06 percent lead, 5.43 percent zinc, and a trace of silver—slightly lower than in 1939. Development work reported by the company totaled 12 feet of shafts, 2,204 feet of drifts and raises, and 18,584 feet of diamond drilling. The remainder of the zinc and nearly all the rest of the lead output of the district were contained in zinc and lead concentrates shipped by the Metaline Mining & Leasing Co. and the American

Zinc, Lead & Smelting Co. The Grandview mill, a 450-ton flotation plant, began treatment of zinc-lead ore from the property of the Metaline Mining & Leasing Co. about the middle of August. Ore (15,757 tons) from the Grandview mine, under lease from Grandview Mines, Inc., by the American Zinc, Lead & Smelting Co., was treated during the last quarter of 1940.

SKAMANIA COUNTY

Niggerhead district.—At the Camp Creek property in 1940, the Primary Gold Co. amalgamated a small amount of gold ore which had been mined during its development program.

SNOHOMISH COUNTY

Index district.—Copper ore and concentrates were shipped in 1940 to Tacoma for smelting from the property of Sunset Cooperative Mines, and crude copper ore was shipped by lessees of the Sunset Copper Co.

Stilaguamish district.—Gold-silver concentrates were shipped to Tacoma for smelting from properties operated by the Ore Recoveries Corporation and Mine Operators, Inc., both at Silverton.

Sultan district.—The Kromona Mines Corporation operating the Florence Rae property and the Sultan Basin Mining Co. operating the Iowa mine shipped crude copper ore to Tacoma for smelting. The Haines Construction Co. recovered a little gold from gravels along the Sultan River.

STEVENS COUNTY

Chewelah district.—Copper concentrates shipped from properties of the Chinto Mining Co. yielded the entire output of gold, silver, and copper from the Chewelah district in 1940. A 25-ton flotation plant was reported put into operation late in the year.

Columbia River district.—The Columbia River district of Stevens County ranked second in importance as a producer of placer gold in the State in 1940. The bulk of the gold was recovered from three properties along the Columbia River—the B & W operated by K. E. Boissoneau, the Valbush Bar worked by August and L. W. Grein, and the Gibson operated by the Harvey R. Cline Co.; all used mechanical equipment. The remainder of the gold output was recovered by small sluicing operations along the river.

Colville district.—A car of crude silver ore was shipped in 1940 to the Bunker Hill smelter from the Old Dominion mine.

Deer Trail district.—Lessees operating the Venus and Providence mines milled a small tonnage of silver ore and produced silver concentrates. A small shipment of high-grade silver ore was made from the Silver Seal mine to the Bunker Hill smelter.

Kettle Falls district.—Lessees milling ore from the Silver Queen mine in the 40-ton flotation plant on the property produced a few tons of lead-copper concentrates, which were shipped to the Bunker Hill smelter.

Northport district.—High-grade lead ore, chiefly from the W. J. Bryan and Electric Point properties, was responsible for the entire output of recovered metal in the Northport district in 1940.

Orient district.—The First Thought Mine Corporation treated 5,189 tons of siliceous gold ore in its 50-ton cyanidation mill and recovered the bulk of the metal output of the Orient district in 1940.

Springdale district.—Operators of the Lucky Boy mine shipped small lots of copper ore to the smelter.

WHATCOM COUNTY

Mount Baker district.—Ore from the Boundary Red Mountain mine, treated by amalgamation, yielded the bulk of the gold produced in Whatcom County in 1940. A little gold was recovered from placers on Ruby Creek.

WHITMAN COUNTY

All the output of gold in 1940 from Whitman County was recovered from placer gravels along the Snake River.

GOLD, SILVER, COPPER, AND LEAD IN WYOMING

(MINE REPORT)

By Chas. W. Henderson

SUMMARY OUTLINE

Gold placer mining—chiefly in the Atlantic City district, Fremont County—contributed 722 fine ounces of gold and 73 fine ounces of silver to the very small output of metals (except iron) produced in Wyoming during 1940. Lode mines yielded 18 ounces of gold, 41 ounces of silver, and 4,000 pounds of recoverable copper; nearly half of both the lode gold and silver and one-eighth of the copper came from the Atlantic City district. The bulk of the placer gold output from the Atlantic City district was produced by two dry-land dredges. The third-largest producer of gold was a dry-land dredge in the Douglas Creek district, Albany County. All other placers except a small dragline, with sluices, in Big Horn County were small and hand-operated. The most ambitious lode project was at the Golden Clover group in Carbon County, 15 miles south of Encampment. A mill building was either newly erected or an old one repaired; a 30-ton Marcy mill, a Wilfley table, and other machinery, as well as a 50-hp. Diesel engine for power, were installed in 1940. A small quantity of gold was recovered by amalgamation, and 3 tons of gold concentrates of very good grade were shipped to smelter in consequence of activity that lasted from June 1 to August 1. Other lode operators carried on small-scale amalgamation or made minor shipments of smelting ore.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1936–40

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1936	$35.00	$0.7745	$0.092	$0.046	$0.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052
1940	35.00	[6] .711+	.113	.050	.063

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+ ($20.671835) per fine ounce.
[2] 1936–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–40: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787. [6] $0.71111111.

The following table shows the annual output of ore from lode mines producing gold, silver, copper, and lead and the quantity and value of the metals recovered from both lode and placer mines in Wyoming from 1936 to 1940; it also gives the total production of metals from 1867 to 1940. About three-fourths of the total recorded value of the four metals is in copper, most of which was mined before 1924 in the Encampment district in Carbon County and the Hartville district in Laramie County.

Mine production of gold, silver, copper, and lead in Wyoming, 1936–40, and total, 1867–1940, 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	
1936	344	1,964.40	$68,754	1,113	$862					$69,616
1937	17	1,776.00	62,160	203	157					62,317
1938	581	798.00	27,930	328	212					28,142
1939	57	583.00	20,405	75	51					20,456
1940	813	740.00	25,900	114	81	4,000	$452			26,433
1867–1940	(1)	77,413.00	1,817,783	74,486	51,648	[2] 16,321	5,683,104	[2] 8	$568	7,553,103

[1] Figures not available. [2] Short tons.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, and copper in Wyoming in 1940, by counties, in terms of recovered metals

County	Mines producing		Ore sold or treated	Gold			Silver			Copper	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*	
Albany		5			68	68		9	9		$2,386
Big Horn		1			10	10					350
Carbon	1	4	750	9	19	28	3	1	4		983
Fremont	5	16	36	8	622	630	17	63	80	540	22,168
Laramie	1		13				4		4	360	44
Park	1		1	1		1					35
Platte	1		13				17		17	3,100	362
Sheridan		1			2	2					70
Teton		1			1	1					35
	9	28	813	18	722	740	41	73	114	4,000	26,433
Total, 1939	9	28	57	31	552	583	13	62	75		20,456

REVIEW BY COUNTIES AND DISTRICTS

ALBANY COUNTY

Centennial district.—The Sterling and Tenderfoot placer locations near Centennial each yielded by hand-sluicing less than 1 ounce of fine gold in 1940.

Douglas Creek district (*Holmes, Keystone*).—From July 17 to October 17 F. H. Pethick moved gravel to a sluice with a ¾-cubic yard dragline shovel and caterpillar bulldozer at the Nevada placers on Douglas Creek.

BIG HORN COUNTY

From September 10 to November 10, George E. Frame worked his placer ground at Narrow Bend on the Big Horn River approximately 7 miles north of Kane. A ½-cubic yard dragline moved the gravel to a 150-foot washing flume, then over a ⅝-inch screen to sluice boxes. Frame moved 3,000 cubic yards to recover 10.56 crude ounces of gold (after melting) with a fineness of 0.920¼ in gold and 0.076½ in silver.

CARBON COUNTY

Encampment or Upper Platte district.—The Golden Clover claim, a prospect hole in 1939, was developed in 1940 by sinking the shaft to 100 feet and extending drifts to 120 feet. A 30-ton amalgamation-concentration mill was built, and several hundred tons were treated before it was closed.

Elkhorn Mountains district.—Three ounces of gold were recovered by sluicing at the Golden Sun placer in the Elkhorn Mountains district.

Savery Creek district.—Ground sluicing was done at three placer claims in the Savery Creek district between April 20 and November 20. The gold recovered at the Working Boy placer had an average fineness of 0.936¾.

FREMONT COUNTY

Atlantic City district.—In 1940 the E. T. Fisher Co. operated its 1¼-cubic yard dragline and screening-amalgamation plant (movable on railroad tracks) for the eighth consecutive season on placer ground in the vicinity of Atlantic City. The output of gold was less than in 1939; in 1940 the digging was done on the Croft placer and on the lower claim of the Timba-Bah Mining Co. property. The E. T. Fisher Co. gold had an average fineness of 0.890 in gold and 0.105 in silver. In 1940 John E. Whisenand operated a 3-cubic yard dragline and washing plant on property adjacent to Dead Horse No. 67 on Wilson Bar in the vicinity of Atlantic City; his gold had an average fineness of 0.899 in gold and 0.071 in silver. The ½-cubic yard dragline of the Wyoming Mining Co. washing plant was moved away and hand-mining was done when water was available (only 2 months) on placer ground in Dutch Tom Flats and Poorman's and O'Marres Gulches. There was other small placering on Rock Creek, Meadow Gulch, and Wilson Bar.

Lode output from the Atlantic City district in 1940 comprised a 4-ton lot of copper-silver-gold smelting ore shipped from the Antelope No. 2 claim; 9 tons of gold ore from the Gold Leaf-Mint and 2 tons from the Jack Rabbit, amalgamated; and 15 and 6 tons, respectively, from the Lone Star and the Mary B, amalgamated.

LARAMIE COUNTY

A 13-ton lot of ore carrying a little copper and silver was shipped to smelter from a prospect in the Silver Crown district.

PARK COUNTY

A 1-ton lot from Eagle Creek Gold Mines in the Clark Fork River district was amalgamated to recover 1 ounce of gold.

PLATTE COUNTY

A small lot of copper ore carrying silver, encountered in mining iron ore at Sunrise, was shipped to the Garfield (Utah) smelter by the Colorado Fuel & Iron Co. The Sunrise iron mine was originally opened as a copper mine and during the World War of 1914–18 shipped much copper ore.

SHERIDAN COUNTY

A 3.25-ounce deposit of placer gold from Sheridan, which melted down to 2.58 ounces with a fineness of 0.960¾ in gold and 0.035½ in silver, was made at the Denver Mint in 1940.

TETON COUNTY

Sluicing on the Mercury placer on Snake River 7 miles southeast of Moran recovered less than 2 ounces of gold, with a fineness of 0.910½ in gold and 0.075 in silver.

SECONDARY METALS—NONFERROUS

By T. H. Miller and F. H. Wright [1]

SUMMARY OUTLINE

The survey of consumption and stocks of secondary metals in 1940 was conducted by the Bureau of Mines according to the procedure first used in 1939. In both years, a vigorous attempt was made to measure completely all of the most important nonferrous scrap metals at the point where they are prepared for reuse. Users of scrap metals were divided into two groups, and returns from remelters, smelters, and refiners were tabulated apart from those from manufacturers and foundries.

The canvass of remelters, smelters, and refiners covered all metal companies in the United States that produce refined and alloyed products for sale to consumers, whereas the convass of manufacturers and foundries covered all companies that consume purchased scrap for use in the manufacture of finished products. Only the manufacturers and foundries were asked to report inventories of plant scrap on hand at the beginning and end of 1940. All manufacturers were not reached, therefore the figures for home scrap represent only the trend in inventories rather than complete totals.

The tables showing the recovery of metals in 1939 and 1940, with the exception of the table reporting tin recovered at detinning plants, are not directly comparable with recovery tables published in years preceding 1939 because of changes in survey procedure.

The greater number of companies reporting consumption of scrap in the last 2 years has naturally resulted in increased totals for secondary recovery, but examination of earlier yearly reviews reveals a continuation of past trends. A historical table of nonferrous secondary metals recovered during the 10-year period 1929–38 was published in the Secondary Metals chapter of Minerals Yearbook, 1940. New tables showing the gross weights of scrap used in 1940, as well as inventories of purchased scrap at the end of 1940, have been included in the current chapter. In many instances, several kinds of scrap having the same general classification have been included as one item owing to space limitations.

The figures on recovery of metals from secondary sources in 1940 were derived from consumption data on the following items of scrap:

[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.

Aluminum:
- Pure clippings
- Pure wire and cable
- Castings
- Die castings
- Pistons
- Crankcases
- Clean sheet
- Painted sheet
- Dural sheet and clippings
- Borings and turnings
- Foil
- Plant-process scrap
- Drosses and skimmings
- Sweepings
- Slag

Antimony:
- Battery-lead plates
- Hard lead
- Common babbitt
- Genuine babbitt
- No. 1 babbitt
- No. 1 pewter
- Cable lead
- Type metals
- Type-metal dross
- Battery mud

Copper:
- No. 1 wire
- No. 2 wire
- No. 1 heavy
- Mixed heavy
- Light
- Composition or red brass
- Railroad car boxes
- Cocks and faucets
- Heavy yellow brass
- Yellow brass castings
- Light brass
- Old rolled brass
- Brass clippings
- Brass pipe
- Low brass
- No. 1 Red composition turnings
- No. 1 Yellow rod-brass turnings
- No. 1 Yellow brass turnings
- Automobile radiators (unsweated)
- Electrotype shells
- Engravers' plates
- Brass backs
- Aluminum-base alloys
- Bronze
- Manganese-bronze
- Aluminum-bronze
- Silicon-bronze
- Phosphor-bronze
- Nickel-silver
- Bell metal
- Secondary blister
- Copper oxide
- Buffings
- Grindings
- Washings
- Brass ashes
- Brass skimmings
- Slags

Copper—Continued.
- Residues
- Miscellaneous copper-bearing materials

Lead:
- Soft lead
- Hard lead
- Cable lead
- Battery-lead plates
- Common babbitt
- Solder
- Type metals
- Dross
- Battery mud
- Copper-base alloys
- Type-metal dross
- Solder dross
- Solder joints
- Lead oxide
- Lead foil
- Slag

Nickel:
- Nickel clippings, anodes, hangers, etc.
- Monel metal
- Stainless steel
- Nickel-silver
- Secondary blister copper
- Nichrome wire
- Nickel-steel
- Nickel-iron
- Nickel brass
- Nickel catalyst
- Batteries
- Slag

Tin:
- New tin-plate clippings
- Old tin-coated containers
- Block-tin pipe
- Tinfoil
- Tin scruff and dross
- No. 1 pewter
- Genuine babbitt
- No. 1 babbitt
- Residues
- Copper-base alloys
- Lead-base alloys
- Condensers
- Music metal
- Pattern metal

Zinc:
- Clippings
- Sheet
- Skimmings
- Dross
- Die castings
- Flue dust
- Residues
- Zinc ashes
- Remelt zinc
- Die-cast slabs
- Castings
- Copper-base alloys
- Addressing-machine plates
- Engravers' plates
- Battery cans

As scrap users had an additional year in which to become accustomed to the revised canvass, the final tables for 1940 include data covering 177 plants of remelters, smelters, and refiners and 1,664 plants of manufacturers and foundries reporting compared with 154 remelters, smelters, and refiners, and 1,367 manufacturers and foundries in 1939.

"New scrap" is defined as the refuse produced during the manufacture of articles for ultimate consumption, including all finished and semifinished articles that are to be reworked. Typical examples of new scrap are defective castings, clippings, punchings, turnings, borings, skimmings, drosses, and slags.

"Old scrap" is defined as scrap derived from metal articles that have been discarded after serving a useful purpose. Typical examples of old scrap are discarded trolley wire, battery plates, railroad-car boxes, automobile crankcases, cocks and faucets, and lithographers' plates.

"Plant scrap" is defined as scrap produced within the plant and, although inventories of plant scrap at manufacturers and foundries at the beginning and end of the year were reported, the quantity of home scrap used was not measured, as it had not entered the market.

GENERAL SUMMARY

The value of the more common nonferrous metals recovered from secondary sources as metal and in alloys and chemical products totaled $236,964,748 in 1940 compared with $201,415,865 in 1939. Metals recovered from market scrap produced as a result of manufacturing operations (new scrap) comprised $91,287,888 and metals returning from use (old scrap) $145,676,860 of the total value.

Salient statistics of nonferrous secondary metals recovered in the United States in 1939–40

Metal	New scrap		Old scrap		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1939						
Aluminum	[1] 16,184	[1] $6,392,680	[1] 37,763	[1] $14,916,385	[1] 53,947	[1] $21,309,065
Antimony	150	37,100	9,660	2,387,900	9,810	2,425,000
Copper	212,800	44,262,400	286,900	59,675,200	499,700	103,937,600
Lead	30,700	2,885,800	210,800	19,815,200	241,500	22,701,000
Nickel	1,910	1,337,000	1,010	707,000	2,920	2,044,000
Tin	12,300	12,349,200	16,860	16,927,400	29,160	29,276,600
Zinc	144,540	15,032,200	45,100	4,690,400	189,640	19,722,600
		[1] 82,296,380		[1] 119,119,485		[1] 201,415,865
1940						
Aluminum	28,936	10,561,640	39,109	14,274,785	68,045	24,836,425
Antimony	245	68,600	11,176	3,129,280	11,421	3,197,880
Copper	198,156	44,783,256	333,890	75,459,140	532,046	120,242,396
Lead	33,763	3,376,300	226,583	22,658,300	260,346	26,034,600
Nickel	2,788	1,951,600	2,362	1,653,400	5,150	3,605,000
Tin	12,736	12,690,150	20,486	20,412,251	33,222	33,102,401
Zinc	141,717	17,856,342	64,204	8,089,704	205,921	25,946,046
		91,287,888		145,676,860		236,964,748

[1] Revised figures.

The nonferrous metal market exhibited declining activity during the first part of 1940 as the reaction from the 1939 flurry continued. A mild buying spurt occurred in June as the war situation became tense, but activity decreased after the capitulation of France. When serious defense production was begun in the United States, secondary metals became more in demand as primary stocks were used up. When the year closed, serious shortages were beginning to develop in several types of scrap.

As a natural reflection of world-wide increased demand, the average prices paid for scrap metals in 1940 were much higher than in 1939. The efforts of responsible leaders in the industry to hold prices within reasonable bounds resulted in withholding of Government control throughout 1940.

The total recorded use of all the more common nonferrous scrap metals in the United States was greater in 1940 than in any previous year, except for the peak of 1928–29.

Movements of aluminum scrap declined in the spring of 1940, following the price reduction in primary metal. Demand early in the year was unpredictable, coming in sudden spurts and falling again as consumers watched European developments. As increased use of aluminum in aircraft production became evident, sales of scrap strengthened in May and June on the prospect of larger demand for scrap to replace primary aluminum withdrawn from the usual channels. During the latter half of 1940, readily available supplies of aluminum scrap became so scarce that prices far above the primary level sometimes were paid for scrap needed to meet sudden demand. There was a serious shortage of aluminum scrap at the end of the year.

Copper scrap displayed its highest price for the year at the beginning of 1940; however, quotations fell sharply as export demand for electrolytic copper and copper scrap vanished. A mild revival of activity was experienced when consumers increased stocks during the critical war period in June, but demand again relaxed after the capitulation of France. Scrap moved more actively during August, and the uptrend continued through October, remaining fairly constant to the end of December. Only selected grades of copper scrap evidenced unusual demand toward the close of the year.

More lead scrap was used in 1940 than in 1939, but a plentiful supply of primary lead prevented any unusual demand. Stocks of lead at consumers' plants at the beginning of 1940 were the lowest in 10 years and apparently remained low most of the year. A scarcity of heavy soft scrap caused a flurry in the market late in October; however, demand then slowed to a normal pace for the balance of the year.

Nickel scrap followed practically the same trend as tin scrap in 1940. Movement was slow early in the year, but increased manufacture of munitions brought increased demand in the latter half. Loss of the European market for nickel scrap raised the problem of development of new refining methods in the United States to reclaim much of the nickel scrap formerly exported.

Tin-scrap market activity in 1940 was strongly marked by fluctuations in tune with the changing international situation. The combination of invasion of the Netherlands and increasing domestic consumption of tin, as well as Government stock-piling, brought strength to the tin-scrap market late in May 1940. Scrap demand continued fairly heavy for the balance of the year.

Zinc-scrap purchases declined after the break in primary zinc price soon after the beginning of 1940, and the consumption of redistilled zinc dropped, particularly in galvanizing operations. With the prospect of renewed activity in the steel and brass industries, scrap movement began to gain strength late in February. Elimination of Belgian zinc production from world markets as a result of the German invasion strongly affected the domestic zinc market, and demand for good scrap was strong for the remainder of the year. Consumers' stocks dropped steadily as the year drew to a close. As in the case of aluminum, premium prices higher than primary zinc levels were paid for zinc scrap to fill urgent orders near the end of the year.

SECONDARY ALUMINUM [2]

The quantity of secondary aluminum recovered totaled 68,045 short tons valued at $24,836,425 in 1940 compared with 53,947 tons valued at $21,309,065 in 1939. The value was computed at 18.25 cents a pound of weight recovered in 1940 compared with 19.75 cents in 1939.

Aluminum recovered from secondary sources in 1940 included 3,237 tons of pure metal (98+ percent) and 64,808 tons of aluminum alloys. The aluminum content of the recovered alloys was approximately 59,394 tons (92 percent).

Secondary aluminum recovered in the United States in 1939–40, in short tons

	1939	1940
Aluminum as metal	2,900	3,237
Aluminum alloys produced and recovered from aluminum scrap	[1] 51,047	64,808
	[1] 53,947	68,045
From new scrap	[1] 16,184	28,936
From old scrap	[1] 37,763	39,109

[1] Revised figures.

Consumption and stocks of aluminum scrap in the United States in 1940, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total used
	Used	Stocks, Dec. 31, 1940	Used	Stocks, Dec. 31, 1940	
Pure clippings, wire, and foil	5,242	620	800	134	6,042
Castings	22,035	1,657	11,865	1,520	33,900
Alloy sheet	6,658	543	422	33	7,080
Scrap sheet and sheet utensil	11,128	309	1,889	96	13,017
Borings and turnings	14,106	999	551	14	14,657
Die castings	415	36	14	(1)	429
Miscellaneous aluminum and dross	8,139	570	195	111	8,334
	67,723	4,734	15,736	1,908	83,459

[1] Less than 1 ton.

[2] Stock figures for the beginning of 1940 do not agree with those previously published for the end of 1939 owing to an increase in the number of firms reporting.

Of the 68,045 tons of aluminum recovered in 1940, remelters supplied 54,073 tons (79 percent) and manufacturers and foundries 13,972 tons (21 percent). The 54,073 tons recovered by remelters included 22,543 tons (42 percent) derived from new scrap and 31,530 (58 percent) from old scrap. The 13,972 tons reported by manufacturers and foundries included 6,393 tons (46 percent) obtained from new scrap and 7,579 (54 percent) from old scrap. Thus, the 68,045 tons of secondary aluminum produced included 28,936 tons (43 percent) recovered from new scrap and 39,109 (57 percent) from old scrap.

Stocks of unmelted aluminum scrap at remelting plants decreased 18 percent from 5,758 tons at the beginning of 1940 to 4,734 at the end. Stocks of purchased aluminum scrap at manufacturing and foundry plants decreased 25 percent from 2,535 tons to 1,908. Total stocks of purchased scrap on hand at all plants dropped from 8,293 tons to 6,642—a net decrease of 20 percent—reflecting the heavy demand for aluminum toward the end of the year. A 23-percent increase in stocks of plant scrap at manufacturing and foundry plants (from 4,907 tons to 6,033) indicated increased activity at those plants.

Aluminum prices in 1940 presented an unusual picture. Owing to economic improvement in production, primary aluminum ingot at New York gradually dropped from 20 cents a pound in January to 17 in December, averaging 18.69 cents for the year. In comparison, secondary ingot composed of remelted high-purity scrap averaged 18.74 cents a pound for the year.

Dealers' scrap-buying prices averaged substantially higher in 1940 than in 1939. Scrap cast aluminum in New York averaged 8.95 cents a pound compared with 7.47 in 1939. Average monthly quotations in 1940 ranged from 9.48 cents in January to 8.55 in September and rose again to 9.70 cents in December.

The average price of new aluminum clippings was 14.47 cents a pound in 1940 compared with 13.90 in 1939. Average monthly quotations dropped from 15.50 cents in January to a low of 13.75 cents in August and September and rose slowly to 13.92 cents in December.

Schedule of maximum Government prices for aluminum scrap in effect May 5, 1941, in cents per pound [1]

Grade	Maximum price	
	Sale by maker	Sale by dealer
Pure clips and cable	13.00	14.50
Segregated alloy-sheet clips	12.00	13.50
Old sheet and utensils	11.00	12.50
Mixed-sheet clips	11.00	12.50
Cast scrap and forged scrap, old and new, clean and dry	11.00	12.00
Borings and turnings other than No. 12, clean and dry	10.00	11.50
No. 12 type borings and turnings, clean and dry	9.50	11.00
Pistons free of struts, clean and dry	11.50	12.50
Pistons with struts, clean and dry	9.50	10.50

[1] F. o. b. point of shipment.

The price trend for most scrap items was downward from January through September but turned upward in October and was still climbing at the end of the year. Early in 1941 the heavy demand of consumers, denied their normal supplies by defense requirements, pushed scrap prices to such high points that maximum prices were set by the Advisory Commission to the Council of National Defense on March 25 and later amended by the Office of Price Administration and Civilian Supply on May 5. Further amendments of the price schedule on June 3, 1941, changed regulations concerning quantity differentials and removed price ceilings on certain classes of scrap but did not affect basic prices.

The effect of the shortage of aluminum was to push the flow of scrap out of normal channels, with the result that efficient remelters were idle while inexperienced consumers attempted to substitute scrap aluminum for unavailable ingot metal. To conserve supplies, the Office of Production Management on June 10, 1941, issued Supplementary Order M–1–c prohibiting all deliveries of aluminum scrap that was to be melted or otherwise processed unless a preference rating of A–10 or higher had been assigned to such delivery or unless such delivery had been specifically authorized by the Director of Priorities. The intention of the order was not to govern sales between dealers who did not process the scrap but to allow shipments only to remelters supplying defense orders.

Imports of aluminum scrap into the United States were only 648 tons in 1940 compared with 5,046 in 1939, whereas exports rose to 955 tons from 476 tons.

Aluminum, including scrap, was placed under export control on July 2, 1940, by proclamation of the President. Effective July 5, 1940, a license was required for exporting materials containing over 10 percent aluminum.

SECONDARY ANTIMONY

A total of 11,421 short tons of secondary antimony valued at $3,197,880 was recovered in 1940 compared with 9,810 tons valued at $2,425,000 in 1939. The value was computed at 14 cents a pound in 1940 (the average price for ordinary brands of American-grade antimony) and at 12.36 cents in 1939.

Antimony recovered in lead-base alloys (in oxide and as metal) totaled 11,073 tons in 1940 and that recovered in tin-base alloys 348 tons.

Secondary antimony recovered in the United States in 1939–40, in short tons

	1939	1940
In lead-base alloys [1]	9,520	11,073
In tin-base alloys	290	348
	9,810	11,421
From new scrap	150	245
From old scrap	9,660	11,176

[1] Includes antimony recovered as metal and in oxide and other compounds; 923 tons of antimony were recovered in antimonial lead produced at primary lead refineries in 1939 and 867 tons in 1940.

Remelters, smelters, and refiners furnished 7,773 tons (68 percent) and manufacturers and foundries 3,648 tons (32 percent) of the 11,421 tons of antimony recovered in 1940. Of the 7,773 tons recovered by remelters, smelters, and refiners, 128 tons (1.6 percent) came from new scrap and 7,645 (98.4 percent) from old scrap. Of the 3,648 tons recovered by manufacturers and foundries, 117 tons (3.2 percent) were obtained from new scrap and 3,531 (96.8 percent) from old scrap. Thus, it may be seen that by far the greater part of the secondary antimony was recovered from old scrap metals. Only 245 tons (2 percent) of the 11,421 tons came from new scrap, whereas 11,176 tons (98 percent) came from old scrap.

Consumption and stocks of antimony-bearing scrap in the United States in 1940, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total used
	Used	Stocks, Dec. 31, 1940	Used	Stocks, Dec. 31, 1940	
Lead-base scrap:					
Hard lead	12,049	1,039	2,063	169	14,112
Cable lead	23,618	1,594	765	56	24,383
Battery-lead plates	139,298	13,925	26,089	2,564	165,387
Mixed common babbitt	5,709	558	9,299	1,368	15,008
Type metals	5,243	544	7,830	576	13,073
Type-metal dross	117	4	609	9	726
Lead sludge	771	106	5	13	776
	186,805	17,770	46,660	4,755	233,465
Tin-base scrap:					
No. 1 pewter	225	16	54	1	279
Genuine babbitt	930	110	171	5	1,101
No. 1 babbitt	701	116	384	36	1,085
	1,856	242	609	42	2,465
	188,661	18,012	47,269	4,797	235,930

Discarded lead storage batteries—the principal source of secondary antimony—provided 52 percent of the antimony recovered in 1940. Other scrap-lead alloys, including hard or antimonial lead, common babbitt, type metals, and drosses, supplied 45 percent and scrap-tin alloys 3 percent.

Antimony, including scrap, was placed under export control on July 2, 1940, by proclamation of the President. Effective July 5, 1940, a license was required for exporting materials containing over 5 percent antimony.

SECONDARY COPPER AND BRASS [3]

Copper recovered from scrap metals, including that in alloys, totaled 532,046 short tons valued at $120,242,396 in 1940 compared with 499,700 tons valued at $103,937,600 in 1939. The value was computed at 11.3 cents a pound in 1940, while the average price of 10.4 cents was used in 1939.

In all, 170,839 tons of copper were recovered in 1940 as essentially pure metal, most of which was refined electrolytically. Alloys other than brass yielded 177,756 tons and brass alloys 174,020 tons of copper. In addition to that recovered as metal and in alloys, 9,431 tons of copper were recovered from scrap metals in the form of chemicals.

[3] Stock figures for the beginning of 1940 do not agree with figures previously published for the end of 1939 owing to an increase in the number of firms reporting.

Secondary copper recovered in the United States in 1939-40, in short tons

	1939	1940		1939	1940
As metal	151,370	170,839	In new scrap:		
In brass and other alloys	348,330	361,207	Brass [1]	111,600	121,531
			All other [1]	101,200	76,625
	499,700	532,046		212,800	198,156
As metal:			In old scrap:		
At primary plants	116,613	117,669	Brass	50,800	52,489
At other plants	34,757	53,170	All other	236,100	281,401
	151,370	170,839		286,900	333,890
In brass [1]	162,400	174,020			
In alloys other than brass [1]	182,730	177,756			
In chemicals [2]	3,200	9,431			
	499,700	532,046			

[1] Includes some plant scrap at brass mills.
[2] Apparent increase in 1940 figures over 1939 owing to inclusion of larger number of concerns in survey.

Of the 532,046 tons of copper recovered in 1940, remelters, smelters, and refiners supplied 290,465 tons (55 percent) and manufacturers and foundries 241,581 tons (45 percent). The 290,465 tons recovered by remelters, smelters, and refiners included 55,958 tons (19 percent) derived from new scrap and 234,507 (81 percent) from old scrap. The 241,581 tons reported by manufacturers and foundries included 142,198 tons (59 percent) obtained from new scrap and 99,383 (41 percent) from old scrap. Thus, the 532,046 tons of copper included 198,156 tons (37 percent) recovered from new scrap and 333,890 (63 percent) from old scrap.

Consumption and stocks of copper-base scrap in the United States in 1940, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total used
	Used	Stocks, Dec. 31, 1940	Used	Stocks, Dec. 31, 1940	
No. 1 wire and heavy	47,553	2,979	25,785	2,112	73,338
No. 2 wire, mixed heavy, and light	98,428	4,920	37,845	1,533	136,273
Composition or red brass	78,536	15,699	43,836	8,008	122,372
Railroad-car boxes	2,076	495	34,056	4,363	36,132
Yellow brass	87,662	9,020	170,716	9,555	258,378
Automobile radiators (unsweated)	32,497	2,813	632	69	33,129
Electrotype shells	180	164	41	74	221
Bronze	2,857	429	4,946	924	7,803
Low brass	169	9	7,293	616	7,462
Nickel silver	1,177	187	7,636	460	8,813
Low-grade scrap and residues	23,260	7,864	743	107	24,003
	374,395	44,579	333,529	27,821	707,924

Stocks of purchased copper scrap at remelting, smelting, and refining plants dropped from 46,098 tons at the beginning of 1940 to 44,579 at the end of the year—a loss of 3 percent. Stocks of purchased copper scrap at manufacturing and foundry plants decreased 24 percent from 36,525 tons to 27,821. Total stocks of purchased scrap on hand at all plants declined from 82,623 tons to 72,400—a net loss of 12 percent. Stocks of plant scrap at manufacturing and foundry plants decreased 5 percent from 32,887 tons at the beginning of the year to 31,272 at the end.

Dealers' buying prices for copper scrap in 1940 closely followed domestic quotations for primary metal. In the New York market, heavy copper scrap averaged 8.20 cents a pound in 1940 compared with 7.80 cents in 1939 and 6.81 in 1938. Average monthly quotations began with 8.91 cents a pound in January and, with the exception of a temporary peak in June, eased to 7.46 cents in July. Thereafter the price rose steadily to an average of 8.87 cents in December.

No. 1 composition averaged 7.68 cents a pound in 1940 compared with 7.04 cents in 1939 and 6.36 in 1938. The monthly trend followed that of heavy copper scrap.

The fall of prices during the first half of the year has been attributed to lessened demand while consumers were retrenching from an overstocked position, whereas the upswing that followed reflected a surge of defense business of such extent that unfilled orders for brass and bronze ingots were in the range of 30,000 short tons during the last 4 months of the year.

Imports of brass scrap totaled 1,232 tons in 1940 (no imports were reported in 1939), and exports rose slightly. Imports of copper scrap increased slightly in 1940, whereas exports dropped sharply.

Copper and brass and bronze, including scrap, were placed under export control on January 10, 1941, by proclamation of the President. Effective February 3, 1941, a license was required for exporting materials containing over 15 percent copper.

Brass and copper scrap imported into and exported from the United States, 1939–40, in short tons

	1939	1940
Brass scrap imported		1,232
Scrap copper imported	132	135
Brass scrap exported	5,338	5,887
Scrap copper exported	17,643	7,149

SECONDARY GOLD AND SILVER

Mints and refineries reported the recovery of 895,096 fine ounces of gold valued at $31,328,360 and 24,972,260 ounces of silver valued at $16,950,867 in 1939. The value of gold recovered was computed at $35 a fine ounce and that of silver at 67.878787 cents an ounce. Data for 1940 were not completed in time to be included in this report.

SECONDARY LEAD [4]

Secondary lead recovered totaled 260,346 short tons in 1940, or 49 percent of the total production of refined lead from domestic and foreign sources in the United States; the value was $26,034,600, computed at 5 cents a pound. This compares with 241,500 tons valued at $22,701,000 in 1939, averaging 4.7 cents a pound.

Lead, recovered as metal, from secondary sources totaled 59,580 short tons, antimonial lead 126,687 tons, other lead alloys 58,586 tons, and alloys other than lead alloys (principally copper alloys) 15,493 tons, in 1940.

[4] Stock figures for the beginning of 1940 do not agree with figures previously published for the end of 1939 owing to an increase in the number of firms reporting.

Secondary lead recovered in the United States in 1939–40, in short tons

	1939	1940
As metal:		
At primary plants	29,011	16,588
At other plants	57,889	42,992
	86,900	59,580
In antimonial lead [1]	113,050	126,687
In other lead alloys [2]	27,900	58,586
In alloys other than lead alloys	13,650	15,493
	241,500	260,346
From new scrap	30,700	33,763
From old scrap	210,800	226,583

[1] Includes 12,658 tons of lead recovered from secondary sources at primary plants in 1939 and 16,431 tons in 1940.
[2] Includes some lead in chemical compounds.

By far the greater part of the lead reclaimed in 1940 was recovered by remelters, smelters, and refiners, who supplied 204,192 tons (78 percent); scrap lead and lead in alloys recovered by manufacturers and foundries totaled 56,154 tons (22 percent). Of the 204,192 tons recovered by remelting, smelting, and refining processes, 23,603 tons (12 percent) came from new scrap and 180,589 (88 percent) from old scrap. Of the 56,154 tons recovered at plants of manufacturers and foundries, 10,160 tons (18 percent) were obtained from new scrap and 45,994 (82 percent) from old scrap. Thus, the 260,346 tons of secondary lead comprised 33,763 tons (13 percent) from new scrap and 226,583 (87 percent) from old scrap.

Consumption and stocks of lead scrap in the United States in 1940, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total used
	Used	Stocks, Dec. 31, 1940	Used	Stocks, Dec. 31, 1940	
Soft lead	19,830	1,621	7,520	201	27,350
Hard lead	12,049	1,039	2,063	169	14,112
Cable lead	23,618	1,594	765	56	24,383
Battery-lead plates	139,298	13,925	26,089	2,564	165,387
Mixed common babbitt	5,709	558	9,299	1,368	15,008
Solder	9,898	393	3,062	266	12,960
Type metals	5,243	544	7,830	576	13,073
Dross	25,620	5,550	7,098	792	32,718
Lead oxide	941	178			941
Residues	1,421	741	5	13	1,426
	243,627	26,143	63,731	6,005	307,358

Stocks of purchased lead scrap at remelting, smelting, and refining plants increased 15 percent from 22,642 tons at the beginning of 1940 to 26,143 at the end of the year. Stocks of purchased lead scrap at manufacturing and foundry plants decreased 13 percent from 6,902 tons to 6,005. Total stocks of purchased scrap on hand at all plants rose 9 percent from 29,544 tons to 32,148. Plant scrap at manufacturing and foundry plants dropped 5 percent from 1,369 tons at the beginning of the year to 1,306 at the end.

Dealers' buying prices for heavy lead scrap in New York averaged 4.27 cents a pound in 1940 compared with 4.19 cents in 1939. From 4.35 cents a pound in January the monthly average dropped to 3.95 cents in February and then held steady at 4.12 cents, except for a slight drop in August and September. With the defense program really under way, lead scrap averaged 5.02 cents in November and subsided to 4.72 cents in December.

Buying prices for battery plates ranged from 2 to 2.50 cents a pound in 1940 until late in September and then increased to as much as 3.05 cents in November, closing the year at 2.90 cents. Battery-plate smelting charges remained at $16 and $17 per ton throughout the year.

Imports of lead scrap into the United States dropped to 24 tons in 1940 from 36 tons in 1939.

Lead, including scrap, was placed under export control on March 4, 1941, by proclamation of the President. Effective March 24, 1941, a license was required for exporting materials containing over 15 percent lead.

SECONDARY NICKEL [5]

Recovery figures for secondary nickel are much larger for 1940 than for previous years owing to expansion of the survey to cover more ferronickel scrap. It is not claimed that the totals presented are truly representative of the secondary nickel industry in 1940 because of the difficulty of measuring the nickel present as a minor percentage of a wide variety of both ferrous and nonferrous scrap.

Secondary nickel recovered totaled 5,150 short tons valued at $3,605,000 in 1940 compared with 2,920 tons valued at $2,044,000 in 1939. The value for both years was computed at 35 cents a pound—the spot-delivery price of electrolytic nickel, including duty.

Nickel recovered as metal from secondary sources totaled 3 tons in 1940. The quantity recovered also included 3,032 tons of nickel in nickel-copper alloys, 864 tons in nickel-iron alloys, 1,117 tons in Monel metal, and 134 tons in stainless steel.

Secondary nickel recovered in the United States in 1939–40, in short tons [1]

	1939	1940
As metal	45	3
In Monel metal	315	1,117
In copper alloys	2,180	3,032
In stainless steel	50	134
In iron alloys	330	864
	2,920	5,150
From new scrap	1,910	2,788
From old scrap	1,010	2,362

[1] Exclusive of nickel recovered from secondary copper treated at electrolytic refineries.

Of the 5,150 tons of nickel recovered in 1940, remelters, smelters, and refiners produced 1,609 tons (31 percent) and manufacturers and foundries 3,541 tons (69 percent). The 1,609 tons recovered by remelters, smelters, and refiners included 334 tons (21 percent) derived

[5] Stock figures for the beginning of 1940 do not agree with figures previously published for the end of 1939 owing to an increase in the number of firms reporting.

from new scrap and 1,275 tons (79 percent) from old scrap. Of the 3,541 tons recovered by manufacturers and foundries, 2,454 tons (69 percent) came from new scrap, whereas 1,087 (21 percent) came from old scrap. Thus, of the total 5,150 tons of secondary nickel recovered, 2,788 tons (54 percent) were derived from new scrap and 2,362 (46 percent) from old scrap.

Consumption and stocks of nickel scrap in the United States in 1940, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total used
	Used	Stocks, Dec. 31, 1940	Used	Stocks, Dec. 31, 1940	
Pure nickel scrap	268	77	829	61	1,097
Monel metal	1,180	175	574	64	1,754
Ferronickel-chrome iron	21	2	895	201	916
Ferronickel-iron alloy	208	11	30	1	238
Stainless steel	680	124	1,176	145	1,856
Nickel steel, 2½-3 percent nickel			10,492	639	10,492
Nickel silver	1,177	187	7,636	460	8,813
Miscellaneous high-nickel alloys	324	454	416	483	740
	3,858	1,030	22,048	2,054	25,906

Stocks of purchased nickel scrap at remelting, smelting, and refining plants decreased 20 percent from 1,052 tons at the beginning of 1940 to 843 at the end of the year. Stocks of purchased nickel scrap at plants of manufacturers and foundries dropped 26 percent from 2,140 tons to 1,594. Total stocks of purchased scrap on hand at all plants declined from 3,192 tons to 2,437—a net loss of 24 percent. Stocks of plant scrap in the hands of manufacturers and foundries decreased 25 percent from 6,918 tons at the beginning of the year to 5,187 at the end.

Dealers' buying prices for new nickel clips in New York averaged 35.30 cents a pound in 1940 compared with 27.30 cents in 1939. The daily quotation stood at 31.50 cents a pound until early in June, when it changed overnight to 38 cents and remained so to the end of the year.

Quotations for Monel clippings in 1940 changed at the same time. Having remained at 15.50 cents a pound for 5 months, the price jumped to 18 cents in June, dropped to 16 cents in September, and regained the 18-cent level for the balance of the year.

Nickel, including scrap, was placed under export control on January 10, 1941, by proclamation of the President. Effective February 3, 1941, a license was required for exporting materials containing over 10 percent nickel.

SECONDARY TIN [6]

Secondary tin recovered totaled 33,222 short tons valued at $33,102,401 in 1940 compared with 29,160 tons valued at $29,276,600 in 1939. The value was computed at 49.82 cents a pound—the average price of Straights tin in New York for the year—in 1940 and at 50.20 cents in 1939.

Metallic tin recovered from secondary sources totaled 5,056 short tons in 1940. The greater portion of the metallic tin recovered in 1940 (4,147 tons) came from tin-plate scrap, whereas other sources con-

[6] Stock figures for the beginning of 1940 do not agree with figures previously published for the end of 1939 owing to an increase in the number of firms reporting.

tributed only small amounts (909 tons). Tin recovered in alloys and chemical compounds represented 28,166 tons. The quantity recovered also included 13,950 tons of tin in copper alloys, 7,848 tons in lead alloys, 5,671 tons in tin alloys, and 697 tons in chemical compounds.

Secondary tin recovered in the United States in 1939–40, in short tons

	1939	1940
As metal:		
At detinning plants	4,089	4,147
At other plants	371	909
	4,460	5,056
In copper alloys	12,420	13,950
In lead alloys	6,925	7,848
In tin alloys	4,675	5,671
In chemical compounds	680	697
	29,160	33,222
From new scrap	12,300	12,736
From old scrap	16,860	20,486

Remelters, smelters, and refiners produced 17,903 tons (54 percent) and manufacturers and foundries (including detinning plants) 15,319 tons (46 percent) of the 33,222 tons of tin recovered in 1940. The 17,903 tons recovered by remelters, smelters, and refiners included 5,661 tons (32 percent) derived from new scrap and 12,242 (68 percent) from old scrap. Of the 15,319 tons recovered by manufacturers and foundries, 7,075 tons (46 percent) were obtained from new scrap and 8,244 (54 percent) from old scrap. Thus, the 33,222 tons of tin recovered included 12,736 tons (38 percent) derived from new scrap and 20,486 (62 percent) from old scrap.

Consumption and stocks of tin scrap in the United States in 1940, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total used
	Used	Stocks, Dec. 31, 1940	Used	Stocks, Dec. 31, 1940	
Block-tin pipe, scrap, and foil	696	65	257	50	953
Tin scruff and dross	4,928	282	8	4	4,936
No. 1 pewter	225	16	54	1	279
High-tin babbitt	1,631	226	555	41	2,186
Residues	1,602	170	1		1,603
Miscellaneous tin and alloys	439	41	(1)	3	439
	9,521	800	875	99	10,396

1 Less than 1 ton.

Stocks of purchased tin-base scrap at remelting, smelting, and refining plants rose from 786 tons at the beginning of 1940 to 800 at the end of the year—a 2-percent increase. Stocks of purchased tin-base scrap at manufacturing and foundry plants (not including detinning plants) decreased 22 percent from 127 tons to 99. Total stocks of purchased tin-base scrap on hand at all plants receded 2 percent from 913 tons to 899. Stocks of plant scrap in the hands of manufacturers and foundries declined 22 percent from 542 tons at the beginning of the year to 425 at the end.

Dealers' buying prices for block-tin pipe in New York averaged 42.90 cents a pound in 1940 compared with 40.07 cents in 1939. The monthly average dropped from 40.89 cents a pound in January to 37.32 cents in February and rose to 46.50 cents in June, when the international situation threatened primary tin imports. Thereafter prices gradually declined, showing an average of 44.50 cents in December.

Detinning plants.—The 268,269 long tons of new tin-plate clippings treated at detinning plants in 1940 exceeded the record quantity of 248,676 tons in 1939 by 19,593 tons (8 percent). Old tin-coated containers treated dropped to 4,963 long tons in 1940 from 6,429 tons in 1939. Tin recovered as metal and in chemical products (4,844 short tons) exceeded the high record of 4,769 tons in 1939 by 75 tons. Tin reclaimed was equivalent to 35.65 pounds per long ton of new tin-plate clippings treated in 1940 compared with 37.70 pounds in 1939.

During the past few years the quantity of pig tin produced from tin-plate clippings has increased while decreases were indicated in the quantity recovered in chemicals until 1940; however, in that year recovery in both pig and chemicals increased 2 percent, and the ratio of one to the other (which stood at 1.8:1 in 1938) was 5.9:1 in both 1939 and 1940. One new detinning plant began operations in October 1940, and another was under construction late in 1940 and began operations early in the new year.

The average cost of new tin-plate clippings delivered at detinning plants, which follows roughly the changes in price of No. 1 Heavy-melting steel, advanced to $16.59 a long ton in 1940—a gain of 10 percent over the average of $15.06 in 1939.

Secondary tin recovered at detinning plants in the United States, 1939–40

	1939	1940
Scrap treated:		
Clean tin plate....long tons..	248,676	268,269
Old tin-coated containers....do....	6,429	4,963
	255,105	273,232
Tin recovered as metal:		
New tin-plate clippings....short tons..	4,007	4,085
Old tin-coated containers....do....	82	62
Tin content of tin tetrachloride, tin bichloride, tin crystals, tin oxide, and sodium stannate produced....short tons..	680	697
	4,769	4,844
Weight of tin tetrachloride, tin bichloride, tin crystals, tin oxide, and sodium stannate produced....short tons..	1,195	1,157
Average quantity of tin recovered per long ton of clean tin-plate scrap used....pounds..	37.70	35.65
Average delivered cost of clean tin-plate scrap....per long ton..	$15.06	$16.59

Imports of tin-plate scrap into the United States, largely from Canada, totaled 16,615 long tons valued at $201,213 in 1940 compared with 12,633 tons valued at $126,518 in 1939.

Exports of tin-plate scrap, waste-waste, circles, strips, cobbles, etc., from the United States amounted to 29,370 long tons valued at $1,227,558 in 1940 compared with 25,888 tons valued at $1,121,153 in 1939. Exports of tin-plate scrap or that portion subject to export licensing (Public, No. 448, 74th Cong.) totaled 3,536 long tons valued at $68,122 in 1940 compared with 10,204 tons valued at $186,393 in 1939.

Export allotments of tin-plate scrap.—Export allotments of tin-plate scrap in 1940 were based upon the individual producer's request therefor, with the provision that no allotment of more than 25 long tons should exceed 20 percent of the producer's output of tin-plate scrap during the calendar year 1938. The United States Department of State issued 57 licenses in 1940 authorizing the exportation of 4,334 tons of tin-plate scrap valued at $80,947.20. All licenses issued in 1940 named Japan as the country of destination.

Tin-plate and terneplate scrap were included in the export-license regulations as iron and steel scrap in the Presidential proclamation of July 26, 1940, effective August 1, 1940. As interpreted by the Administrator of Export Control, the order affected tin-plate circles, strips, cobbles, and scroll-shear butts; waste-waste tin plate; and terneplate waste-waste, clippings, and scrap.

The new order also included all types of tin-plate scrap that had been under export control since April 16, 1936.

SECONDARY ZINC [7]

Zinc recovered from secondary sources totaled 205,921 short tons valued at $25,946,046 in 1940 compared with 189,640 tons valued at $19,722,600 in 1939. The value was computed at 6.3 cents a pound in 1940 (the average selling price of all grades) and at 5.2 cents in 1939.

Zinc recovered as metal from distillation and remelting of purchased secondary metals totaled 35,529 short tons in 1940; moreover, 112,306 tons of zinc were recovered in copper alloys, 15,810 tons in zinc oxide, 1,958 tons in zinc sulfate, 9,132 tons in zinc chloride, 17,321 tons in zinc dust, and 13,865 tons in lithopone.

Secondary zinc recovered in the United States in 1939–40, in short tons

	1939	1940
As metal:		
By distillation [1]	33,135	32,825
By remelting	2,835	2,704
	35,970	35,529
In copper alloys [2]	98,879	112,306
In chemical products:		
Zinc oxide	16,429	15,810
Zinc sulfate	1,674	1,958
Zinc chloride	6,686	9,132
Zinc dust	16,293	17,321
Lithopone	13,709	13,865
	189,640	205,921
From new scrap	144,540	141,717
From old scrap	45,100	64,204

[1] In addition, 17,293 tons of zinc were recovered by redistillation of plant scrap in 1939 and 16,092 tons in 1940. Reported output of redistilled secondary zinc was 50,428 tons in 1939 and 48,917 tons in 1940.
[2] Includes some plant scrap at brass mills.

Of the 205,921 tons of zinc recovered in 1940, remelters, smelters, and refiners supplied 109,455 tons (53 percent) and manufacturers and foundries 96,466 tons (47 percent). The 109,455 tons recovered by remelters, smelters, and refiners included 55,366 tons (51 percent) derived from new scrap and 54,089 (49 percent) from old scrap. The 96,466 tons reported by manufacturers and foundries included 86,351 tons (90 percent) obtained from new scrap and 10,115 (10 percent)

[7] Stock figures for the beginning of 1940 do not agree with figures previously published for the end of 1939 owing to an increase in the number of firms reporting.

from old scrap. Thus, the 205,921 tons of zinc recovered included 141,717 tons (69 percent) derived from new scrap and 64,204 (31 percent) from old scrap.

Consumption and stocks of zinc scrap in the United States in 1940, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total used
	Used	Stocks, Dec. 31, 1940	Used	Stocks, Dec. 31, 1940	
Clippings	2,759	175	915	150	3,674
Sheet	11,936	640	72	10	12,008
Castings	822	66	18	2	840
Skimmings and ashes	26,582	7,106	527	340	27,109
Dross	29,045	2,600	1,257	376	30,302
Die castings	17,087	2,261	169	1	17,256
Flue dust and residues	7,589	6,342	13,288	732	20,877
	95,820	19,190	16,246	1,611	112,066

Stocks of purchased zinc scrap on hand at remelting, smelting, and refining plants increased 12 percent from 17,162 tons at the beginning of 1940 to 19,190 at the end. Stocks of purchased zinc scrap on hand at manufacturing and foundry plants decreased 46 percent from 2,982 tons to 1,611. Total stocks of purchased scrap on hand at all plants rose 3 percent from 20,144 tons to 20,801. Stocks of plant scrap at manufacturing and foundry plants advanced from 972 tons at the beginning of the year to 1,346 at the end—a rise of 38 percent.

Dealers' buying prices for new zinc clips in New York averaged 4.81 cents a pound in 1940 compared with 3.58 cents in 1939—a rise of 34.4 percent. Monthly averages began with 4.35 cents a pound in January and held at 4.19 cents for 4 months, then rose evenly to 6.02 cents in December. On December 31, 1940, the quotation was 6.75 cents a pound, and the first quarter of 1941 brought March quotations to 8.50 cents. Effective March 31, 1941, maximum prices for zinc scrap were set by the Advisory Commission to the Council of National Defense.

Schedule of maximum Government prices for zinc scrap in effect Mar. 31, 1941 [1]

Grade	Maximum price (cents per pound)
New zinc clippings and trimmings	[2] 6.75
Engravers' and lithographers' plates	[2] 6.75
Old zinc scrap	[2] 5.10
Unsweated zinc dross	[3] 5.10
Die-cast slab	[3] 4.95
New die-cast scrap	[3] 4.60
Radiator grilles, old and new	[3] 4.60
Old die-cast scrap	[3] 4.25

[1] Maximum prices to be paid for zinc-scrap materials after the free iron and other foreign materials are removed. [2] Delivered buyer's plant. [3] F. o. b. point of shipment.

The importance of secondary zinc in defense production was demonstrated by its inclusion in the General Preference Order M-11 relating to the distribution of zinc, which was announced by the Office of Production Management on June 11, 1941. It was stated that a definite shortage of zinc existed (which might increase in future, as the domestic supply was insufficient for all defense and civilian needs) and that conservation by means of priority control was needed to insure the satisfaction of requirements for national defense.

Full priority control replaced the partial control to which zinc had been subject through a production pool established voluntarily by producers beginning April 1.

The new order, effective July 1, 1941, provides that all defense needs would be filled ahead of all other requirements, that an emergency pool would be created to meet urgent needs, and that the remaining zinc would be allocated among competing civilian demands. Deliveries of all defense orders that did not bear a higher preference rating were assigned a rating of A–10, which afforded priority over civilian requirements.

As defined in the order, "zinc" meant all grades of metallic zinc (spelter) produced directly from ores, concentrates, and other primary material or redistilled from scrap, including dross, skimmings, and ashes; all zinc oxide, both lead-free and leaded; and zinc dust.

During each month, beginning July 1, each producer of metallic zinc, zinc oxide, and zinc dust was to set aside from his total production an amount to be determined from time to time by the Director of Priorities, to be delivered only upon his express direction. Zinc that remained after the required amount had been set aside in a pool was to be shipped in such manner that each customer should receive a percentage of the producer's commitments to him for the month, including both defense orders and nondefense orders, equal to the percentage received by every other customer. The restrictions on shipments applied not only to outside customers but also to affiliates, subsidiaries, and agents of the seller and to shipments of zinc from the producing branch of a single business enterprise to any other business enterprise owned or controlled by the same person or corporation.

The order was accompanied by the disclosure that 1,165,000 short tons of zinc were estimated by the Office of Production Management to be the 1941 requirements for both military and civilian needs, whereas available figures indicated that the total supply for the year would be 890,000 to 950,000 tons, indicating an over-all shortage of from 215,000 to 275,000 tons, even if the 200,000 short tons to be produced from foreign ores were made available. Inability to get ships to move concentrates from South America could reduce seriously the estimated supply for the year. In addition, potential demands in cartridge brass as new cartridge facilities came into production were expected to intensify the shortage.

In 1940, the reported production of secondary zinc in the United States as metal redistilled from scrap (including dross, skimmings, and ashes) and as zinc oxide and zinc dust produced from scrap amounted to 65,956 short tons or 32 percent of the total recovery of secondary zinc in all forms.

Imports of zinc scrap into the United States dropped to 164 tons in 1940 from 173 in 1939, and imports of zinc dross rose to 356 tons from 30.

Zinc, including scrap, was placed under export control on January 10, 1941, by proclamation of the President. Effective February 3, 1941, a license was required for exporting materials containing over 15 percent zinc.

IRON AND STEEL SCRAP [1]

By Robert H. Ridgway and Harold E. Carmony

SUMMARY OUTLINE

The iron and steel scrap industry in 1940 was characterized by the unprecedented consumption of scrap and by increases in prices and in consumers' stocks of scrap. Reflecting the 27-percent rise in steel ingot production in 1940, the use of ferrous scrap increased 23 percent over that in 1939 and 17 percent above that in the record year 1937. During the first 4 months of 1940, scrap consumption followed the downward trend of the steel-ingot production rate, which gradually declined as an aftermath of the abrupt upturn in production following the advent of war in 1939. However, as steel production soared to record proportions during the latter half of the year, the demand for scrap improved. The consumption of scrap probably reached an all-time peak in October 1940.

The proportion of purchased scrap used in open-hearth furnaces—the largest consumers of purchased scrap—has, in general, trended downward for a number of years. Again in 1940 the ratio of scrap to pig iron decreased; practically all of this decline was due to the reduced proportion of purchased scrap used, while the proportion of home scrap used dropped only slightly. The decline in the proportion of purchased scrap used in 1940 was accentuated by the enlarged demand for steel and resulted in an increased amount of steel produced from duplexing operations. The rise in steel production to record heights created an abnormal demand for scrap, and for a short period the price of scrap exceeded that of pig iron. During November and December, many consumers were obliged to increase the amount of pig iron used because of the high cost of scrap and the curtailment of available supplies caused by the continued large demand.

The total consumption of ferrous scrap and pig iron in 1940 increased 27 percent over that in 1939. Of the 90,715,499 net tons used, 73,933,517 were charged to steel-making furnaces and 16,781,982 to iron furnaces. In making the average ton of steel in 1940, less scrap and more pig iron were used than in 1939; the relative consumption of purchased scrap declined in 1940 from 1939, while that of home scrap increased slightly. In iron furnaces, moreover, the relative use of total scrap decreased while that of pig iron increased, owing to a smaller consumption of purchased scrap in 1940 compared with 1939.

[1] Minerals Yearbook, 1939, p. 513, gives definitions of the various scrap terms used in this chapter.

Exports of ferrous scrap from the United States in 1940 declined 21 percent from 1939 mainly because exports to several countries that were involved in the European War were eliminated and because exports to countries other than the United Kingdom and the Western Hemisphere were restricted beginning in October. Consignments to Japan, which in 1939 comprised 56 percent of the total, declined to 34 percent of the 1940 exports, while those to the United Kingdom and Canada were greater than in 1939. Shipments to Italy in the first 6 months of 1940 were 17 percent greater than in the corresponding period in 1939 but disappeared when Italy entered the war in June. Several bills and resolutions that would directly or indirectly impose restrictions on scrap exports from the United States were introduced during the third session of the Seventy-sixth Congress. On July 2, 1940, after extensive testimony, H. R. 9850 was approved and became Public, No. 703, 76th Congress.

Immediately after war broke out in September 1939 the International Scrap Convention—a centralized buying agency for European consumers—suspended operations. Consequently, all of the European countries that purchased scrap in 1940 acted independently in their buying, while purchases in the United States by Japan were negotiated by the several large mercantile houses of that nation.

Prices for scrap fluctuated within narrower limits in 1940 than in 1939. According to Iron Age, the quotation for No. 1 Heavy-melting steel scrap at Pittsburgh ranged from a low of $16.25 a gross ton the first week in April to a high of $22.75 the second week in December. The average for 1940 was $19.26 compared with $17.17 in 1939 and was the highest yearly average since 1923. Scrap prices received little support in the first 6 months of 1940 from either domestic or foreign markets; however, increased domestic demand and greater activity in export loading early in the third quarter strengthened the price structure, and prices trended upward in sympathy with the increased rate of steel production. The increasing price of scrap during the last few months of 1940 caused the Office of Price Stabilization of the Advisory Commission to the Council of National Defense to confer with representatives of the steel and scrap industries early in October to discuss the scrap-market situation. Although no Government control was exercised, these conferences tended to result in voluntary halting of the advancing trend in scrap-steel prices. However, this stability was short-lived, and prices continued to rise until December, when scrap was quoted above the price for basic pig iron. This new increase brought about another series of conferences late in December and during the first week of the new year between steel-mill and scrap-trade representatives and the Office of Price Stabilization, when both prices and the supply situation were discussed. The quoted price of basic pig iron remained stationary in 1940 until the latter part of December, when it increased $1.00 a gross ton to $23.50 at Valley furnaces and held at the higher level into 1941.

The high operating rates in steel production during the latter half of 1940 precipitated such an abnormal demand for scrap that dealers and brokers found it difficult to cover commitments. This occasioned considerable alarm as to the depleted condition of domestic stocks of iron and steel scrap. The Bureau of Mines survey of suppliers' and consumers' stocks for the last quarter of 1940 [2] indicated inventories

[2] Bureau of Mines, Quarterly Iron and Steel Scrap Stock Reports: No. 8, February 27, 1941, 10 pp.

exceeding 7,843,000 net tons which was equivalent to approximately a 2-month supply at the December rate of consumption. Some authorities interpreted this as representing an adequate supply. Consumers' stocks of scrap increased from 5,310,098 tons at the beginning of 1940 to 5,471,554 at the close.

Salient statistics of ferrous scrap and pig iron in the United States, 1939–40

	1939	1940	Change in 1940 (percent)
Stocks, Dec. 31:			
Ferrous scrap and pig iron at consumers' plants:	*Net tons*	*Net tons*	
Home scrap	1,936,735	1,783,920	−8
Purchased scrap	3,373,363	3,687,634	+9
Pig iron	3,773,432	3,242,324	−14
	9,083,530	8,713,878	−4
Ferrous scrap at suppliers' yards and in transit:			
Prepared scrap	2,007,390	1,418,266	−29
Unprepared scrap	741,911	724,087	−2
Scrap in transit to yards or for export and at docks	118,670	48,958	−59
	2,867,971	2,191,311	−24
Consumption:			
Ferrous scrap and pig iron charged to—			
Steel furnaces: [1]			
Home scrap	15,288,727	19,680,106	+29
Purchased scrap	12,135,071	14,080,677	+16
Pig iron	30,459,914	40,172,734	+32
	57,883,712	73,933,517	+28
Iron furnaces: [2]			
Home scrap	4,333,169	5,367,617	+24
Purchased scrap	4,569,569	5,401,271	+18
Pig iron	4,772,785	6,013,094	+26
	13,675,523	16,781,982	+23
All furnaces:			
Home scrap	19,621,896	25,047,723	+28
Purchased scrap	16,704,640	19,481,948	+17
Pig iron	35,232,699	46,185,828	+31
	71,559,235	90,715,499	+27
Ferrous scrap (total)	36,326,536	44,529,671	+23
Exports:			
Iron and steel	3,985,577	3,126,389	−22
Tin plate, waste—waste, circles, strips, cobbles, etc.	28,995	15,923	−45
Average prices per gross ton:			
Scrap:			
No. 1 Heavy-melting, Pittsburgh [3]	$17.17	$19.26	+12
No. 1 Cast cupola [3]	17.21	19.85	+15
For export	15.40	16.87	+10
Pig iron, f. o. b. Valley furnaces: [3]			
Basic	21.09	22.53	+7
No. 2 Foundry	21.59	23.03	+7

[1] Includes open-hearth, bessemer, and electric furnaces.
[2] Includes cupola, air, Brackelsberg, puddling, crucible, and blast furnaces; also direct castings.
[3] Iron Age.

Figure 1 and its accompanying table show the consumption of purchased scrap and output of pig iron and steel ingots and castings from 1905 to 1940, inclusive.

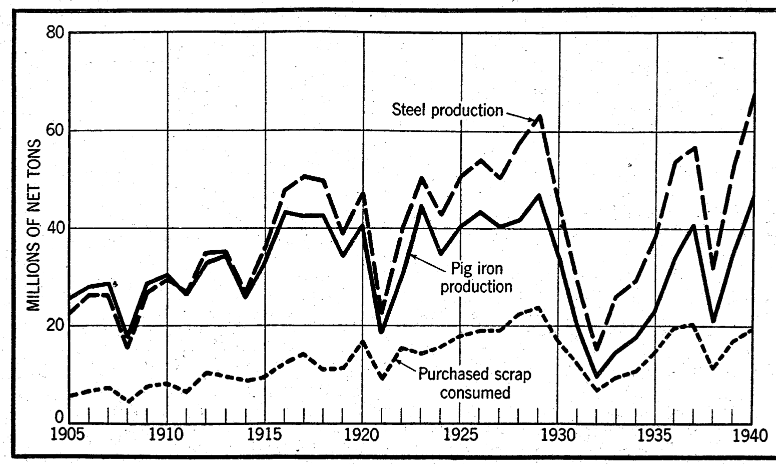

FIGURE 1.—Consumption of purchased scrap and output of pig iron and steel in the United States, 1905–40. Figures on consumption of purchased scrap for 1905–32 shown in the table below, are from *State of Minnesota vs. Oliver Iron Mining Co. et al.*, Exhibits, vol. 5, 1935, p. 328; those for 1933–34 are estimates by authors; and those for 1935–40 are based upon Bureau of Mines reports. Figures on output of pig iron and steel are as given by the American Iron and Steel Institute.

Year	Millions of net tons			Year	Millions of net tons		
	Purchased-scrap consumption	Pig-iron production	Steel production		Purchased scrap consumption	Pig-iron production	Steel production
1905	5.6	25.4	22.4	1923	14.3	44.5	50.3
1906	6.6	27.9	26.2	1924	15.7	34.6	42.5
1907	7.3	28.4	26.2	1925	17.9	40.5	50.8
1908	4.5	17.6	15.7	1926	19.0	43.3	54.1
1909	7.7	28.5	26.8	1927	19.0	40.2	50.3
1910	8.2	30.2	29.2	1928	22.4	41.9	57.7
1911	6.5	26.2	26.5	1929	23.9	46.8	63.2
1912	10.2	32.9	35.0	1930	16.8	34.7	45.6
1913	9.6	34.3	35.1	1931	12.3	20.1	29.1
1914	8.8	25.8	26.3	1932	6.7	9.6	15.3
1915	9.7	33.1	36.0	1933	9.5	14.6	26.0
1916	12.1	43.4	47.9	1934	10.6	17.6	29.2
1917	14.1	42.4	50.5	1935	14.6	23.3	38.2
1918	11.0	42.7	49.8	1936	19.6	33.8	53.5
1919	11.2	34.2	38.8	1937	20.3	40.5	56.6
1920	16.8	40.6	47.2	1938	11.2	20.8	31.8
1921	9.1	18.4	22.2	1939	16.7	34.8	52.8
1922	15.5	30.0	39.9	1940	19.5	46.1	67.0

PRICES [3]

The undertone of scrap prices in 1940 was moderate, except for the last 5 months when steel-ingot production consistently exceeded 90 percent. Market quotations for No. 1 Heavy-melting steel and No. 1 Cast cupola scrap, which had averaged $18.50 and $19.38 a gross ton (Pittsburgh), respectively, in December 1939, eased off with No. 1 Heavy-melting steel dropping to $16.25 and No. 1 Cast cupola scrap dropping to $17.75 (the low point of the year) in the first week of April. However, this weakness was short-lived, and there was a gradual uptrend in prices until the last of June, when—after the capitulation of France—French steel orders were suspended and scrap markets

[3] Pittsburgh price quotations from Iron Age.

assumed a sympathetic tone. During the middle of August, domestic demand having increased, the weakness in the markets was reversed, and the price structure strengthened gradually. Quotations for scrap reached the high point of the year during the second week of December, when No. 1 Heavy-melting steel and No. 1 Cast cupola scrap were both quoted at $22.75 a ton. The average price of scrap during 1940 increased in a more orderly fashion than after the advent of the renewed Allied and German hostilities in 1939. In the closing weeks of 1940 prices remained stable, with an average of $22.94 a ton for No. 1 Heavy-melting steel and $22.75 for No. 1 Cast cupola scrap.

In contrast to the relatively wide fluctuations in scrap prices in 1940, the price of basic pig iron, established at $22.50 a gross ton at Valley furnaces late in September 1939, remained unchanged until the final weeks of December 1940, when it rose to $23.50 and held there during the remainder of the year.

Export scrap prices in 1940, as indicated by the declared value of iron- and steel-scrap exports, averaged $16.87 a gross ton for the year and were slightly above the 1939 average of $15.40. In recent years the 1940 average price—$16.87—was surpassed in only 1 year—1937—when the average was $18.91. In the first 3 months of 1940 the price structure was weak because of the lack of shipping facilities and the amount of material in dealers' yards with which to cover orders, but in the second quarter prices were strengthened when shipping increased. The average value of exports in April—$15.85—represented the low monthly average of the year. Exports increased in the second and third quarters of the year even though Italy—one of the large purchasers of scrap—was out of the market after entering the war in June. Although licensing of exports of No. 1 Heavy-melting steel became effective on August 1, exports continued at accelerated rate until October 16, when the restriction of foreign shipments was extended to include all grades of iron and steel scrap, except to Great Britain and the Western Hemisphere. After October exports decreased approximately 75 percent; but, on account of the increased demand for scrap in the inland steel districts, which was the dominant factor in the domestic market, export prices trended upward. Export values advanced steadily through the last half of the year and reached an average of $17.89 a ton in October.

LEGISLATION

Several new bills [4] calling for the licensing or restricted embargoing of iron and steel scrap were introduced during the third session of the Seventy-sixth Congress. After extensive testimony before the Committee on Military Affairs of the House of Representatives and considerable debate in Congress, the efforts of the proponents for an embargo or a licensing system were successful when H. R. 9850, 76th Congress, was approved and became Public, No. 703, on July 2, 1940. Section 6 of this law provides for the licensing, under proclamation by the President, of exports of materials deemed necessary

[4] S. 3037. A bill to protect the domestic iron and steel industry of the United States in the interest of national defense.
S. 4025. A bill to expedite the strengthening of the national defense.
H. R. 7658 and 10059. Bills to provide for the protection and preservation of domestic sources of iron and steel.
H. R. 9802, 9825, and 9850. Bills to expedite the strengthening of the national defense.

in the interest of national defense. Acting under this law, the President on July 2, 1940, proclaimed that certain listed articles and materials should be exported only when authorized by license. This proclamation did not include iron and steel scrap, but on July 26 was extended to include No. 1 Heavy-melting scrap, providing for licensing effective August 1. On September 26, the proclamation was again extended, this time to include all grades of iron and steel scrap, with the provision that all existent licenses permitting the exportation of No. 1 Heavy-melting steel scrap would be revoked, effective October 15. Under the new regulations, effective October 16, licenses would be issued to permit shipments only to countries of the Western Hemisphere and to Great Britain. Japan, which received 56 percent of all iron and steel scrap exported from the United States in 1939, was the nation principally affected by the new licensing controls.

STOCKS

Visible supplies of iron and steel scrap and pig iron in the United States were determined by the regular annual canvass of consumers of these materials and the quarterly canvass of suppliers (including scrap-iron dealers, automobile wreckers, and selected lists of railroads and manufacturers). The final results of the annual survey indicate that total consumers' and suppliers' stocks of iron and steel scrap totaled 7,662,865 net tons on December 31, 1940, or 180,135 tons less than the 7,843,000 previously published as a result of the quarterly survey. This total of 7,662,865 tons represents a 6-percent decrease from the 8,178,069 tons on hand December 31, 1939.

Consumers' stocks.—Consumers' stocks of home and purchased scrap were slightly larger at the end of 1940 than at the beginning of the year. The supply of 1,783,920 net tons of home scrap on hand December 31, 1940, represented an 8-percent decrease from the 1,936,735 tons on hand at the beginning of the year, while the supply of 3,687,634 tons of purchased scrap on hand at the end of 1940 was a 9-percent increase over the 3,373,363 tons on hand at the beginning of the year. Thus, stocks of scrap totaling 5,471,554 tons at the year end were 3 percent greater than the 5,310,098 tons on hand at the beginning of the year.

In contrast to consumers' stocks of scrap, stocks of pig iron totaling 3,242,324 tons at the end of the year had decreased 14 percent from the 3,773,432 tons on hand at the beginning of the year.

Suppliers' stocks.—Stocks held by dealers, automobile wreckers, railroads, and manufacturers declined from 2,867,971 net tons (reported by 4,680 concerns) on December 31, 1939, to 2,191,311 (reported by 4,848 concerns) on December 31, 1940. Thus, supplies of iron and steel scrap held by suppliers at the year end were 24 percent less than those on hand at the beginning of the year. Stocks in the hands of the larger suppliers were 36 percent lower at the end of 1940 than at the end of 1939, and railroad inventories declined 37 percent during the same period. Although suppliers' stocks declined, nine States, which represented 11 percent of the total replies in the December 1940 canvass and 13 percent of the total suppliers' stocks, showed actual increases, notably Indiana and Missouri, both of which contain large scrap-consuming areas.

Consumers' stocks of ferrous scrap and pig iron on hand in the United States on Dec. 31, 1939–40, by States and districts, in net tons

State and district	Dec. 31, 1939				Dec. 31, 1940			
	Scrap			Pig iron	Scrap			Pig iron
	Home	Purchased	Total		Home	Purchased	Total	
Connecticut	13,312	32,790	46,102	32,602	8,706	36,996	45,702	37,777
Maine	517	2,879	3,396	4,826	132	2,037	2,169	4,911
Massachusetts	16,701	52,411	69,112	146,701	14,979	52,504	67,483	146,512
New Hampshire	514	1,279	1,793	858	313	1,792	2,105	1,082
Rhode Island	3,902	6,741	10,643	11,919	2,285	6,725	9,010	13,560
Vermont	101	2,976	3,077	1,325	161	3,939	4,100	1,354
Total New England	35,047	99,076	134,123	198,231	26,576	103,993	130,569	205,196
Delaware, New Jersey	27,577	88,242	115,819	96,461	17,480	100,860	118,340	109,604
New York	134,431	228,708	363,139	401,957	126,159	267,085	393,244	292,844
Pennsylvania	564,465	626,430	1,190,895	806,568	483,899	646,922	1,130,821	585,514
Total Middle Atlantic	726,473	943,380	1,669,853	1,304,986	627,538	1,014,867	1,642,405	987,962
Alabama	64,171	71,127	135,298	205,971	55,988	60,753	116,741	119,388
District of Columbia, Kentucky, Maryland	147,367	92,401	239,768	134,300	97,213	77,985	175,198	95,741
Florida, Georgia	2,039	29,249	31,288	20,393	902	21,789	22,691	18,137
Mississippi	1	496	497	166	162	58	220	156
North Carolina	1,434	2,659	4,093	1,135	613	4,232	4,845	1,236
South Carolina	79	2,770	2,849	1,707	64	219	283	494
Tennessee, Virginia	12,356	56,949	69,305	46,932	11,806	42,923	54,729	43,944
West Virginia	2,152	122,045	124,197	53,957	4,677	138,320	142,997	38,963
Total Southeastern	229,599	377,696	607,295	464,561	171,425	346,279	517,704	318,059
Arkansas, Louisiana, Oklahoma	691	16,754	17,445	1,155	1,676	12,580	14,256	805
Texas	2,061	15,711	17,772	551	4,179	16,199	20,378	573
Total Southwestern	2,752	32,465	35,217	1,706	5,855	28,779	34,634	1,378
Illinois	135,609	393,320	528,929	391,815	172,885	472,129	645,014	390,589
Indiana	270,014	225,678	495,692	147,488	255,897	289,139	545,036	210,365
Iowa	1,078	20,775	21,853	21,629	872	25,174	26,046	18,785
Kansas, Nebraska	1,261	11,710	12,971	1,138	1,829	13,421	15,250	1,217
Michigan, Wisconsin	89,022	239,182	328,204	357,951	93,050	256,213	349,263	378,790
Minnesota	4,178	36,209	40,387	20,983	10,469	28,829	39,298	16,022
Missouri	13,048	108,767	121,815	14,361	3,830	77,956	81,786	13,249
North Dakota, South Dakota	2,352	265	2,617	43	905	163	1,068	44
Ohio	368,527	592,779	961,306	790,336	381,846	708,397	1,090,243	573,352
Total North Central	885,089	1,628,685	2,513,774	1,745,744	921,583	1,871,421	2,793,004	1,602,413
Arizona, Nevada, New Mexico	4,823	11,780	16,603	6	3,928	6,413	10,341	77
Colorado, Utah	13,228	113,295	126,523	34,193	12,837	109,490	122,327	101,823
Idaho	168	1,904	2,072	33	316	1,004	1,320	40
Wyoming	6	----	6	1	5	----	5	2
Montana	55	6,255	6,310	361	23	5,105	5,128	257
Total Rocky Mountain	18,280	133,234	151,514	34,594	17,109	122,012	139,121	102,199
Alaska, Oregon, Washington	4,474	48,575	53,049	3,011	1,105	49,820	50,925	3,250
California	35,021	110,252	145,273	20,599	12,729	150,463	163,192	21,867
Total Pacific Coast	39,495	158,827	198,322	23,610	13,834	200,283	214,117	25,117
Total United States	1,936,735	3,373,363	5,310,098	3,773,432	1,783,920	3,687,634	5,471,554	3,242,324

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Suppliers' stocks of iron and steel scrap on hand and in transit, December 31, 1939, and December 31, 1940, by States and districts, in net tons

State and district	December 31, 1939				December 31, 1940			
	Yards reporting	Scrap			Yards reporting	Scrap		
		Prepared	Unprepared	Total		Prepared	Unprepared	Total
Connecticut	92	25,462	8,280	33,742	95	19,568	10,387	29,955
Maine	38	15,360	1,923	17,283	41	7,718	3,020	10,738
Massachusetts	195	63,125	30,870	93,995	201	30,897	23,394	54,291
New Hampshire	22	2,768	3,956	6,724	32	2,864	2,417	5,281
Rhode Island	22	10,152	6,674	16,826	19	5,903	3,141	9,044
Vermont	32	2,059	1,671	3,730	30	2,348	2,335	4,683
Total New England	401	118,926	53,374	172,300	418	69,298	44,694	113,992
Delaware	14	2,460	766	3,226	13	2,041	1,094	3,135
New Jersey	181	66,453	48,052	114,505	193	46,492	30,524	77,016
New York	515	182,142	66,742	248,884	518	107,723	63,841	171,564
Pennsylvania	444	185,051	106,403	291,454	475	112,154	88,274	200,428
Total Middle Atlantic	1,154	436,106	221,963	658,069	1,199	268,410	183,733	452,143
Alabama	47	23,081	10,694	33,775	53	13,077	5,190	18,267
District of Columbia	27	18,205	2,444	20,649	25	1,597	2,228	3,825
Florida	42	13,040	4,051	17,091	44	17,575	4,532	22,107
Georgia	59	13,931	3,000	16,931	58	14,580	4,404	18,984
Kentucky	52	28,950	10,417	39,367	47	28,192	6,635	34,827
Maryland	48	54,170	9,303	63,473	52	24,962	22,482	47,444
Mississippi	25	6,558	1,374	7,932	25	4,392	1,492	5,884
North Carolina	46	20,582	7,179	27,761	65	18,125	5,419	23,544
South Carolina	24	12,611	5,034	17,645	30	12,801	5,251	18,052
Tennessee	49	16,635	9,964	26,599	53	12,669	8,334	21,003
Virginia	62	41,568	11,500	53,068	69	46,784	7,135	53,919
West Virginia	43	11,135	2,877	14,012	45	8,238	5,292	13,530
Total Southeastern	524	260,466	77,837	338,303	566	202,992	78,394	281,386
Arkansas	21	8,411	4,643	13,054	20	9,134	3,695	12,829
Louisiana	34	24,827	9,762	34,589	36	20,739	9,666	30,405
Oklahoma	65	19,635	5,000	24,635	64	7,637	6,395	14,032
Texas	163	179,570	43,876	223,446	169	122,366	21,141	143,507
Total Southwestern	283	232,443	63,281	295,724	289	159,876	40,897	200,773
Illinois	294	212,234	125,940	338,174	315	141,387	124,616	266,003
Indiana	161	54,088	9,869	63,957	175	55,920	16,885	72,805
Iowa	109	40,390	15,609	55,999	119	22,231	9,725	31,956
Kansas	95	11,098	7,250	18,348	94	11,682	6,420	18,102
Michigan	199	80,560	26,532	107,092	210	65,058	28,391	93,449
Minnesota	85	122,890	45,345	168,235	85	112,563	27,837	140,400
Missouri	111	33,017	21,212	54,229	113	26,677	29,927	56,604
Nebraska	47	12,025	6,038	18,063	51	10,462	5,235	15,697
North Dakota	17	2,968	1,749	4,717	17	1,893	1,430	3,323
Ohio	383	134,556	65,773	200,329	406	101,752	86,092	187,844
South Dakota	16	1,316	2,576	3,892	17	577	2,230	2,807
Wisconsin	126	34,133	18,543	52,676	125	27,109	22,053	49,162
Total North Central	1,643	739,275	346,436	1,085,711	1,727	577,311	360,841	938,152
Arizona	17	1,751	300	2,051	11	459	1,056	1,515
Colorado	70	23,324	5,756	29,080	66	15,969	8,723	24,692
Idaho	21	413	2,535	2,948	21	129	1,135	1,264
Montana	16	6,076	1,974	8,050	15	3,271	1,403	4,674
Nevada	10	717	549	1,266	10	185	610	795
New Mexico	6	1,282	224	1,506	4	560	73	633
Utah	11	4,098	3,076	7,174	18	4,355	4,020	8,375
Wyoming	14	1,613	7,227	8,840	14	24,730	1,809	26,539
Total Rocky Mountain	165	39,274	21,641	60,915	159	49,658	18,829	68,487
California	364	104,309	36,688	140,997	351	58,971	27,762	86,733
Oregon	69	45,258	9,895	55,153	62	22,290	5,728	28,018
Washington	77	31,333	29,466	60,799	77	9,460	12,167	21,627
Total Pacific Coast	510	180,900	76,049	256,949	490	90,721	45,657	136,378
Total United States	[1] 4,680	2,007,390	[2] 860,581	2,867,971	[1] 4,848	1,418,266	[2] 773,045	2,191,311

[1] Includes 2,580 dealers, 1,832 automobile wreckers, 66 railroads, and 202 manufacturers in December 1939; and 2,717 dealers, 1,884 automobile wreckers, 77 railroads, and 170 manufacturers in December 1940.
[2] Includes 118,670 tons in transit to yards or to shipping point for export and at docks awaiting export in December 1939; and 48,958 tons in December 1940.

CONSUMPTION

In the canvass of consumers of ferrous scrap and pig iron, statistics are compiled to show the consumption of scrap and pig iron by districts and States and by types of furnace. To avoid disclosing details concerning individual plants reporting, figures for some States must be combined in certain instances. All such combinations are made to reveal details of consumption by types of furnace rather than by geographic subdivisions.

The importance of scrap from the standpoint of conservation is illustrated by the relative quantities of scrap and ore used in the domestic iron and steel industry. The total scrap consumed in 1940 was equivalent to 111 percent of the iron content of all domestic and foreign iron and manganiferous ores used in blast furnaces, and purchased scrap alone equaled 48 percent of the iron content of the ores; in 1939 the comparable percentages were 121 and 56.

Scrap constitutes by far the greater part of the ferrous raw materials used in iron and steel plants in the Southwestern, Pacific Coast, and New England districts. These regions, however, used less than 5 percent of the total scrap consumed in 1940. In the New England, Middle Atlantic, and North Central districts, proportionately less scrap was used in 1940 than in 1939, whereas in the Southeastern, Southwestern, Rocky Mountain, and Pacific Coast districts—areas remote from pig-iron-producing centers—proportionately more scrap was used.

Ferrous scrap and pig iron consumed in the United States and percent of total derived from home scrap, purchased scrap, and pig iron, 1939–40, by districts

District	1939					1940				
	Total used (net tons)	Percent of total used				Total used (net tons)	Percent of total used			
		Scrap			Pig iron		Scrap			Pig iron
		Home	Purchased	Total			Home	Purchased	Total	
New England	866,489	27.8	44.5	72.3	27.7	999,597	28.4	41.4	69.8	30.2
Middle Atlantic	22,752,408	25.7	20.5	46.2	53.8	31,205,021	26.2	18.0	44.2	55.8
Southeastern	10,466,112	24.8	19.3	44.1	55.9	12,528,675	25.1	19.8	44.9	55.1
Southwestern	170,408	23.4	73.9	97.3	2.7	180,017	22.0	75.5	97.5	2.5
North Central	35,124,870	29.5	24.1	53.6	46.4	43,350,393	29.5	22.2	51.7	48.3
Rocky Mountain	917,559	24.4	30.6	55.0	45.0	1,060,303	24.6	32.2	56.8	43.2
Pacific Coast	1,261,389	25.2	60.5	85.7	14.3	1,391,493	23.5	62.9	86.4	13.6
	71,559,235	27.4	23.4	50.8	49.2	90,715,499	27.6	21.5	49.1	50.9

Proportion of home and purchased scrap and pig iron used in furnace charges in the United States, 1939–40, in percent

Type of furnace	1939				1940			
	Scrap			Pig iron	Scrap			Pig iron
	Home	Purchased	Total		Home	Purchased	Total	
Open hearth	27.3	21.5	48.8	51.2	27.2	18.9	46.1	53.9
Bessemer	5.6	.2	5.8	94.2	6.1	.2	6.3	93.7
Electric	47.2	51.0	98.2	1.8	43.7	54.5	98.2	1.8
Cupola	29.3	36.4	65.7	34.3	30.2	36.0	66.2	33.8
Air [1]	39.8	22.6	62.4	37.6	41.1	22.2	63.3	36.7
Crucible	43.2	52.1	95.3	4.7	49.5	45.3	94.8	5.2
Puddling	6.0	14.2	20.2	79.8	5.5	19.4	24.9	75.1
Blast	58.2	41.8	100.0	----------	61.9	38.1	100.0	----------

[1] Includes data for 2 Brackelsberg furnaces.

Open-hearth steel furnaces use by far the largest quantities of ferrous scrap and pig iron. They consumed 70 percent of the total scrap in 1940 (70 percent in 1939), 73 percent of the home scrap (73 percent in 1939), 65 percent of the purchased scrap (67 percent in 1939), and 79 percent of the pig iron (76 percent in 1939).

Cupolas, the second largest consumers of scrap, took 22 percent of the purchased scrap in 1940 compared with 21 percent in 1939. Their relative consumption of home scrap did not change from 1939, when the percentage was 15; however, their consumption of pig iron decreased to 9 percent in 1940 from 10 percent in 1939.

Open-hearth and cupola furnaces together consumed 88 percent of both home and purchased scrap and 87 percent of the pig iron in 1940. Bessemer converters used 8 percent of the pig iron consumed in 1940 but only relatively small quantities of scrap (0.58 percent of the total). Although electric furnaces consumed only 6 percent of the total scrap in 1940, 98 percent of the total charge to this type of equipment was home and purchased scrap.

CONSUMPTION BY DISTRICTS AND STATES

All 48 States, the District of Columbia, and Alaska contain plants consuming ferrous scrap or pig iron. The greatest consumption, however, is concentrated in the steel-making centers of the North Central, Middle Atlantic, and Southeastern States. These areas include the 8 largest consuming States, which used 83 percent of the total scrap, 92 percent of the pig iron, and 87 percent of the total scrap and pig iron charged into furnaces in 1940. These States (whose relative position changed only slightly from 1939) and the percentage of the total ferrous scrap and pig iron each consumed in 1940 were as follows: Pennsylvania 28, Ohio 19, Indiana 11, Illinois 9, Michigan 6, New York 5, Alabama 5, and Maryland 4.

Consumption of ferrous scrap and pig iron in the United States, 1936–40, by districts

District and year	Active plants reporting	Scrap: Home, Net tons	Scrap: Home, Change from previous year (percent)	Scrap: Purchased, Net tons	Scrap: Purchased, Change from previous year (percent)	Scrap: Total, Net tons	Scrap: Total, Change from previous year (percent)	Pig iron, Net tons	Pig iron, Change from previous year (percent)
New England:									
1936	238	198, 581	+22. 8	436, 033	+27. 6	634, 614	+26. 0	216, 947	+32. 1
1937	257	262, 011	+31. 9	449, 901	+3. 2	711, 912	+12. 2	268, 295	+23. 7
1938	257	140, 344	−46. 4	250, 830	−44. 2	391, 174	−45. 1	145, 825	−45. 6
1939	263	240, 931	+71. 7	385, 805	+53. 8	626, 736	+60. 2	239, 753	+64. 4
1940	270	283, 607	+17. 7	413, 993	+7. 3	697, 600	+11. 3	301, 997	+26. 0
Middle Atlantic:									
1936	804	6, 457, 589	+51. 6	5, 711, 920	+59. 3	12, 169, 509	+55. 1	11, 940, 909	+65. 4
1937	825	7, 298, 064	+13. 0	6, 146, 227	+7. 6	13, 444, 291	+10. 5	14, 202, 765	+18. 9
1938	817	3, 882, 649	−46. 8	2, 967, 931	−51. 7	6, 850, 580	−49. 0	6, 617, 829	−53. 4
1939	835	5, 840, 586	+50. 4	4, 660, 910	+57. 0	10, 501, 496	+53. 3	12, 250, 912	+85. 1
1940	831	8, 197, 874	+40. 4	5, 607, 105	+20. 3	13, 804, 979	+31. 5	17, 400, 042	+42. 0
Southeastern:									
1936	408	2, 303, 302	+31. 2	2, 269, 682	+15. 9	4, 572, 984	+23. 1	4, 244, 412	+32. 3
1937	448	2, 415, 160	+4. 9	2, 183, 669	−3. 8	4, 598, 829	+. 6	5, 033, 838	+18. 6
1938	445	1, 765, 819	−26. 9	1, 393, 961	−36. 2	3, 159, 780	−31. 3	3, 827, 133	−24. 0
1939	470	2, 593, 437	+46. 9	2, 019, 620	+44. 9	4, 613, 057	+46. 0	5, 853, 055	+52. 9
1940	473	3, 137, 588	+21. 0	2, 485, 652	+23. 1	5, 623, 240	+21. 9	6, 905, 435	+18. 0
Southwestern:									
1936	104	39, 565	+68. 8	129, 124	+53. 0	168, 689	+56. 5	7, 809	+39. 2
1937	111	58, 078	+46. 8	165, 435	+28. 1	223, 513	+32. 5	26, 771	+242. 8
1938	114	39, 377	−32. 2	110, 366	−33. 3	149, 743	−33. 0	5, 027	−81. 2
1939	131	39, 865	+1. 2	125, 968	+14. 1	165, 833	+10. 7	4, 575	−9. 0
1940	132	39, 674	−. 5	135, 909	+7. 9	175, 583	+5. 9	4, 434	−3. 1
North Central:									
1936	1, 230	11, 697, 765	+39. 4	9, 939, 013	+23. 9	21, 636, 778	+31. 9	16, 775, 247	+37. 7
1937	1, 350	11, 717, 880	+. 2	10, 286, 435	+3. 5	22, 004, 315	+1. 7	18, 016, 942	+7. 4
1938	1, 333	6, 526, 443	−44. 3	5, 759, 245	−44. 0	12, 285, 688	−44. 2	9, 871, 485	−45. 2
1939	1, 374	10, 365, 278	+58. 8	8, 468, 527	+47. 0	18, 833, 805	+53. 3	16, 291, 065	+65. 0
1940	1, 377	12, 801, 283	+23. 5	9, 622, 839	+13. 6	22, 424, 122	+19. 1	20, 926, 271	+28. 5
Rocky Mountain:									
1936	62	186, 885	+52. 0	288, 194	+105. 4	475, 079	+80. 5	362, 198	+85. 3
1937	66	222, 943	+19. 3	319, 004	+10. 7	541, 947	+14. 1	416, 878	+15. 1
1938	66	101, 953	−54. 3	161, 999	−49. 2	263, 952	−51. 3	152, 974	−63. 3
1939	68	224, 007	+119. 7	280, 988	+73. 5	504, 995	+91. 3	412, 564	+169. 7
1940	66	260, 825	+16. 4	341, 269	+21. 5	602, 094	+19. 2	458, 209	+11. 1
Pacific Coast:									
1936	217	285, 869	+21. 2	777, 587	+53. 6	1, 063, 456	+43. 3	162, 948	+34. 6
1937	231	281, 421	−1. 6	760, 797	−2. 2	1, 042, 218	−2. 0	177, 821	+9. 1
1938	234	223, 317	−20. 6	582, 092	−23. 5	805, 409	−22. 7	104, 598	−41. 2
1939	252	317, 792	+42. 3	762, 822	+31. 0	1, 080, 614	+34. 2	180, 775	+72. 8
1940	258	326, 872	+2. 9	875, 181	+14. 7	1, 202, 053	+11. 2	189, 440	+4. 8
United States:									
1936	[1] 3, 063	21, 169, 556	+41. 6	19, 551, 553	−33. 6	40, 721, 109	+37. 6	33, 710, 470	+46. 0
1937	[1] 3, 288	22, 255, 557	+5. 1	20, 311, 468	+3. 9	42, 567, 025	+4. 5	38, 143, 310	+13. 1
1938	[1] 3, 266	12, 679, 902	−43. 0	11, 226, 424	−44. 7	23, 906, 326	−43. 8	20, 724, 871	−45. 7
1939	[1] 3, 393	19, 621, 896	+54. 7	16, 704, 640	+48. 8	36, 326, 536	+52. 0	35, 232, 699	+70. 0
1940	[1] 3, 407	25, 047, 723	+27. 7	19, 481, 948	+16. 6	44, 529, 671	+22. 6	46, 185, 828	+31. 1

[1] Where 2 or more separate departments, such as blast furnace, open hearth, foundry, etc., are situated at the same place and are operated by 1 establishment, each appears as 1 plant in the total.

Consumption of ferrous scrap and pig iron in the United States in 1940, by States and districts

State and district	Active plants reporting	Scrap: Home, Net tons	Scrap: Home, Percent of total	Scrap: Purchased, Net tons	Scrap: Purchased, Percent of total	Scrap: Total, Net tons	Scrap: Total, Percent of total	Pig iron: Net tons	Pig iron: Percent of total
Connecticut	76	89,096	0.4	143,670	0.7	232,766	0.5	96,574	0.2
Maine	20	7,657	(1)	8,685	(1)	16,342	(1)	8,392	(1)
Massachusetts	129	141,506	.6	206,245	1.1	347,751	.8	146,886	.3
New Hampshire	19	3,167	(1)	3,163	(1)	6,330	(1)	2,479	(1)
Rhode Island	13	31,080	.1	39,938	.2	71,018	.2	37,308	.1
Vermont	13	11,101	(1)	12,292	.1	23,393	.1	10,358	(1)
Total New England	270	283,607	1.1	413,993	2.1	697,600	1.6	301,997	.6
Delaware	10	297,289	1.2	449,300	2.3	746,589	1.7	362,758	.8
New Jersey	94								
New York	234	1,336,584	5.4	1,225,046	6.3	2,561,630	5.7	2,403,248	5.2
Pennsylvania	493	6,564,001	26.2	3,932,759	20.2	10,496,760	23.6	14,634,036	31.7
Total Middle Atlantic	831	8,197,874	32.8	5,607,105	28.8	13,804,979	31.0	17,400,042	37.7
Alabama	90	966,765	3.8	759,285	3.9	1,726,050	3.9	2,809,064	6.1
District of Columbia	4								
Kentucky	29	1,539,589	6.1	689,460	3.5	2,229,049	5.0	2,825,324	6.1
Maryland	35								
Florida	24	47,750	.2	119,450	.6	167,200	.4	73,045	.2
Georgia	51								
Mississippi	11	860	(1)	1,445	(1)	2,305	(1)	365	(1)
North Carolina	50	15,211	.1	25,783	.1	40,994	.1	15,901	(1)
South Carolina	18	2,060	(1)	3,412	(1)	5,472	(1)	2,355	(1)
Tennessee	58	140,276	.6	234,402	1.2	374,678	.8	162,936	.4
Virginia	69								
West Virginia	34	425,077	1.7	652,415	3.4	1,077,492	2.4	1,016,445	2.2
Total Southeastern	473	3,137,588	12.5	2,485,652	12.7	5,623,240	12.6	6,905,435	15.0
Arkansas	17								
Louisiana	26	10,744	(1)	53,476	.3	64,220	.1	2,107	(1)
Oklahoma	21								
Texas	68	28,930	.2	82,433	.4	111,363	.3	2,327	(1)
Total Southwestern	132	39,674	.2	135,909	.7	175,583	.4	4,434	(1)
Illinois	231	2,086,614	8.3	1,898,341	9.7	3,984,955	8.9	3,764,275	8.1
Indiana	154	3,128,225	12.5	1,723,393	8.9	4,851,618	10.9	5,522,177	12.0
Iowa	64	79,619	.3	103,247	.5	182,866	.4	63,834	.1
Kansas	39	17,561	.1	52,014	.3	69,575	.2	3,742	(1)
Nebraska	14								
Michigan	212	2,365,947	9.4	1,629,253	8.4	3,995,200	9.0	2,232,069	4.8
Wisconsin	137								
Minnesota	72	113,108	.5	166,357	.9	279,465	.6	214,340	.5
Missouri	76	137,200	.5	514,750	2.6	651,950	1.5	45,486	.1
North Dakota	2	1,441	(1)	569	(1)	2,010	(1)	106	(1)
South Dakota	3								
Ohio	373	4,871,568	19.5	3,534,915	18.1	8,406,483	18.9	9,080,242	19.7
Total North Central	1,377	12,801,283	51.1	9,622,839	49.4	22,424,122	50.4	20,926,271	45.3
Arizona	8								
Nevada	4	10,114	(1)	21,254	.1	31,368	.1	35	(1)
New Mexico	1								
Colorado	26	245,615	1.0	314,453	1.7	560,068	1.2	457,487	1.0
Utah	15								
Idaho	4	518	(1)	1,911	(1)	2,429	(1)	96	(1)
Wyoming	1	2	(1)	----	----	2	(1)	2	(1)
Montana	7	4,576	(1)	3,651	(1)	8,227	(1)	589	(1)
Total Rocky Mountain	66	260,825	1.0	341,269	1.8	602,094	1.3	458,209	1.0
Alaska	1								
Oregon	39	46,747	.2	158,274	.8	205,021	.5	7,519	(1)
Washington	71								
California	147	280,125	1.1	716,907	3.7	997,032	2.2	181,921	.4
Total Pacific Coast	258	326,872	1.3	875,181	4.5	1,202,053	2.7	189,440	.4
Total United States:									
1940	[2] 3,407	25,047,723	100.0	19,481,948	100.0	44,529,671	100.0	46,185,828	100.0
1939	[2] 3,393	19,621,896	100.0	16,704,640	100.0	36,326,536	100.0	35,232,699	100.0

[1] Less than 0.05 percent.
[2] Where 2 or more separate departments, such as blast furnace, open hearth, foundry, etc., are situated at the same place and are operated by 1 establishment, each appears as 1 plant in the total.

CONSUMPTION BY TYPE OF FURNACE

Open-hearth furnaces.—Ferrous scrap and pig iron consumed in open hearths in 1940 totaled 67,304,994 net tons—a 29-percent increase over 1939. Of the 1940 total, home scrap comprised 27 percent, purchased scrap 19 percent, and pig iron 54 percent; in 1939 the percentages were 27, 22, and 51, respectively. The use of home scrap increased 28 percent, purchased scrap 13 percent, and pig iron 35 percent.

Charges to open-hearth furnaces in 1940 consisted of 46 percent total scrap and 54 percent pig iron compared with percentages in 1939 of 49 and 51, respectively. Of the total scrap consumed in open hearths in 1940, 41 percent was purchased scrap compared with 44 percent in 1939 and 46 percent in 1938. Higher proportions of purchased scrap are used in areas remote from pig-iron-producing centers, but the practice of using scrap exclusively is relatively rare. In 1940, only 4 plants out of a total of 135 operated on a 100-percent scrap basis; they consumed only 369,650 tons, less than 1 percent of the total consumption of ferrous raw materials in open hearths.

Pennsylvania, the leading steel-producing State, outranked all other States in 1940 in the consumption of ferrous scrap and pig iron in open hearths, followed by Ohio, Indiana, and Illinois.

Consumption of ferrous scrap and pig iron in the United States, 1939–40, by type of furnace, in net tons

Type of furnace or equipment	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
1939					
Open hearth	136	14,272,346	11,258,540	25,530,886	26,826,173
Bessemer	26	213,157	6,972	220,129	3,603,199
Electric	267	803,224	869,559	1,672,783	30,542
Cupola	2,716	2,856,956	3,557,738	6,414,694	[1] 3,349,198
Air	122	348,165	198,001	546,166	329,317
Brackelsberg	2				
Crucible	22	844	1,018	1,862	92
Puddling	7	2,091	4,972	7,063	27,958
Blast	77	1,125,113	807,840	1,932,953	----------
Direct castings	18	----------	----------	----------	1,066,220
	[2] 3,393	19,621,896	16,704,640	36,326,536	35,232,699
1940					
Open hearth	135	18,320,111	12,687,633	31,007,744	36,297,250
Bessemer	26	248,868	9,322	258,190	3,828,978
Electric	280	1,111,127	1,383,722	2,494,849	46,506
Cupola	2,708	3,657,048	4,372,777	8,029,825	[1] 4,106,119
Air	122	419,771	226,257	646,028	374,187
Brackelsberg	2				
Crucible	25	1,749	1,599	3,348	184
Puddling	7	2,064	7,294	9,358	28,293
Blast	79	1,286,985	793,344	2,080,329	----------
Direct castings	23	----------	----------	----------	1,504,311
	[2] 3,407	25,047,723	19,481,948	44,529,671	46,185,828

[1] Includes some pig iron used in making direct castings.
[2] Where 2 or more separate departments, such as blast-furnace, open-hearth, foundry, etc., are situated at the same place and are operated by 1 establishment, each appears as 1 plant in the total.

Consumption of ferrous scrap and pig iron in open-hearth furnaces in the United States in 1940, by districts and States, in net tons

District and State	Active plants reporting	Scrap: Home	Scrap: Purchased	Scrap: Total	Pig iron
New England:					
Connecticut	1				
Massachusetts	2	74,608	183,901	258,509	94,266
Rhode Island	1				
Total: 1940	4	74,608	183,901	258,509	94,266
1939	4	54,652	197,075	251,727	65,844
Middle Atlantic:					
Delaware	1				
New Jersey	1	1,139,466	829,953	1,969,419	2,238,504
New York	7				
Pennsylvania	49	5,431,318	2,975,643	8,406,961	12,012,046
Total: 1940	58	6,570,784	3,805,596	10,376,380	14,250,550
1939	59	4,648,509	3,250,724	7,899,233	9,766,083
Southeastern and Southwestern:					
Alabama	3				
Georgia	1				
Tennessee	1	610,261	605,627	1,215,888	2,140,677
Oklahoma	1				
District of Columbia	1				
Kentucky	2				
Maryland	1	1,751,418	1,162,536	2,913,954	3,254,910
West Virginia	2				
Total: 1940	12	2,361,679	1,768,163	4,129,842	5,395,587
1939	12	1,912,404	1,453,671	3,366,075	4,573,428
North Central:					
Illinois	11	1,456,407	1,183,741	2,640,148	2,722,307
Indiana	7	2,772,159	1,422,884	4,195,043	5,008,487
Michigan	4	860,946	691,274	1,552,220	1,252,962
Iowa	1				
Missouri	3	65,313	287,559	352,872	13,483
Minnesota	1				
Wisconsin	2	101,197	93,914	195,111	204,461
Ohio	25	3,697,909	2,383,292	6,081,201	6,805,380
Total: 1940	54	8,953,931	6,062,664	15,016,595	16,007,080
1939	54	7,313,958	5,626,939	12,940,897	11,910,549
Rocky Mountain and Pacific Coast:					
Colorado	1				
California	5	359,109	867,309	1,226,418	549,767
Washington	1				
Total: 1940	7	359,109	867,309	1,226,418	549,767
1939	7	342,823	730,131	1,072,954	510,269
Total United States: 1940	135	18,320,111	12,687,633	31,007,744	36,297,250
1939	136	14,272,346	11,258,540	25,530,886	26,826,173

Bessemer converters.—The consumption of ferrous scrap and pig iron in bessemer converters in 1940 totaled 4,087,168 net tons—a 7-percent increase over 1939. The proportion of scrap consumed in converter practice is low (amounting to only 6.3 percent in 1940), and virtually the entire quantity was home or plant scrap. Almost all of the small tonnage of purchased scrap consumed in converters was used in small steel-foundry plants.

Ohio was the principal consumer of scrap in bessemer converters in 1940.

Electric steel furnaces.—Ferrous scrap and pig iron consumed in electric furnaces in 1940 totaled 2,541,355 net tons—a 49-percent increase over 1939. Pig iron comprised less than 2 percent of the total ferrous raw materials used in electric furnaces in 1940. Of the 280 active plants reporting in 1940, 94 operated exclusively on scrap and consumed 681,636 tons—about 27 percent of the total scrap and pig iron used.

Ohio led all States in 1940 in the consumption of scrap in electric furnaces, followed by Pennsylvania, Illinois, Michigan, and New York.

Consumption of ferrous scrap and pig iron in bessemer converters in the United States in 1940, by districts and States, in net tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England and Middle Atlantic:					
Delaware	1				
Massachusetts	1	1,510	793	2,303	1,121
New Jersey	1				
Pennsylvania	9	88,997	1,694	90,691	1,455,845
Total: 1940	12	90,507	2,487	92,994	1,456,966
1939	12	59,214	2,125	61,339	1,211,355
Southeastern and Southwestern:					
Alabama	1				
Maryland	1	32,723	1,786	34,509	296,942
West Virginia	1				
Louisiana	1				
Total: 1940	4	32,723	1,786	34,509	296,942
1939	4	27,087	1,180	28,267	254,154
North Central:					
Illinois	2				
Indiana	2	21,916	5,049	26,965	549,738
Michigan	1				
Missouri	1				
Ohio	4	103,722		103,722	1,525,332
Total: 1940	10	125,638	5,049	130,687	2,075,070
1939	10	126,856	3,667	130,523	2,137,690
Total United States: 1940	26	248,868	9,322	258,190	3,828,978
1939	26	213,157	6,972	220,129	3,603,199

Cupola furnaces.—Consumption of ferrous scrap and pig iron in cupola furnaces in 1940 totaled 12,135,944 net tons—a 24-percent increase over 1939. Use of home scrap increased 28 percent, purchased scrap 23 percent, total scrap 25 percent, and pig iron 23 percent. Thus, the proportion of purchased scrap held its own with that of pig iron, although the relatively low prices of scrap as compared to pig iron during the first 9 months of the year were an important factor.

Charges to cupola furnaces in 1940 consisted of 30 percent home scrap, 36 percent purchased scrap, and 34 percent pig iron; in 1939 the percentages were 29, 37, and 34, respectively. Many cupola plants operate on a 100-percent scrap charge; a total of 456 plants reported the use of 1,086,456 tons of ferrous scrap without pig iron in 1940 compared with 472 plants that reported the use of 784,634 tons in 1939.

The relative position of States that are large consumers of scrap in cupola furnaces was not changed in 1940. Michigan continued to be the principal consumer, followed in order by Ohio, Pennsylvania, Illinois, and New York.

Consumption of ferrous scrap and pig iron in electric steel furnaces in the United States in 1940, by districts and States, in net tons

District and State	Active plants reporting	Scrap: Home	Scrap: Purchased	Scrap: Total	Pig iron
New England:					
Connecticut	4				
New Hampshire	1	6,487	8,353	14,840	597
Rhode Island	1				
Massachusetts	9	10,576	4,709	15,285	123
Total: 1940	15	17,063	13,062	30,125	720
1939	12	14,896	10,143	25,039	613
Middle Atlantic:					
Delaware	1	25,626	35,432	61,058	1,581
New Jersey	6				
New York	17	57,883	87,933	145,816	3,891
Pennsylvania	53	251,496	268,737	520,233	10,792
Total: 1940	77	335,005	392,102	727,107	16,264
1939	77	222,661	251,249	473,910	9,687
Southeastern:					
District of Columbia	1				
Kentucky	1	8,434	15,510	23,944	79
Maryland	2				
West Virginia	1				
Alabama	3				
Florida	1	5,436	20,337	25,773	2
Georgia	1				
Tennessee	2	13,249	20,766	34,015	364
Virginia	3				
Total: 1940	15	27,119	56,613	83,732	445
1939	12	23,415	21,699	45,114	384
Southwestern:					
Arkansas	1				
Oklahoma	1	15,265	21,732	36,997	536
Louisiana	4				
Texas	7				
Total: 1940	13	15,265	21,732	36,997	536
1939	12	15,178	13,638	28,816	270
North Central:					
Illinois	19	132,687	250,483	383,170	3,030
Indiana	11	22,334	38,202	60,536	633
Iowa	2				
Kansas	1	5,149	8,537	13,686	106
Nebraska	1				
Michigan	24	162,373	104,069	266,442	15,168
Minnesota	3	2,607	4,687	7,294	214
Missouri	10	4,913	7,528	12,441	627
Ohio	27	309,685	363,811	673,496	5,802
Wisconsin	13	33,108	52,815	85,923	2,246
Total: 1940	111	672,856	830,132	1,502,988	27,826
1939	107	488,768	511,487	1,000,255	18,685
Rocky Mountain:					
Arizona	2				
Colorado	2	6,784	8,859	15,643	100
Nevada	1				
Utah	1				
Total: 1940	6	6,784	8,859	15,643	100
1939	6	5,391	7,057	12,448	57
Pacific Coast:					
Alaska	1	3,115	8,048	11,163	10
Oregon	4				
California	23	26,765	27,458	54,223	551
Washington	15	7,155	25,716	32,871	54
Total: 1940	43	37,035	61,222	98,257	615
1939	41	32,915	54,286	87,201	847
Total United States: 1940	280	1,111,127	1,383,722	2,494,849	46,506
1939	267	803,224	869,559	1,672,783	30,543

Consumption of ferrous scrap and pig iron in cupola furnaces in the United States in 1940, by districts and States, in net tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut	61	57,406	50,374	107,780	65,964
Maine	20	7,657	8,685	16,342	8,392
Massachusetts	108	65,524	107,900	173,424	80,065
New Hampshire	16	1,469	2,521	3,990	1,738
Rhode Island	10	17,302	17,523	34,825	18,780
Vermont	13	11,101	12,292	23,393	10,358
Total: 1940	228	160,459	199,295	359,754	185,297
1939	228	142,232	161,329	303,561	152,748
Middle Atlantic:					
Delaware	6	2,370	4,692	7,062	2,584
New Jersey	81	108,881	261,734	370,615	192,327
New York	190	213,742	314,603	528,345	196,143
Pennsylvania	319	307,306	456,976	764,282	467,174
Total: 1940	596	632,299	1,038,005	1,670,304	858,228
1939	603	487,265	875,625	1,362,890	642,440
Southeastern:					
Alabama	75	204,336	180,670	385,006	667,725
District of Columbia	2	51,392	49,187	100,579	59,598
Maryland	30				
Florida	23	1,199	4,910	6,109	453
Georgia	49	20,903	30,450	51,353	23,857
Kentucky	24	29,081	24,569	53,650	74,420
Mississippi	11	860	1,445	2,305	365
North Carolina	50	15,211	25,783	40,994	15,901
South Carolina	18	2,060	3,412	5,472	2,355
Tennessee	54	82,294	84,525	166,819	132,884
Virginia	63	43,011	116,858	159,869	29,366
West Virginia	26	27,834	25,743	53,577	147,047
Total: 1940	425	478,181	547,552	1,025,733	1,153,971
1939	426	363,662	457,752	821,414	997,379
Southwestern:					
Arkansas	16	1,150	4,484	5,634	179
Louisiana	21	1,693	12,529	14,222	661
Oklahoma	19	1,580	8,349	9,929	1,076
Texas	60	14,912	70,907	85,819	985
Total: 1940	116	19,335	96,269	115,604	2,901
1939	116	19,452	90,272	109,724	3,285
North Central:					
Illinois	179	325,585	377,525	703,110	269,196
Indiana	119	201,635	225,205	426,840	173,687
Iowa	59	70,186	85,139	155,325	53,956
Kansas	38	11,885	40,384	52,269	2,203
Michigan	170	914,104	555,667	1,469,771	719,668
Minnesota	64	22,015	65,393	87,408	15,233
Missouri	61	66,548	231,547	298,095	33,484
Nebraska	13	3,062	7,202	10,264	1,474
North Dakota	2	1,441	569	2,010	106
South Dakota	3				
Ohio	264	351,089	472,817	823,906	397,053
Wisconsin	111	227,256	151,971	379,227	152,060
Total: 1940	1,083	2,194,806	2,213,419	4,408,225	1,818,120
1939	1,084	1,694,182	1,721,236	3,415,418	1,473,054
Rocky Mountain:					
Arizona	6	5,788	17,595	23,383	----------
Colorado	21	11,113	35,549	46,662	29,143
Idaho	4	518	1,911	2,429	96
Montana	7	4,576	3,651	8,227	589
Nevada	3	378	475	853	29
New Mexico	1				
Wyoming	1	2	----------	2	2
Utah	13	13,228	26,170	39,398	15,881
Total: 1940	56	35,603	85,351	120,954	45,740
1939	58	32,185	75,120	107,305	41,379
Pacific Coast:					
California	115	125,128	160,052	285,180	37,371
Oregon	35	2,795	9,339	12,134	2,152
Washington	54	8,442	23,495	31,937	2,339
Total: 1940	204	136,365	192,886	329,251	41,862
1939	201	117,978	176,404	294,382	38,913
Total United States: 1940	2,708	3,657,048	4,372,777	8,029,825	[1] 4,106,119
1939	2,716	2,856,956	3,557,738	6,414,694	[1] 3,349,198

[1] Includes some pig iron used in making direct castings.

Air furnaces.—Ferrous scrap and pig iron consumed in air furnaces in 1940 amounted to 1,020,215 net tons—a 17-percent increase over 1939. The use of home scrap increased 21 percent, while that of purchased scrap and pig iron both increased only 14 percent, respectively, with the use of total scrap increasing 18 percent. Thus, equipment of this type used relatively more total scrap than pig iron in 1940, in contrast to 1939 when relatively more pig iron than total scrap was used. Only four operators of air furnaces reported exclusive use of scrap in 1940, the quantity amounting to 15,673 tons.

Pennsylvania led all States in 1940 in the consumption of scrap in air furnaces, followed in order by Ohio, Indiana, Illinois, Michigan, and Wisconsin

Consumption of ferrous scrap and pig iron in air furnaces[1] in the United States in 1940, by districts and States, in net tons

District and State	Active plants reporting	Scrap: Home	Scrap: Purchased	Scrap: Total	Pig iron
New England:					
Connecticut	7	11,825	3,241	15,066	9,931
Massachusetts	3				
New Hampshire	1	11,889	5,983	17,872	11,406
Rhode Island	1				
Total: 1940	12	23,714	9,224	32,938	21,337
1939	12	21,457	9,927	31,384	20,227
Middle Atlantic:					
Delaware	1				
New Jersey	3	10,713	2,550	13,263	7,730
New York	11	31,312	11,046	42,358	22,919
Pennsylvania	25	63,761	47,116	110,877	59,927
Total: 1940	40	105,786	60,712	166,498	90,576
1939	37	82,844	45,424	128,268	75,556
Southeastern and Southwestern:					
Virginia	1				
West Virginia	2	7,813	15,613	23,426	5,401
Texas	1				
Total: 1940	4	7,813	15,613	23,426	5,401
1939	4	7,278	13,833	21,111	4,843
North Central:					
Illinois	13				
Indiana	10	128,176	55,496	183,672	99,688
Michigan	7	43,536	27,708	71,244	45,370
Iowa	1				
Minnesota	1	7,374	2,901	10,275	9,727
Missouri	1				
Ohio	21	67,518	42,112	109,630	63,882
Wisconsin	11	33,218	11,688	44,906	35,721
Total: 1940	65	279,822	139,905	419,727	254,388
1939	68	234,600	128,056	362,656	226,818
Rocky Mountain and Pacific Coast:					
Colorado	1				
California	2	2,636	803	3,439	2,485
Total: 1940	3	2,636	803	3,439	2,485
1939	3	1,986	761	2,747	1,873
Total United States: 1940	124	419,771	226,257	646,028	374,187
1939	124	348,165	198,001	546,166	329,317

[1] Includes 2 Brackelsberg furnaces, 1 each in Indiana and Ohio.

Crucible and puddling furnaces.—Crucible and puddling furnaces, whose combined output of iron and steel is very small, consume only minor quantities of ferrous raw materials.

Consumption of ferrous scrap and pig iron in crucible and puddling furnaces in the United States in 1940, by districts and States, in net tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut	3	949	1,067	2,016	29
Massachusetts	5				
New Hampshire	1				
Total: 1940	9	949	1,067	2,016	29
1939	5	133	595	728	1
Middle Atlantic:					
New Jersey	2	1,084	364	1,448	6,234
New York	1				
Pennsylvania	9	1,151	5,332	6,483	17,778
Total: 1940	12	2,235	5,696	7,931	24,012
1939	12	2,493	3,221	5,714	22,559
Southeastern and North Central:					
Kentucky	1	451	1,977	2,428	4,376
Virginia	1				
Indiana	1				
Michigan	1				
Ohio	5	160	133	293	60
Total: 1940	9	611	2,110	2,721	4,436
1939	10	297	2,164	2,461	5,488
Pacific Coast:					
California	1	18	20	38	----------
Washington	1				
Total: 1940	2	18	20	38	----------
1939	2	12	10	22	2
Total United States: 1940	32	3,813	8,893	12,706	28,477
1939	29	2,935	5,990	8,925	28,050

Blast furnaces.—Ferrous scrap constitutes only a small proportion of the metal-bearing materials consumed in blast furnaces. The other materials used in 1940 were 80,348,923 net tons of iron and manganiferous iron ores, 5,506,967 tons of cinder and scale, and 2,674,000 tons of flue dust. Total consumption of scrap in 1940, as reported by 79 plants operating blast furnaces, was 2,080,329 tons, an 8-percent increase over 1939. Of the 1940 total, 62 percent was home scrap and 38 percent purchased scrap.

The proportion of scrap used in blast furnaces again declined in 1940, amounting to 4.5 percent of the pig iron produced in 1940 compared with 5.6 percent in 1939 and 5.7 percent in 1938. Purchased scrap was equivalent to 1.7 percent of the pig iron produced in 1940 compared with 2.3 percent in 1939 and 1.6 percent in 1938.

Blast furnaces in Ohio continued to consume more scrap than those in any other State, in 1940, using 3 percent more than Pennsylvania, the second ranking State; in 1939, Ohio furnaces consumed 52 percent more than Pennsylvania furnaces.

Consumption of ferrous scrap in blast furnaces in the United States in 1940, by districts and States, in net tons

District and State	Active plants reporting	Scrap		
		Home	Purchased	Total
New England and Middle Atlantic:				
Massachusetts	1	48,100	132,690	180,790
New York	6			
Pennsylvania	21	419,972	177,261	597,233
Total: 1940	28	468,072	309,951	778,023
1939	29	345,161	239,280	584,441
Southeastern:				
Alabama	7	175,183	52,122	227,305
Kentucky	1		20,516	20,516
Maryland	1	44,717	21,563	66,280
Tennessee	1	112	415	527
Virginia	1			
West Virginia	2	14,687	17,247	31,934
Total: 1940	13	234,699	111,863	346,562
1939	11	264,566	91,401	355,967
North Central:				
Illinois	4	109,627	54,359	163,986
Indiana	3	45,225	10,110	55,335
Iowa	1		500	500
Michigan	5	72,202	19,421	91,623
Minnesota	2	5,528	14,390	19,918
Ohio	21	341,485	272,750	614,235
Total: 1940	36	574,067	371,530	945,597
1939	35	506,877	477,119	983,996
Rocky Mountain:				
Colorado	1	10,147		10,147
Utah	1			
Total: 1940	2	10,147		10,147
1939	2	8,509	40	8,549
Total United States: 1940	79	1,286,985	793,344	2,080,329
1939	77	1,125,113	807,840	1,932,953

FOREIGN TRADE [5]

Imports.—Imports of iron and steel scrap into the United States, which never have been very significant, totaled only 2,199 net tons valued at $47,979 in 1940 compared with 33,031 tons valued at $301,513 in 1939. Of the 1940 total, 737 tons came from Mexico, 661 from Canada, 454 from Europe (mainly Sweden), and only 347 from other countries. In addition, 18,609 tons of tin-plate scrap were imported in 1940, largely from Canada, compared with 14,149 in 1939 and 11,697 in 1938.

Exports.—Ferrous scrap exports (all types) from the United States in 1940 were only 79 percent as large in tonnage and 86 percent as great in value as those during 1939; this decrease was caused by the restriction of exports of all grades of scrap, except to Great Britain and the Western Hemisphere, on October 16. In all, 3,159,284 net tons valued at $48,314,146 were exported in 1940 compared with 4,014,572 tons valued at $55,911,516 in 1939. The shipments included 15,923 tons of tin-plate scrap, waste-waste tin plate, tin-plate strips, cobbles, etc., valued at $753,184 in 1940 compared with 28,995 tons valued at $1,121,153 in 1939. The following table shows the principal countries to which shipments of scrap were consigned during the 5-year period 1936–40.

[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.

Ferrous scrap exported from the United States, 1936–40, by countries, in net tons

Country	1936	1937	1938	1939	1940
Canada	71,357	207,840	103,283	196,556	411,571
Germany	7,615	98,731	258,611	18,574	
Italy	319,341	427,161	486,883	477,004	357,627
Japan	1,184,536	2,140,889	1,547,617	2,279,315	1,079,141
Netherlands	5,350	160,609	231,341	60,665	165
Poland and Danzig	34,837	308,680	169,625	173,161	
United Kingdom	408,659	948,838	433,829	569,288	1,100,774
Other countries	136,773	300,987	127,233	240,009	210,006
	2,168,468	4,593,735	3,358,422	4,014,572	3,159,284
Total value	$24,684,084	$79,387,459	$45,829,533	$55,911,516	$48,314,146

Of the total exports of ferrous scrap from the United States in 1940, 1,498,840 net tons cleared through customs districts on the Atlantic coast (2,241,053 tons in 1939), 896,688 tons from districts bordering the Gulf of Mexico (982,213 tons in 1939), 437,944 tons from districts along the Pacific coast (609,900 tons in 1939), and 325,812 tons from other customs districts (181,405 tons in 1939).

Exports were drawn largely from seaboard areas where the cost of transportation from the point of origin to the port of exportation is relatively low and where the cost of transportation to domestic iron and steel plants not within the area is high.

WORLD ASPECTS

The additional increase in world steel production in 1940 over that in 1939, resulting from the continued turbulent conditions among the powerful foreign nations, resulted in further expansion of the use and demand for iron and steel scrap compared with 1939. According to Metal Statistics 1941,[6] world production of steel in 1940 created a new all-time record, totaling 159,600,000 net tons and representing a 6-percent increase over the 1939 record production of 150,416,000 tons and a 33-percent increase over the 1938 production of 119,840,000 tons. In the United States, Canada, Russia, and Japan, steel production increased 15,716,000 net tons in 1940, whereas the remaining countries reduced production 6,532,000 tons. World production of steel in 1940 (excluding the United States) declined to 92,600,000 tons—a 5-percent decrease from the all-time record (97,617,000 tons) established in 1939, but 5 percent higher than the 1938 figure (88,088,000 tons). Steel production in the United States in 1940 increased 27 percent over 1939 and was 6 percent greater than in the record year 1929.

World production of pig iron (including ferro-alloys) also made a new all-time record in 1940 and totaled 120,960,000 net tons—an increase of 8,904,000 tons over the 1939 production of 112,056,000 tons and of 6,104,000 tons over the previous record of 114,856,000 tons established in 1937. In four countries (United States, Russia, Canada, and the United Kingdom), pig-iron production increased 17,825,000 tons, while the remaining countries reduced their output 8,921,000 tons. World production of pig iron in 1940 (excluding the United States), declined to 68,096,000 tons—a decrease of 8,282,000 tons from the 1939 output of 76,378,000 tons.

[6] American Metal Market, Metal Statistics, 1941: New York City, 1941, p. 233.

The increased spread between the production of pig iron and steel in 1940 compared with 1939 indicates a continued rise in the world use of iron and steel scrap during 1940.

Cartel activities.—The International Scrap Convention suspended operations after the outbreak of war in September 1939, hence there was no activity for purchasing of iron and steel scrap by any cartel on behalf of individual nations.[7] Throughout 1940 each European nation that purchased scrap bought independently; the pro-Axis nations procured less scrap than formerly, whereas the democracies increased their purchases and the United Kingdom and Canada almost doubled the quantities bought in 1939. As in former years, all purchases of scrap by Japan (until licensing of exports was made effective in October) in the United States during 1940 were negotiated by the several large mercantile houses of that nation.

REVIEW BY COUNTRIES

Germany.—Steel output in Germany, which had proceeded feverishly during 1939 and established new records, declined almost 500,000 net tons in 1940 but was approximately twice as large as that of the United Kingdom. The productive capacity of Germany again was augmented—this time by the conquests of Norway, Belgium, Holland, Luxemburg, and France—which tended to relieve the raw-material supply situation as concerned iron ore and scrap, although steel production remained dependent to a certain extent on imports of iron ores from the Scandanavian Peninsula. The stringent measures that Germany adopted in 1939 to conserve its domestic supplies of iron and steel scrap were extended in 1940 to include plants not previously controlled. The use of pig iron produced from low-grade domestic ores and high-grade imported ores was continued.

Italy.—Steel production in Italy, which reached new records in 1939, declined slightly in 1940, although it was still greater than in previous years. Italian production of pig iron also declined from the record set in 1939, causing the iron and steel industry to remain dependent on foreign raw materials by a wide margin. Italian imports of iron and steel scrap from the United States during the first 6 months of 1940 (or until Italy entered the war) had increased considerably, approximating 75 percent of the total imported in 1939. Italy is keenly aware of the vulnerability of its iron and steel industry and, to minimize the demand for raw materials from foreign sources, has by Royal Decree Laws promulgated stringent regulations governing the use and possession of scrap.[8] A Royal Decree Law was also issued which required that all railings of iron or other metals, unless specifically exempt, such as the entrance gates or railings of the Holy See, and diplomatic or consular property of foreign governments, etc., must be dismantled and delivered as scrap to the Scrap Distribution Board.[9]

[7] Daily Metal Reporter, vol. 39, No. 197, October 14, 1939, p. 10.
[8] Bureau of Mines, Mineral Trade Notes: Vol. 10, No. 2, February 20, 1940, p. 9.
[9] Bureau of Mines, Mineral Trade Notes: Vol. 11, No. 1, July 20, 1940, pp. 5, 6.

Japan.—The Japanese steel industry, which has maintained a spectacular growth during the past decade, established new production records in 1940. The problem of raw materials (serious even in previous years) assumed greater importance in 1940, especially after the export-licensing provisions on iron and steel scrap, as set up by the United States, eliminated Japan from that market.[10] This difficulty is evidenced by the fact that steel production, which has practically tripled since 1930, has not been accompanied by proportionate increases in the output of pig iron, a commodity that was produced in smaller amounts in 1940 than in 1939. Consequently the maintenance of present production rates depends entirely on imports of pig iron and iron and steel scrap. Although sources of scrap within the empire are not large, strict Government control is exercised over all available supplies. The announced restriction on exports of iron and steel scrap from the United States and the further spread of the war in Europe caused no little apprehension within Japanese iron and steel circles during the last 6 months of 1940, as Japan depends for its aircraft, automobile, and machine-tool industries on iron and steel scrap imports from the United States, iron ore and pig iron brought in from colonial possessions of belligerent countries, and importation of special and alloy steels.[11]

United Kingdom.—Scrap remained an extremely significant factor in the production of steel in the United Kingdom in 1940, even though less steel was produced than in 1939. All domestic iron and steel scrap collected was rapidly absorbed as soon as received at the consuming centers. Imports of scrap from the United States established a new high during 1940, even though shipping was difficult due to lack of ships. In addition to house-to-house scrap-collection campaigns, requests were made to enterprises that ordinarily do not produce scrap to make all obsolete equipment available.[12] Even though industry undertook to use higher ratios of pig iron in furnace charges, the demand for scrap material continued unabated and consistently exceeded the supply.[13] Additional control of iron and steel scrap by stabilizing collection and conserving supplies was inaugurated with issuance of an order requiring purchasers of scrap to obtain a license for acquiring more than 1 ton in any 1 week.[14] Official orders were also issued for conserving supplies of iron and steel scrap by further limiting allocations for nonessential uses and for construction.[15] Pig-iron production in the United Kingdom in 1940 was exceeded in recent years only by that in 1937.

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[10] Iron Age, vol. 146, No. 19, November 7, 1940, p. 88.
[11] Iron and Steel Fortnightly, vol. 2, No. 14, July 20, 1940, p. 105.
[12] Iron and Steel Fortnightly, vol. 2, No. 1, January 5, 1940, p. 5.
[13] Iron and Steel Fortnightly, vol. 2, No. 13, July 5, 1940, p. 100.
[14] Iron and Steel Fortnightly, vol. 2, No. 10, May 20, 1940, p. 77.
[15] Iron and Steel Fortnightly, vol. 2, No. 14, July 20, 1940, p. 106; vol. 2, No. 16, August 20, 1940, p. 119.

IRON ORE, PIG IRON, FERRO-ALLOYS, AND STEEL

By Robert H. Ridgway, H. W. Davis, and N. B. Melcher [1]

SUMMARY OUTLINE

The sharp rise in world production of iron and steel in the latter half of 1939 continued throughout 1940, elevating it to new records during 1940. The major part of the world increase in 1940 was due largely to the gain in American output, which established a new high during the year. Although the iron and steel industry in Germany proper and the United Kingdom probably operated at near capacity during 1940, some restriction may have been imposed, as in other belligerent countries, by destruction incident to actual warfare. The present annual steel capacity of the Reich (including that of seven conquered countries) is estimated by Iron Age to be 48,000,000 net tons, and is obtained by adding to Germany's own capacity the following approximate amounts gained by territorial accession: France 10,000,000 tons, Belgium 4,300,000 tons, Luxemburg 2,800,000 tons, Poland 2,100,000 tons, Czechoslovakia, 1,750,000 tons, Hungary 750,000 tons, Rumania 250,000 tons. Although Germany's conquests have solved some difficulties in augmenting steel-making capacity, it is probable that new problems of fuel, labor, and transportation, in addition to destruction by bombing, will limit output considerably. Iron Age has estimated that production in the present Reich, although higher during 1940, was lower than the combined tonnage of these eight countries in 1939. Although no official data are available regarding the production of iron and steel in foreign countries other than Canada during 1940, probably the U. S. S. R. broke all previous records for steel production.

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

Salient statistics of iron ore, pig iron, ferro-alloys, and steel in the United States, 1939–40

	1939		1940	
	Gross tons	Value	Gross tons	Value
Iron ore:				
Production by—				
Districts:				
Lake Superior	41,679,608	(2)	[3] 61,471,323	(2)
Southeastern and southwestern	[1] 6,021,781		7,446,103	
Northeastern	3,112,893		3,559,924	
Western	917,448		1,218,549	
	[1] 51,731,730	(2)	73,695,899	(2)
Mining methods:				
Open pit	[1] [4] 32,751,997	(2)	[4] 49,591,309	(2)
Underground	[4] 18,979,733		[4] 24,104,590	
	[1] 51,731,730	(2)	73,695,899	(2)
Varieties:				
Hematite	[5] [6] 47,756,770	(2)	[5] 68,869,837	(2)
Brown ore	[1] 596,733		[7] 934,625	
Magnetite	[5] [6] 3,377,764		[5] [7] 3,890,924	
Carbonate	463		513	
	[1] 51,731,730	(2)	73,695,899	(2)
Shipments (exclusive of ore for paint)	[1] 54,827,100	[1] $158,537,696	75,198,084	$189,086,799
Average value per ton at mine		$2.89		2.51
Stocks at mines Dec. 31	[1] 4,750,357	(2)	3,613,742	(2)
Imports	2,412,515	5,865,510	2,479,326	6,204,641
Exports	1,057,304	3,578,086	1,386,304	4,624,555
Pig iron:				
Production	31,075,914	(2)	41,253,542	(2)
Shipments	32,091,485	626,824,690	41,927,615	840,442,032
Average value per ton at furnaces		19.53		20.05
Imports	38,592	663,091	10,242	189,379
Exports	177,024	3,435,739	553,871	13,057,901
Ferro-alloys:				
Production	735,171	(2)	1,093,179	(2)
Shipments:				
Ferromanganese	296,631	24,137,211	449,367	42,755,485
Spiegeleisen	84,739	2,484,042	106,707	3,487,565
Ferrosilicon	343,822	16,850,356	429,494	24,027,652
Other varieties	115,970	32,684,979	168,593	57,857,108
	841,162	76,156,588	1,154,161	128,127,810
Imports:				
Ferromanganese	41,227	2,935,214	10,369	1,321,369
Spiegeleisen	38,264	1,329,814	15,585	638,732
Ferrosilicon	8,203	237,543	9,158	262,397
Steel production:				
Open hearth:				
Basic	42,704,197	(2)	54,359,679	(2)
Acid	518,839		616,288	
Bessemer	2,999,032		3,311,226	
Crucible	831		914	
Electric	918,810		1,517,863	
	47,141,709	(2)	59,805,970	(2)

[1] Revised figures.
[2] Figures not available.
[3] Includes a small quantity of ore produced in southern Wisconsin.
[4] Some underground included with open pit.
[5] Small quantity of hematite included with magnetite.
[6] Small quantity of magnetite included with hematite.
[7] Small quantity of brown ore included with magnetite.

Trends in production.—During the first half of 1940 the domestic iron and steel industry operated at a slightly lower rate than during the latter half of 1939, and steel plants were operating at about 72 percent of capacity compared with about 53 percent for the same period of 1939. During the latter half of 1940, however, production increased rapidly, amounting to nearly 1,508,000 net tons weekly in November (96.6 percent of capacity) compared with 93 percent in November—

the peak month in 1939. About 29 percent of the 1940 output was made in the final 3 months, when the production rate for steel ingots rose to new heights. At the close of 1940 activities were off a little but were still at a high rate (94 percent of capacity for December); the average rate of production in the last quarter of 1940 was 96 percent compared with 73 percent in the second quarter. The operating rate during 1940 was 82 percent compared with 64 percent in 1939. The producers of such mineral products as iron ore, manganiferous iron ore, fluorspar, fluxing stone, and coke, which depend on iron and steel furnaces for their chief market, felt the increased demand during 1940. Domestic production of iron ore, the principal raw material, increased 42 percent over 1939—13 percent above the 1925–29 average—and

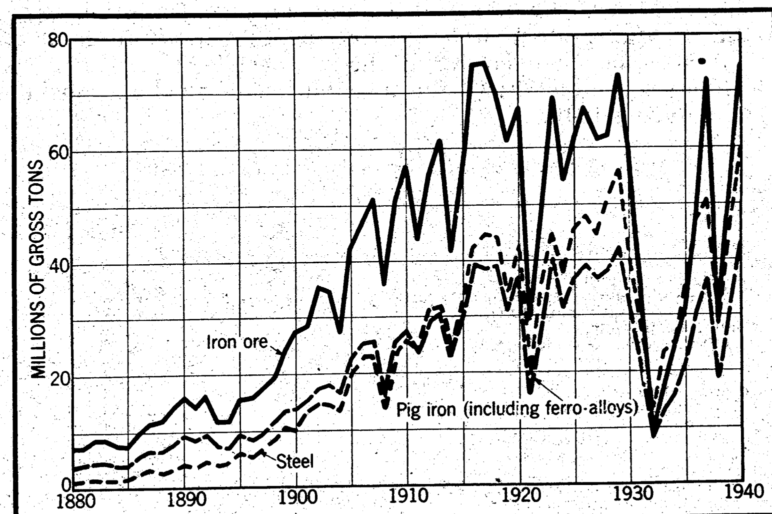

FIGURE 1.—Trends in production of iron ore, pig iron, and steel in the United States, 1880–1940.

was the third highest on record. Figure 1 shows the trends in domestic production of iron ore, pig iron, and steel for more than half a century.

Steel-consuming industries.—The automobile industry, with a strong fourth-quarter demand, was the largest consuming outlet for steel. The production of automobiles in 1940 increased 25 percent over 1939 and totaled 4,469,354 units, which was still somewhat below the 5-million car year 1929. According to the American Iron and Steel Institute, 8,099,000 tons (17.7 percent) of the total of 45,851,000 tons of finished steel shipped by companies representing 98 percent of the total domestic output was for export, principally to England and South America. The automobile industry consumed 7,185,000 tons (15.7 percent). Shipments to jobbers and dealers amounted to 14.6 percent of the total, construction took 10.8 percent, and the railroads and allied trades 8.2 percent.

The capital-goods industries expanded in 1940, and more steel was consumed in this outlet. The railroads bought large quantities of equipment during the entire year 1940, under the stimulus of heavier traffic. Freight carloadings followed a trend similar to that of earnings and held above the 1939 level until October. The fall seasonal rise in traffic stopped slightly short of the peak reached in 1939, largely because of a lag in movement of coal, and was responsible for the inability of earnings to match their improvement of earlier months.

Naval expansion that would have been considered fantastic a year ago is under way in the United States. The program assures capacity operations in the country's shipyards, not only for 1941 but for several years to follow, and will require, in addition, the greatest expansion of ways and yards in this country's history.

Construction, the first industry to feel defense-program needs for steel, lifted orders for fabricated structural material to approximately 1,700,000 tons last year. Both public and private work contributed to the increase, and residential building and defense construction were especially active. Despite the increase, total expenditures for construction in 1940 were less than three-fourths those in the peak years 1926–29; however, the physical volume and consumption of raw material, including steel, were greater, as the distribution of construction costs has changed during the last decade.

The following table shows the distribution of steel to consuming industries during 1940.

Distribution of steel to consuming industries—1940 [1]

	Net tons	Percent of total
Steel converting and processing industries:		
(a) Wire drawers and wire product manufacturers	504,000	
(b) Bolt, nut, and rivet manufacturers	708,000	
(c) Forging manufacturers	574,000	
(d) All other steel plants and foundries	1,143,000	
Total	2,929,000	6.4
Jobbers, dealers, and distributors:		
(a) Oil and natural-gas industry	654,000	
(b) All other	6,033,000	
Total	6,687,000	14.6
Construction industry	4,968,000	10.8
Shipbuilding industry	940,000	2.0
Pressing, forming, and stamping industry:		
(a) Metal furniture and office equipment	470,000	
(b) Hardware and household equipment	950,000	
(c) All other	740,000	
Total	2,160,000	4.7
Container industry	2,985,000	6.5
Agricultural, including implement and equipment manufacturers	920,000	2.0
Machinery and tools:		
(a) Machinery and tools, excluding electric	1,108,000	
(b) Electrical machinery and equipment	777,000	
Total	1,885,000	4.1
Automotive industry	7,185,000	15.7
Aircraft industry	48,000	0.1
Railroad industry:		
(a) All railroads	2,575,000	
(b) Car and locomotive builders and parts manufacturers	1,202,000	
Total	3,777,000	8.2
Oil, natural-gas, and mining industry:		
(a) Oil and natural gas, including pipe lines	991,000	
(b) Mining, quarrying, and lumbering	141,000	
Total	1,132,000	2.5
Other industries	2,136,000	4.7
Export, all industries	8,099,000	17.7
Total	45,851,000	100.0

[1] American Iron and Steel Institute.

Prices.—After a slight decline in the early part of 1940, the metals group moved above its 1937 peak. The composite price of finished steel, as compiled by Iron Age, remained at 2.261 cents a pound throughout 1940. Scrap prices advanced weekly from $16.22 a net ton on August 6 to $18.75 on November 26; in December the upward movement in scrap was slowed until the final week of the year, when it advanced to $19.49. Pig iron held firm at $20.19 a net ton during the year but advanced to $20.93 during the last week of 1940.

Despite the sharp advance in prices for scrap, the iron-and-steel component in the Bureau of Labor Statistics wholesale index, which is based upon posted prices was lower for Decemebr than it had been for January and 6 percent under the 1938 peak for the decade. Structural steel and many other finished-steel prices stayed the same throughout the year—unchanged, in fact, from July 1938. Consequently, the boost in metal prices for the year as a whole is traceable largely to the other metals.

The price of ferromanganese at seaboard remained steady at $89.29 a net ton through May, rose to $98.21 during June, and reached

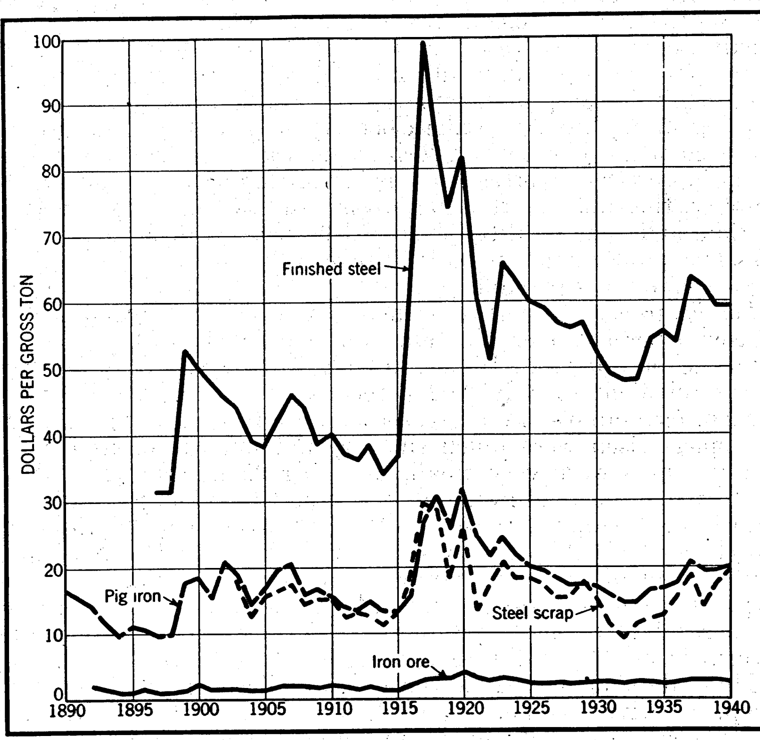

FIGURE 2.—Trends in prices of iron ore, pig iron, finished steel, and steel scrap, 1890–1940. The prices of iron ore and pig iron are the averages f. o. b. mines and furnaces, respectively, as reported to the Bureau of Mines; the price of finished steel is an average composite computed by American Metal Market; that of steel scrap is an average at Pittsburgh of No. 1 Heavy Melting, computed by Iron Age.

$107.14 in July. Spiegeleisen, as quoted by Steel, rose from $28.57 to $30.71 a net ton in June and to $32.14 in July. Lake ores were reduced 50 cents a ton on April 17, 1940.

Figure 2 gives trends in prices of iron ore, pig iron, steel, and steel scrap since 1890.

Employment and wages.—Time lost as a result of industrial disputes was cut to one-third of that for 1939. The total number of persons employed in the United States in the final quarter of 1940 was larger than at any other time since 1929. The Bureau of Labor Statistics reports an increase of 25,600 employees in the steel industry from December 1939 to December 1940. According to the American Iron and Steel Institute, average hourly earnings were 84.6 cents—the highest for any year in the history of the industry. The same source states that total pay rolls in the industry in 1940 were $961,000,000 compared with $810,000,000 in 1939. The wages-and-hours law, which provided for a change from 42 to 40 hours as of October 24, 1940, had little or no effect on the iron and steel industry.

Meeting demand for steel.—The record rate of activity in the steel industry during 1940 brought production nearly to capacity. As record production was inadequate to meet the unprecedented demand for steel, attention was drawn to increasing iron and steel capacity during 1940.

The brisk demand for steel in the last quarter of 1939 had prompted the repairing and remodeling of much equipment. Thus, many beehive ovens were restored to workability. In the second half, many predictions of impending bottlenecks were made, mentioning coke, pig iron, scrap, armor plate, and forging departments and heat-treating units, but up to the close of the year no significant delays had occurred. There was a rush to build new electric steel units, and many bessemer converters were being made ready to start again. In October, the first month when output of steel ingots reached a new all-time high, the industry averaged 96 percent of capacity, whereas bessemer production was only 80 percent of capacity, indicating that further effort was possible.

Foreign trade.—Imports of iron ore into the United States in 1940 increased 3 percent over 1939 and were equivalent to 3 percent of the domestic production. Imports of pig iron declined 73 percent and were equivalent to only 0.02 percent of the domestic output. Imports of ferro-alloys also decreased because receipts of ferromanganese and spiegeleisen were much smaller, and imports of iron and steel manufactures were very small, dropping 92 percent from the total for 1939. Exports of iron and steel products, which are much higher than imports, topped those of 1939 by 211 percent. Exports of pig iron totaled 620,336 net tons and were much higher than in 1939, and exports of iron ore (largely to Canada), increased 31 percent. Exports of ferro-alloys were much higher than in 1939 and comprised 3.4 percent of domestic production. Exports of scrap decreased 21 percent from 1939 and were 31 percent below the 1937 total.

These data do not show the effect of licensing all iron and steel scrap, effective October 16, 1940, which will virtually stop exports to some countries and will substantially decrease total exports.

Import duties on iron and steel products were unchanged during 1940, and no new trade agreements were made during the year.

CONSUMPTION OF FERROUS SCRAP AND PIG IRON

Data on the consumption of ferrous scrap and pig iron, formerly included in this chapter, will be found in the chapter on Iron and Steel Scrap. Data on the consumption of pig iron will be found in the pig-iron section of this chapter.

IRON ORE

Production and shipments.—Iron-ore mining in the United States experienced its best year since 1917; in fact, 1940 was the third best year on record. Production totaled 73,695,899 gross tons—a gain of 42 percent over 1939 and of 13 percent over the 1925–29 average. Output in 1940 came from 230 [2] mines, of which 15 produced more than 1 million tons each compared with 209 [2] mines (revised figure) having only 11 in the million-ton class in 1939. Nineteen States were active producers in 1940 compared with 17 (revised figure) in 1939. Minnesota, with 47,736,810 tons, supplied 64 percent of the domestic total; and Michigan, with 12,472,448 tons or 17 percent, was the second largest producer. These two States and mines in northern Wisconsin (1,261,467 tons or 2 percent) constitute the Lake Superior region, which supplied 83 percent of the domestic total. Of the 1940 output, about two-thirds came from open-pit operations compared with about three-fifths in 1939. Shipments of iron ore likewise were much larger in 1940, amounting to 75,198,084 gross tons—an increase of 37 percent over 1939 and of 12 percent over the 1925–29 average. The greater part of the iron ore mined in the United States is employed in the manufacture of iron and steel, but 54,627 tons of domestic ore were shipped in 1940 for other uses, as follows: Cement, 30,689 tons; paint, 8,912 tons; ferromagnesite, 3,592 tons; flux at nonferrous smelters, 3,863 tons; and other industries, 7,571 tons.

The quantities of iron ore in the following tables include ore that was beneficiated—that is, treated in any way—as well as ore that did

Iron ore mined in the United States in 1940, by States and varieties, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	Number of active mines	Hematite	Brown ore	Magnetite	Carbonate	Total
Alabama	[1] 51	6,544,446	771,681			7,316,127
California	2		(3)	[2] 1,071		1,071
Georgia	[1] 14	7,163	94,123			101,286
Michigan	40	12,472,448				12,472,448
Minnesota	79	47,736,810				47,736,810
Mississippi	1		50			50
Missouri	[1] 14	13,978	39,660			53,638
New Jersey	4			659,425		659,425
New York	4	(3)		[3] 2,899,986	513	2,900,499
Pennsylvania	2					
South Dakota	1		640			640
Tennessee	3	169	23,018			23,187
Virginia	3					
Texas	1		5,453			5,453
Oklahoma	2					
Utah	2			326,500		326,500
Washington	3	1,444		3,942		5,386
Wisconsin	3	1,262,065				1,262,065
Wyoming	1	831,314				831,314
Total: 1940	[1] 230	[3] 68,869,837	[2] 934,625	[2 3] 3,890,924	513	73,695,899
1939	[1 4] 209	[3 5] 47,756,770	[4] 596,733	[3 5] 3,377,764	463	[4] 51,731,730

[1] Excludes an undetermined number of small pits. Output of these pits included in tonnage given.
[2] Small quantity of brown ore included with magnetite.
[3] Small quantity of hematite included with magnetite.
[4] Revised figure.
[5] Small quantity of magnetite included with hematite.

[2] This figure does not include an undetermined number of small operations whose aggregate output is only a fraction of 1 percent of the total.

not require treatment. Although included in the figures on production, the iron ore sold for the manufacture of paint—8,912 tons in 1940 valued at $45,578 ($5.11 a ton) compared with 12,235 tons in 1939 valued at $66,817 ($5.46 a ton)—is not included in shipments from mines. The output of manganiferous ore that contained 5 to 35 percent manganese also is not included; 1,136,547 tons (valued at $3,348,042) were shipped in 1940 compared with 709,247 tons (valued at $2,148,321) in 1939. Moreover, the statistics do not include iron sinter recovered from the roasting of domestic pyrite concentrates in Tennessee.

Quantity and tenor of iron ore mined in the United States, 1939–40, by States and mining methods

State	1939				1940			
	Open pit (gross tons)	Underground (gross tons)	Total		Open pit (gross tons)	Underground (gross tons)	Total	
			Gross tons	Iron content, natural (percent)			Gross tons	Iron content, natural (percent)
Alabama	533,665	5,426,842	5,960,507	36.42	837,488	6,478,639	7,316,127	36.43
California	17,173		17,173	56.40	1,071		1,071	63.03
Georgia	26,333		26,333	47.91	100,641	645	101,286	47.14
Michigan	1,246,550	7,912,672	9,159,222	51.68	1,505,812	10,966,636	12,472,448	52.03
Minnesota	27,639,063	3,908,638	31,547,701	52.43	43,560,321	4,176,489	47,736,810	52.36
Mississippi					50		50	40.90
Missouri	37,989	1,250	39,239	52.51	53,238	400	53,638	51.66
New Jersey		399,289	399,289	63.32		659,425	659,425	62.35
New York	[1] 2,713,604	(1)	2,713,604	66.85	[1] 2,900,499	(1)	2,900,499	66.56
Pennsylvania				40.15				39.73
Tennessee	[2] 34,941		[2] 34,941	46.41	23,187		23,187	47.24
Virginia				53.28				54.32
Texas				51.32	5,453		5,453	51.50
Oklahoma								45.02
Utah	262,087		262,087	53.18	326,500		326,500	54.97
Washington	8,326	2,431	10,757	44.48	3,942	1,444	5,386	65.00
Wisconsin		972,685	972,685	53.10		1,262,065	1,262,065	53.35
South Dakota	300		300	53.22	640		640	51.03
Wyoming	231,966	355,926	587,892		272,467	558,847	831,314	
	[1,2] 32,751,997	[1] 18,979,733	[2] 51,731,730	50.28	[1] 49,591,309	[1] 24,104,590	73,695,899	50.64

[1] Some underground included with open pit.
[2] Revised figures.

Iron ore mined in the United States, by mining districts and varieties in 1940, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

District	Hematite	Brown ore	Magnetite	Carbonate	Total
Lake Superior [1]	61,470,725				61,470,725
Birmingham	6,541,074	349,119			6,890,193
Chattanooga	10,704	239,715			250,419
Adirondack and Cornwall			[1] 2,899,986		[2] 2,899,986
Northern New Jersey			659,425		659,425
Other districts	[2,3] 847,334	[4] 345,791	[3,4] 331,513	513	[2] 1,525,151
	[2,3] 68,869,837	[4] 934,625	[2,3,4] 3,890,924	513	73,695,899

[1] Includes only those mines in Wisconsin that are in the true Lake Superior district.
[2] Small quantity of hematite from "Other districts" included with magnetite from Adirondack and Cornwall districts.
[3] Small quantity of magnetite included with hematite.
[4] Small quantity of brown ore included with magnetite.

Iron ore shipped from mines in the United States, 1939–40, by States

[Exclusive of ore containing 5 percent or more manganese and ore sold for paint]

State	1939		1940	
	Gross tons	Value	Gross tons	Value
Alabama	5,985,208	$9,971,024	7,330,412	$12,606,369
California	17,173	(1)	1,071	(1)
Georgia	25,846	51,078	100,342	182,613
Michigan	11,238,605	37,026,665	13,751,970	40,474,951
Minnesota	32,370,241	97,113,591	47,904,137	118,947,968
Mississippi			50	38
Missouri	36,638	53,839	50,217	123,234
New Jersey	394,709	1,865,037	693,998	3,328,467
New York } Pennsylvania }	2,693,856	7,403,750	2,942,948	8,172,955
Tennessee } Virginia }	[2] 30,270	(1)	23,038	(1)
Texas } Oklahoma }			8,665	(1)
Utah	262,087	(1)	326,500	(1)
Washington	10,747	44,188	5,582	(1)
Wisconsin	1,173,828	3,526,980	1,227,840	3,290,389
Wyoming	587,892	(1)	831,314	(1)
Undistributed		[2 3] 1,481,544		[3] 1,959,815
	[2] 54,827,100	[2] 158,537,696	75,198,084	189,086,799

[1] Included under "Undistributed."
[2] Revised figures.
[3] Includes value for States entered as "1."

Principal mines.—The importance of large mining units in the iron-mining industry is shown by the fact that 15 yielding more than 1,000,000 tons each produced over half of the entire output in 1940. In years of heavy demand this situation is more pronounced; thus concentration of production was considerably greater in 1940 than in 1939, when 11 mines yielding more than a million tons each furnished somewhat less than half the smaller output for that year. Of the 15 million-ton producers in 1940, 11 were in Minnesota (all on the Mesabi range), 2 in Alabama, and 1 each in Pennsylvania and Wisconsin. Of the 15 principal producers in 1940, 9 were open pits, 3 were operated by underground methods, and 3 were combinations. Except for 1 mine that produced magnetite, all the principal mines produced hematite.

Iron-ore mines of the United States in 1940, by size of output

Name of mine	State	Nearest town	Range or district	Mining method	Gross tons
Hull-Rust-Burt-Sellers group.	Minnesota	Hibbing	Mesabi	Open pit	10,254,416
Mahoning	do	do	do	do	5,177,201
Missabe Mountain	do	Virginia	do	do	4,330,739
Red Mountain group	Alabama	Bessemer	Birmingham	Underground	3,857,417
Hill Annex	Minnesota	Calumet	Mesabi	Open pit	2,991,068
Adams-Spruce group	do	Eveleth	do	Combination	1,960,489
Morris	do	Hibbing	do	do	1,667,328
Frazer	do	Chisholm	do	Open pit	1,566,078
Woodward No. 3	Alabama	Bessemer	Birmingham	Underground	1,175,837
Minnewas	Minnesota	Virginia	Mesabi	Open pit	1,088,635
Grant	do	Buhl	do	do	1,064,000
Hill-Trumbull	do	Marble	do	do	1,055,310
Biwabik	do	Biwabik	do	do	1,019,851
Montreal	Wisconsin	Montreal	Gogebic	Underground	1,015,463
Negaunee	Michigan	Negaunee	Marquette	do	928,580
Sunrise	Wyoming	Sunrise	Hartville	Combination	831,314
Arcturus	Minnesota	Marble	Mesabi	Open pit	808,149
Morrison (Lewis)	do	Coleraine	do	do	799,606

Iron-ore mines of the United States in 1940, by size of output—Continued

Name of mine	State	Nearest town	Range or district	Mining method	Gross tons
Maas	Michigan	Negaunee	Marquette	Underground	734,054
Hartley-Burt	Minnesota	Chisholm	Mesabi	Open pit	729,414
Raimund Nos. 1 and 2.	Alabama	Bessemer	Birmingham	do	722,870
Mesabi Chief	Minnesota	Nashwauk	Mesabi	do	722,200
Plymouth	Michigan	Wakefield	Gogebic	do	706,658
Corsica	Minnesota	Elcor	Mesabi	do	679,358
Penn group	Michigan	Vulcan	Menominee	Underground	675,604
Anvil-Palms-Keweenaw.	do	Bessemer	Gogebic	do	638,053
Bennett	Minnesota	Keewatin	Mesabi	Combination	622,137
Susquehanna	do	Hibbing	do	Open pit	606,628
Scranton	do	do	do	do	587,010
Cliffs Shaft	Michigan	Ishpeming	Marquette	Underground	582,559
Sloss Nos. 1 and 2	Alabama	Bessemer	Birmingham	do	582,478
Penokee	Michigan	Ironwood	Gogebic	do	574,000
Godfrey	Minnesota	Chisholm	Mesabi	do	566,753
Sunday Lake	Michigan	Wakefield	Gogebic	do	563,797
Webb	Minnesota	Hibbing	Mesabi	Combination	563,153
Pioneer	do	Ely	Vermilion	Underground	547,734
Newport	Michigan	Ironwood	Gogebic	do	542,064
Albany	Minnesota	Hibbing	Mesabi	Open pit	524,742
Athens	Michigan	Negaunee	Marquette	Underground	515,940
Lloyd	do	Ishpeming	do	do	512,385
Eureka	do	Ramsay	Gogebic	do	509,678
Output of 41 [1] mines producing more than 500,000 tons each					[1] 55,600,750
Output of 8 [1] mines producing between 400,000 and 500,000 tons each					[1] 5,393,144
Output of 7 mines producing between 300,000 and 400,000 tons each					2,273,228
Output of 16 mines producing between 200,000 and 300,000 tons each					4,195,249
Output of 27 mines producing between 100,000 and 200,000 tons each					3,988,437
Output of 19 mines producing between 50,000 and 100,000 tons each					1,293,851
Output of 112 [2] mines producing less than 50,000 tons each					951,240
Grand total of United States (230 [2] mines)					73,695,899

[1] Output of 2 mines producing more than 500,000 tons included with mines producing between 400,000 and 500,000 tons each.
[2] Excludes an undetermined number of small pits. The output of these pits is included in the tonnage given.

Beneficiation.—Beneficiation of iron ore was reported at 70 mines in 8 States compared with 52 mines in 9 States in 1939. At many mines, the ore is crushed and screened to improve its structure, but ore so improved is not included in the statistics on beneficiated ore. Some iron ore is recovered in the form of dust from blast furnaces; data on ore so recovered, however, have been accounted for previously in shipments from mines.

Beneficiated ore shipped from domestic mines in 1940 increased 37 percent over 1939 and comprised 17 percent of the total shipments both in 1939 and 1940.

Beneficiated iron ore shipped from mines in the United States, 1939–40

[Exclusive of ore containing 5 percent or more managanese and of ore sold for paint]

State	Variety	1939		1940	
		Gross tons	Value	Gross tons	Value
Alabama	Brown ore	471,054	$995,860	750,131	$1,792,584
Georgia	do	11,840	21,312	41,015	63,353
Minnesota	Hematite	6,658,596	18,082,918	9,353,270	23,839,368
New Jersey	Magnetite	321,037	1,438,902	604,249	2,817,541
New York Pennsylvania	do do	1,933,404	5,869,653	2,149,197	8,569,580
Tennessee Texas	Brown ore do	[1] 29,878 (with California)	[1] 79,206 (with California)	27,879	91,164
California	Magnetite			-----	-----
		[1] 9,425,809	[1] 26,487,851	12,925,741	37,173,590

[1] Revised figures.

The quantity of crude ore beneficiated in the Lake Superior district (all in Minnesota) in 1940 totaled 14,547,504 gross tons and the beneficiated ore recovered 9,439,921 tons—a ratio of 1.541:1. In 1939 the crude ore treated totaled 10,194,506 tons and the beneficiated ore recovered therefrom 6,170,779 tons—a ratio of 1.652:1. Most of the concentration in this district is done by washing, but a few plants are equipped with jigs, and two plants sinter ore after washing. Processes have been described by Zappfe and Hunner.[3] Most of the concentrated ore shipped from Minnesota is obtained in the treatment of wash ores from the western end of the Mesabi range, which yield 65 percent concentrates and 35 percent tailings containing about 22 percent iron.

In April 1940 the Evergreen Mines Co. put into operation at the Chandler mine at Ely, Minn., a concentrator designed to beneficiate Vermilion ores.[4] This concentrator is of unusual interest because it is the first beneficiation plant erected on the Vermilion iron range. The metallurgical process consists of washing the ore and screening it into three products—a plus-2½-inch material, which is hand-picked to produce open-hearth lump; a minus-2½-inch, plus-⅞-inch material, which is crushed to pass ⅞-inch; and a minus-⅞-inch material. This crushed 2½-inch material, combined with the original minus-⅞-inch material, is all handled through three 3-cell Wood's jigs, which can be regulated to make a wide range of products from a material suitable for open-hearth charge ore, analyzing 62 percent (natural) iron, to relatively lean material running 48 percent (natural) iron. Whether the concentrator has any application on low-grade ore of the Ely district will not be known until the plant has been operated on this type of material.

Holt [5] has described in detail the method and results of heavy fluid concentration at the Harrison concentrator of Butler Bros. at Cooley, Minn., using 15-percent ferrosilicon as a medium. During the summer of 1937, a commercial-size unit was built at the Merritt plant at Ironton, Minn., following experimental work at the University of Minnesota during the winter of 1936 to 1937. Definite tests as to suspension qualities were made on crushed steel and ferrosilicon in the early fall of 1937 by Butler Bros. staff in conjunction with Henry Wade of the Minnesota Mines Experimental Station. During the ensuing test work various shapes of cones were used in small laboratory models, and the inverted-top type was found to be best of several tried.

A 3-foot-diameter cone of this type, with complete magnetic recovery flow sheet, was used at the experimental station, followed by a 4-foot-diameter cone unit with a complete magnetic recovery flow sheet installed at the Patrick plant in the summer of 1938.

This 4-foot cone treated tonnages up to 40 gross tons feed an hour and operated throughout the shipping season of 1938. As a result of this pilot unit, two cones 7½ feet in diameter were installed in the Harrison plant in 1939, capable of treating over 350 gross tons an hour. These cones operated steadily during the shipping season, except for time spent in remodeling the units to remove unsatisfactory features. These units replaced a battery of 60 coarse jig cells.

[3] Zappfe, Carl, and Hunner, E. E., Preparation for Market Requirements, Shipment, and Reduction: Lake Superior Iron Ores, chap. 6, Lake Superior Iron Ore Assoc., Cleveland, 1938, pp. 77–84.
[4] Skillings' Mining Review, Duluth, Minn., vol. 29, No. 6, June 1, 1940, pp. 1–2.
[5] Holt, Grover J., Development of Sink-and-float or Heavy Fluid Concentration on the Minnesota Iron Ranges: Mining Cong. Jour., September 1940, pp. 25–29.

A medium of 15-percent ferrosilicon was found to be most economical from the first-cost standpoint. For specific purposes, however, other alloys may be used. The particle size of the ferrosilicon used is preferably minus-65-mesh, with about 96 percent minus-100-mesh and about 65 percent minus-200-mesh. In practice, the material is mixed with water to give the desired gravity and is changed at will by regulation of the water content of the pulp.

A true specific-gravity separation has been the aim of development in all forms of jigs, tables, and other gravity-concentration equipment. The heavy-fluid concentration process does not depend on the laws of either free- or hindered-settling ratios of mineral and gangue. Other methods depending on these laws are found to be affected by the size and shape of particles, as well as by ratios of concentration, which require adjustment even on ores similar in structure.

Beneficiated ore in 1940 comprised the same proportion (17 percent) of the total shipments as in 1939 and in 1937, a year of high production. As pressure for production increases, a relatively larger proportion of the total comes from direct-shipping ores. Furthermore, in 1940 the immediate need for a high tonnage late in the year also favored production of the more easily obtainable direct-shipping ores. Data for recent years are shown in the following table, and corresponding statistics for 1914 (the first year for which they were gathered) to 1929 are given in Mineral Resources, 1930, part 1. Data for 1930 to 1934, inclusive, are given in Minerals Yearbook, 1935, and for 1932 to 1936, inclusive, in Minerals Yearbook, 1937.

Iron ore shipped from mines in the United States, 1925–29 (average) and 1936–40, in gross tons, and percentage of beneficiated ore compared to the total shipped

[Exclusive of ore containing 5 percent or more manganese and of ore sold for paint]

Year	Beneficiated	Total	Proportion of beneficiated to total (percent)	Year	Beneficiated	Total	Proportion of beneficiated to total (percent)
1925–29 (av.)	8,653,590	66,697,126	13.0	1938	4,836,435	26,430,910	18.3
1936	9,658,699	51,465,648	18.8	1939	[1] 9,425,809	[1] 54,827,100	17.2
1937	12,350,136	72,347,785	17.1	1940	12,925,741	75,198,084	17.2

[1] Revised figures.

Average value.—The average value per gross ton of iron ore at the mines was $2.51 in 1940 compared with $2.89 in 1939.

The table that follows gives the average value at the mines of the different classes of iron ore in 1939–40 for each of the producing States or groups of States, except where there are fewer than three shippers of a certain variety of ore in a State and permission was not given to publish the value. These data are taken directly from statements of producers and probably represent the commercial selling prices only approximately, as not all reports are comparable. Some evidently include mining costs only; others contain, in addition, the cost of selling and insuring the ore; others include an allowance for a sinking fund; and still others comprise only costs charged against blast furnaces. None of the reports, however, is supposed to include freight charges.

Average value per gross ton of iron ore at mines in the United States, 1939–40

[Exclusive of ore containing 5 percent or more manganese and of ore sold for paint]

State	Hematite		Brown ore		Magnetite	
	1939	1940	1939	1940	1939	1940
Alabama	$1.62	$1.65	$2.16	$2.33		
Georgia	2.53	2.24	1.74	1.79	(1)	
Michigan	3.29	2.94				
Minnesota	3.00	2.48				
Missouri	2.14	2.32	(1)	2.50		
New Jersey					$4.73	$4.80
New York } Pennsylvania }					2.75	2.78
Wisconsin	3.00	2.68				
Other States [2]	1.13	1.11	[3] 2.77	3.13	2.83	2.82
	2.89	2.48	[3] 2.14	2.31	2.99	3.13

[1] Less than 3 producers; permission to publish not given, therefore value may not be shown.
[2] 1939: California, Tennessee, Texas, Utah, Virginia, Washington, and Wyoming; 1940: California, Mississippi, Oklahoma, Tennessee, Texas, Utah, Virginia, Washington, and Wyoming.
[3] Revised figures.

Consumption.—The production of 46,203,967 net tons of pig iron in 1940 required 80,348,923 net tons of iron and manganiferous iron ores, 5,506,967 tons of mill cinder and roll scale, and 793,344 tons of purchased scrap, an average of 1.875 tons of metalliferous materials (exclusive of home scrap and flue dust) per ton of iron made.

The greater part of the iron ore used in Alabama furnaces in 1940 was hematite, chiefly from mines in Jefferson County, but some hematite came from Etowah and Cherokee Counties. Considerable brown ore, iron sinter, pyrite ash, and imported iron ore and manganese ore and small quantities of domestic manganese-bearing ores were used. The brown ore originated chiefly in mines of the Birmingham and Russellville districts, Alabama. In addition to iron sinter (sintered pyrite ash) from Tennessee, considerable pyrite ash was shipped to Birmingham in 1940 from acid plants in other Southern States. The pyrite from which this ash was made was of both domestic and foreign origin. The domestic manganese-bearing ores come chiefly from Alabama, Arkansas, Georgia, and Tennessee. Imported manganese-bearing ores come from Cuba. In 1940, Alabama furnaces consumed an average of 2.454 tons of ore in making 1 ton of pig iron—the highest average for any State.

Maryland furnaces consumed considerable domestic ore in 1940, in addition to ores from Africa, Asia, Brazil, Chile, and Cuba. These furnaces used an average of 1.572 tons of ore per ton of pig iron; however, they used proportionately more cinder, scale, and scrap than any other State.

Illinois, Indiana, Kentucky, Michigan, Minnesota, and West Virginia blast furnaces handled Lake Superior iron ore and manganiferous iron ore almost exclusively. Kentucky furnaces had the lowest consumption of metal-bearing material per ton of iron.

In New York the furnaces in the Buffalo district used ore chiefly from the Lake Superior district, as well as considerable magnetite from New York, and the furnace at Troy consumed magnetite from the Chateaugay mine at Lyon Mountain, N. Y.

Blast furnaces in Ohio consumed considerable magnetite from New York and hematite and brown ore from Missouri, in addition to ore from the Lake Superior district.

Virtually all the ore consumed in western Pennsylvania furnaces comes from the Lake Superior district. Those in the eastern part of the State used some Lake ore; magnetite ores from Pennsylvania, New Jersey, and New York; and some ore from Africa, Australia, Brazil, Chile, Cuba, Spain, Sweden, and U. S. S. R.

The Pueblo (Colo.) blast furnaces handled hematite from the Sunrise mine in Wyoming and manganese-bearing ores, chiefly from Colorado and New Mexico.

The Provo (Utah) furnace treated chiefly semialtered magnetite from the Iron Mountain mine near Cedar City, Utah, manganese tailings from Montana, and manganiferous ore from Utah.

The Tennessee furnace used chiefly Tennessee brown ore and iron sinter.

Iron ore and other metallic materials consumed and pig iron produced in 1940, by States, in net tons

State	Metalliferous materials consumed				Pig iron produced, exclusive of ferro-alloys	Materials consumed per ton of iron made		
	Iron and manganiferous iron ores		Cinder, scale, and purchased scrap	Total		Ores	Cinder, scale, and purchased scrap	Total
	Domestic	Foreign						
Alabama	8,387,785	10,936	141,548	8,540,269	3,423,296	2.454	0.041	2.495
Illinois	7,047,301		419,075	7,466,376	4,047,376	1.741	.104	1.845
Indiana	9,375,760		689,257	10,065,017	5,337,935	1.757	.129	1.886
Kentucky	451,935		40,939	492,874	290,514	1.556	.141	1.697
Maryland	1,529,104	2,154,406	511,293	4,194,803	2,342,519	1.572	.219	1.791
Michigan	2,231,326	75,686	108,453	2,415,465	1,349,775	1.709	.081	1.790
Minnesota	499,895		46,295	546,190	277,069	1.804	.167	1.971
New York	5,167,096	25,479	187,655	5,380,230	3,009,567	1.725	.063	1.788
Ohio	16,930,844		1,460,918	18,391,762	10,094,448	1.677	.145	1.822
Pennsylvania	23,255,895	149,493	2,567,613	25,973,001	14,294,453	1.637	.180	1.817
West Virginia	1,551,371		92,600	1,643,971	921,812	1.683	.100	1.783
Undistributed [1]	1,477,496	27,115	34,665	1,539,276	815,203	1.846	.042	1.888
	77,905,808	2,443,115	6,300,311	86,649,234	46,203,967	1.739	.136	1.875

[1] Includes Colorado, Iowa, Massachusetts, Tennessee, Utah, and Virginia.

Foreign iron and manganiferous iron ore consumed in the manufacture of pig iron in the United States, 1939–40, by sources of ore, in net tons

Source of ore	1939	1940	Source of ore	1939	1940
Africa	52,734	18,261	Norway	304	4,591
Australia	61,534	13,755	Palestine	1,269	16,509
Brazil	14,467	15,912	Spain		8,567
Canada		101,165	Sweden	8,644	586
Chile	2,062,813	1,920,525	U. S. S. R.	60	151
Cuba	305,012	324,643	Undistributed	4,835	
Newfoundland	21,816	18,450			
				2,533,488	2,443,115

Stocks at mines.—During 1940 stocks at the mines declined 24 percent from 1939 and at the end of the year were the lowest since 1907.

Stocks of iron ore at mines, December 31, 1939–40, by States, in gross tons

State	1939	1940	State	1939	1940
Alabama	2,805	15,485	Pennsylvania	95,492	52,753
Michigan	3,384,077	2,302,980	Texas	[1] 3,850	638
Minnesota	986,467	952,813	Virginia	3,126	3,086
Missouri	2,207	2,375	Washington	265	69
New Jersey	99,674	65,550	Wisconsin	158,939	197,673
New York	13,255	20,120			
North Carolina	200	200		[1] 4,750,357	3,613,742

[1] Revised figures.

Foreign trade.—Imports of iron ore increased 3 percent over 1939. Chile continued to be the chief source of imports into this country, furnishing 68 percent of the 1940 total; Canada and Cuba supplied 9 percent each, and Sweden 8 percent. In addition to the figures in the following table, 3,908 tons of dross or pyrite ash were imported from Canada in 1940.

Iron ore imported for consumption in the United States, 1938–40, by countries, in gross tons

Country	1938		1939		1940	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Algeria	7,480	$32,170	7,000	$25,167		
Australia	82,827	138,614	16,520	30,184		
Brazil	9,650	44,170	16,700	68,267	99,165	$460,669
British West Africa (other)			11,540	55,677	7,190	32,775
Canada	875	26,441	23,275	129,251	217,938	1,050,051
Chile	1,577,750	2,853,060	1,586,625	2,824,252	1,682,600	3,028,699
Cuba	148,701	357,730	269,866	596,318	219,653	436,515
Iran (Persia)	5,648	90,969	110	5,207	3,650	85,733
Mexico			1,722	3,319	3,590	7,206
Newfoundland and Labrador			14,450	41,183	23,320	63,698
Norway	75,625	394,705	199,966	845,355		
Philippine Islands			22	230		
Spain					11,010	55,793
Sweden	213,616	1,339,393	264,353	1,227,864	210,804	968,925
United Kingdom	228	10,131	356	13,214	393	14,290
Yugoslavia	55	812			10	160
Other countries			10	22	3	127
	2,122,455	5,288,195	2,412,515	5,865,510	2,479,326	6,204,641

Exports of iron ore from the United States totaled 1,386,304 gross tons valued at $4,624,555 ($3.34 a ton) in 1940 compared with 1,057,304 gross tons valued at $3,578,086 ($3.38 a ton) in 1939. Of the 1940 total, 1,386,097 tons went to Canada.

Mining in Cuba.—Shipments of iron ore from Cuba to the United States decreased 25 percent in 1940 from 1939. The 1940 total of 210,068 gross tons included 91,120 tons of hematite, carrying (dried) 54.37 percent iron, and 85,924 tons of siliceous ore, carrying (dried) 29.84 percent iron—from the Daiquiri-Juragua mines on the southern coast; and 32,463 tons of nodulized brown ore, carrying (dried) 55.09 percent iron, and 561 tons of crude ore, averaging (dried) 47.68 percent iron—from the Mayari district near the northern coast. The Mayari mine was nonproductive in 1940.

The total stock of ore reported on hand was 111,797 gross tons at the end of the year compared with 164,059 tons at the end of 1939.

The following table shows shipments of iron ore from Cuba since the mines were opened in 1884. The statistics on shipments of Cuban iron ore are collected by the Bureau of Mines.

Iron ore shipped from mines in the Province of Oriente, Cuba, 1884–1940, 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
1884–1938	[1] 21,925,710	20,438	3,858,464	41,241	903,103	26,748,956
1939	236,414		42,719			279,133
1940	177,044		33,024			210,068
	22,339,168	20,438	3,934,207	41,241	903,103	27,238,157

[1] Of this quantity, 5,932 tons were sent to Pictou, Nova Scotia, and 64,228 tons to other ports outside of the United States.

REVIEW OF LAKE SUPERIOR DISTRICT

Production and shipments.—Activities in the Lake Superior district (the principal producing district) were at a greatly increased rate throughout the year. The season began with much larger shipments than in 1939; and as the output of iron and steel increased, shipments of iron ore were accelerated. Over three-fourths (83 percent in 1940) of the domestic output comes from the Lake Superior region, where schedules were held at high levels, and available lake transportation capacity was pressed into service. Monthly shipments down the Lakes, the main artery of iron ore movement, were exceptionally large. As much of the Lake ore comes from the Mesabi range (74 percent in 1940), where open-pit operations predominate, great flexibility in output is attained, and large increases are possible on short notice. Although the shipping season was not exceptionally long, the increased demand for ore permitted a lake movement of 63,352,768 tons of iron ore and manganiferous iron ore compared with 45,002,085 tons in 1939. More ore could have moved if the season had been longer, but the tonnage shipped was sufficient to raise combined stocks at furnaces and lower Lake ports at the end of the season above those on hand at the end of the 1939 season, notwithstanding the fact that consumption was at a much higher rate. Total shipments of ore by water and all-rail from the Lake Superior district totaled 63,949,536 gross tons (62,884,545 gross tons of iron ore and 1,064,991 of manganese ores containing 5 percent or more manganese) compared with 44,849,573 tons (44,197,610 tons of iron ore and 651,963 of manganese-bearing ore containing 5 percent or more manganese) in 1939. The iron-ore-shipment figures given above include 598 tons of paint ore in 1940 and 872 in 1939.

Production in the Lake Superior region in 1940 increased 47 percent over 1939 but still was slightly below the record. The district furnished 83 percent of the United States total compared with 81 percent in 1939 and thereby continued to gain ground lost to other districts in recent years. Several ranges contributed to the district total. The Mesabi was the largest producer, furnishing 74 percent of the district and 62 percent of the United States total. The output, by ranges, is listed in the following table. After 1905 the figures do not include manganiferous iron ore containing 5 percent or more manganese.

Iron ore mined in the Lake Superior district, 1854–1940, by ranges, in gross tons

[Exclusive after 1905 of ore containing 5 percent or more manganese]

Year	Marquette	Menominee	Gogebic	Vermilion	Mesabi	Cuyuna	Total
1854–1938	197, 627, 627	182, 848, 860	209, 478, 721	65, 735, 066	1, 043, 720, 468	25, 430, 953	1, 724, 841, 695
1939	3, 906, 195	1, 921, 704	4, 304, 008	1, 400, 341	29, 522, 227	625, 133	41, 679, 608
1940	5, 284, 194	2, 679, 364	5, 770, 357	1, 531, 963	45, 483, 450	721, 397	61, 470, 725
	206, 818, 016	187, 449, 928	219, 553, 086	68, 667, 370	1, 118, 726, 145	26, 777, 483	1, 827, 992, 028

In 1940, 73 percent of the ore produced on the iron ranges of the Lake Superior district came from open-pit mines. A large part of the open-pit production originates in the Mesabi range, which in 1940 supplied 95 percent of the open-pit ore mined in the district. There is no open-pit mining in northern Wisconsin and relatively little in Michigan. In addition to the output on the Mesabi range, there is some open-pit production in Minnesota on the Cuyuna and Vermilion ranges.

Recent years have witnessed significant changes in open-cut mining practice in the iron country.[6] The use of small tractor shovels, tractor wagons, scrapers, scraper hoists, heavy trucks, and conveyors continued to expand in 1940. Beginning the season in May, the Canisteo mine of the Canisteo Mining Co. employed a new method of gathering by truck and delivering by conveyor belt, as compared with previous practice of both gathering and delivering by steam locomotive;[7] four or five 15-ton trucks haul from two shovels. A 600-ton-an-hour supply of crude ore is trucked to the pit pocket, and the haul averages 2,400 feet, with a maximum grade of 8 percent. The crude ore is dumped into the 100-ton pocket and carried by an 8-foot pan conveyor to a 4-inch grizzly. The grizzly undersize is fed through a chute direct to the 36-inch belt conveyor. The oversize falls onto a 5-foot pan conveyor, leading to a 40- by 42-inch primary jaw crusher. The large rock is scalped from the 5-foot pan conveyor and dropped into the rock chutes, from which it is hauled by truck to adjacent waste dumps. Oversize ore material is crushed to 4 inches in the primary crusher and fed through a chute to the 36-inch belt conveyor, where it falls upon a cushion of undersize. By means of the conveyor, it is delivered 1,000 feet on an 18° slope to the top of the washing plant; the ore then passes through the two transfer houses at the top of the mill and is dumped onto a 5- by 41-foot double-decked vibrating screen; the undersize goes directly to log washers. The oversize is carried on a 36-inch picking belt, from which additional rock is removed by hand-picking, to secondary cone crushers (which reduce the material to five-eighths inch); it is then fed into the log washers. The log product is passed over 4- by 6-foot vibrating screens, where it is deslimed, and delivered directly into the concentrate bin. The log

[6] Mosier, McHenry, and Gardner, E. D., Open-cut Metal Mining: Bureau of Mines Bull. 433, 1941, 176 pp.
Ridgway, Robert H., and Davis, H. W., Iron Ore, Pig Iron, Ferro-alloys, and Steel: Bureau of Mines Minerals Yearbook, 1939, pp. 547–548.
[7] Sterling, W. A., The Canisteo Open Pit Adopts Trucks and Conveyors: Eng. and Min. Jour., vol. 142. No. 5, May 1941, pp. 36–38.

tailings and the tailings from the desliming screens are carried to 17-foot Dorr bowl classifiers for further concentration. The classifier product is taken by 24-inch cross conveyors to the concentrate bin, where it is mixed with the log product and delivered directly into ore cars for shipment. The classifier tailings are carried through the tailings-disposal system to the settling basin. The operations at the Canisteo mine for the 1940 shipping season were completed early in October after yielding 478,339 tons of concentrates.

Transport by conveyor had been installed before the 1940 season at four other open-pit operations in the iron ranges—the La Rue, St. Paul, Spruce, and Judd mines.

Hubbell [8] has described the effect on a moderate-size open-cut iron mine of replacing locomotive haulage of ore with truck haulage, as illustrated by the Albany pit of Pickands, Mather & Co. during 1940.

In 1939, with railroad haulage, the trackage from the yards to the pit bottom totaled 11,400 feet, including six switch-backs and the main line. The average grade was 3.6 percent, compensated 0.04 percent for each degree of curvature. Three locomotives (20- by 24-inch) were required per shift and either two 75-ton-capacity cars or three 50-ton cars were handled per trip. A seventh switch-back was being developed when the change was made to truck haulage. With railroad haulage, ore shipments from this pit were 323,207 tons in 1939. With the truck installation, which was used throughout the 1940 season, shipments from the pit totaled 524,742 tons. The length of truck road from the ultimate pit bottom out to the dumping ramp is 5,200 feet. The grade of the main truck road is 8 percent, except on curves, where it is dropped to 6 percent; on the ore benches the grade varies; and the average grade from the ultimate bottom to the ramp is 7 percent. There are seven trucks in the fleet, each of 15 tons capacity.

Trucks and related equipment in considerable variety are also being used for cleaning up in the larger pits and elsewhere, in places where a small but worth-while tonnage of ore is so situated that larger shovels and cars cannot be put to work on it. Equipment recently noticed on such work included conventional rear-dump trucks, Athey crawler wagons, La Plant-Choate (and other) wheeled scrapers, and the Koehring Dumptor—a quick-dumping Diesel-driven unit designed for being shuttled back and forth, without turning, between loading and dumping points. A not-unusual combination in this clean-up work is a 1½-cubic-yard shovel and two trucks for a 700- to 800-foot haul. The advent of truck haulage has brought to the operators the need of knowing how to construct a good road out of a pit, one that is able to withstand the punishment inflicted by heavy trucks, loaded or unloaded. The portion of the road that is likely to be permanent must be especially well constructed. One operator (the E. W. Coons Co., of Hibbing, which is also in the contracting business) has built 1,200 feet of concrete ribbons 36 inches wide, at its nearby pit to facilitate the movement of its trucks out and their quick return.

Of interest is the extent to which road-maintenance equipment is being adapted to open-pit work; tractors (with and without the bull-dozer blade), road graders, and sprinklers are being introduced, in some instances calling for shop changes to permit servicing.

[8] Hubbell, A. H., Iron Country Jottings: Eng. and Min. Jour., vol. 142, No. 1, January 1941, pp. 37–39.

Shipments from the Michipicoten range in Ontario, Canada, continued in 1940. Although this output is not included in Bureau of Mines production figures, it enters the same commercial channels. The ore comes from the old Helen mine of the Algoma Steel Corporation, which in August 1939 began production from new open-pit operations and made shipments for the first time since 1922. A total of 361,394 tons of sinter, made from the carbonate ores, was shipped during the season, compared with 111,307 tons in 1939.

Analyses.—The following table, compiled by the Lake Superior Iron Ore Association, summarizes the average analyses of the total tonnages of all grades of ore shipped and shows the remarkable uniformity maintained during the past 5 years. This uniformity does not mean, of course, that the average grade of available Lake Superior ore is not declining. The grade of shipments has been maintained partly by beneficiation and partly by mixing ores from different deposits. The method of sampling and grading Lake Superior iron ores has been described by Bayer [9] and the method of classification and sampling by Murray.[10]

Average analyses of total tonnages (bill-of-lading weights) of all grades of iron ore from all ranges of Lake Superior district, 1936–40

Year	Gross tons	Iron (natural)	Phosphorus	Silica	Manganese	Moisture
		Percent	*Percent*	*Percent*	*Percent*	*Percent*
1936	44,745,754	51.45	0.091	8.62	0.81	10.92
1937	61,972,823	51.53	.091	8.27	.82	11.31
1938	19,353,497	51.90	.089	8.25	.81	10.13
1939	44,983,754	51.75	.085	8.27	.76	10.73
1940	63,308,413	52.09	.085	8.00	.77	10.93

Stocks at Lake Erie ports.—At the close of navigation in 1940, according to the Lake Superior Iron Ore Association, 4,786,643 gross tons were in stock at Lake Erie ports compared with 5,216,496 tons on the corresponding date in 1939. At the opening of navigation in May 1941, 1,935,069 tons were in stock at these ports—a decrease of 1,015,683 tons from the figure on May 1, 1940. Withdrawals from docks were therefore 2,851,574 tons during the winter of 1940–41.

Prices of Lake Superior ore.—The prices established April 17, 1940, for the four standard grades of Lake Superior ore were 50 cents a ton lower than the price maintained during 1937, 1938, and 1939 and 5 cents a ton lower than the price maintained from 1929 to 1936. Beginning April 17, 1940, the unit prices for base ore of the various grades quoted at Lake Erie ports were as follows: Old-range bessemer, 9.223 cents; Mesabi bessemer, 8.932 cents; old-range nonbessemer, 8.932 cents; and Mesabi nonbessemer, 8.641 cents. The prices that correspond to these unit prices are, respectively, \$4.75, \$4.60, \$4.60, and \$4.45 a gross ton. The base of the four standard grades for 1925–40 is an iron content of 51.5 percent natural. For the bessemer grades, the phosphorus content is 0.045 percent (dry), and for the nonbessemer grades the phosphorus content ranges from 0.045 to 0.18

[9] Bayer, E. P., Sampling and Grading Mesabi Iron Ore: Min. and Met., vol. 18, No. 372, December 1937, pp. 547–548.
Bayer, E. P., Grading Lake Superior Iron Ores: Eng. and Min. Jour., vol. 139, No. 3, March 1938, pp. 50–51.

[10] Murray, C. B., Classification and Sampling: Lake Superior Iron Ores, chap. 4, Lake Superior Iron Ore Assoc., Cleveland, 1938, pp. 69–72.

percent. Ores containing more than 0.18 percent phosphorus are classed as high-phosphorus ores, whereas those containing 18 percent or more silica are classed as siliceous ores.

Reserves.—Estimates of ore reserves for Minnesota, furnished by the Minnesota Tax Commission, and for Michigan, furnished by the Michigan Board of Tax Commissioners, are shown in the following tables. These estimates reveal decreases from 1939 of 7,219,612 gross tons in Minnesota and 7,831,796 tons in Michigan. Reserves in Wisconsin have been estimated recently at 5,500,000 tons.

Unmined iron-ore reserves in Minnesota, May 1, 1936–40, in gross tons

Range	1936	1937	1938	1939	1940
Mesabi	1,164,802,947	1,173,108,376	1,150,817,768	1,132,513,348	1,122,593,126
Vermilion	13,074,509	13,943,325	14,274,025	13,631,484	13,208,699
Cuyuna	63,066,428	61,922,739	60,690,596	61,902,885	65,026,280
	1,240,943,884	1,248,974,440	1,225,782,389	1,208,047,717	1,200,828,105

Iron-ore reserves in Michigan, January 1, 1937–41, in gross tons

Range	1937	1938	1939	1940	1941
Gogebic	42,757,025	40,706,291	40,456,002	37,160,900	31,603,731
Marquette	51,339,347	49,869,363	52,130,385	49,573,794	48,370,114
Menominee	59,936,572	58,031,692	57,168,510	56,922,733	55,851,786
	154,032,944	148,607,346	149,754,897	143,657,427	135,825,631

MINING BY STATES

Alabama.—Production of iron ore in Alabama during 1940 increased 23 percent over 1939 and was the largest in its history, exceeding the previous record, made in 1925, by 3 percent. About 89 percent of the 1940 production came from underground mines and the remainder from open-cuts. One mine used combination open-pit and underground methods. Hematite represented 89 percent of the 1940 total, and much of this red ore contained enough or nearly enough lime to be self-fluxing. The hematite is derived chiefly from underground mines on Red Mountain near Birmingham in Jefferson County, where, in 1940, Raimund Nos. 1 and 2, Red Mountain group (comprising the Muscoda, Wenonah, and Ishkooda groups), Ruffner, Sloss Nos. 1 and 2, Spaulding, and Woodward No. 3 mines were producers. Several smaller mines (open-pit and underground) in Etowah, Jefferson, and Cherokee Counties contributed to the total output of hematite ore. The hematite produced in 1940 averaged (natural) 35.22 percent iron, 0.16 percent manganese, 0.31 percent phosphorus, and 15.43 percent lime. The Red Mountain group, with 3,857,417 tons, was the fourth largest producer in the United States in 1940.

Limonite (brown ore) is mined from a number of widely scattered deposits in Alabama, but production is not nearly as large as that of red ore. In 1940, the output of brown ore comprised 11 percent of the Alabama total. Brown ores, however, are higher-grade and usually have been subjected to beneficiation, although some operations are rather crude. The brown ore mined in 1940 averaged (natural) 47 percent iron and 0.78 percent manganese. Brown ore is mined from open-cuts and was produced chiefly from the Tecumseh mine in Cherokee County, the Russellville and Parish mines in Franklin County, and the Martaban and Reno mines in Tuscaloosa County.

California.—Production in California in 1940 was small, and virtually all came from one mine in Inyo County. All of the ore was magnetite and averaged 63 percent iron.

Georgia.—Production of iron ore in Georgia increased 285 percent in 1940 over 1939, totaled 101,286 tons, and was the largest since 1924. The output from Georgia in 1940 comprised 94,123 tons of brown ore—chiefly from Bartow and Polk Counties—containing (natural) 35 to 60 percent iron and 0.14 to 2.40 percent manganese; and 7,163 tons of hematite—from Walker County—containing (natural) 46 to 50 percent iron and 0.16 percent manganese. Shipments of iron ore comprised 87,202 tons to blast furnaces, 13,140 tons to cement plants, and 944 tons to paint manufacturers.

Michigan.—Output from Michigan comes from three ranges—the Marquette, the Menominee, and the Gogebic. All ranges increased their production in 1940, the Marquette showing the largest gain in tonnage. Production in Michigan rose 36 percent in 1940 over 1939 and totaled 12,472,448 gross tons. Of the 1940 total, 88 percent came from underground mines; the Negaunee mine—an underground producer on the Marquette range—was the largest producer. The iron content (natural) of the ore mined in Michigan in 1940 averaged 52.03 percent compared with 51.68 percent in 1939.

Iron-ore reserves in Michigan at the end of 1940 totaled 135,825,631 gross tons—a decrease of 7,831,796 tons during the year.

A report of the iron-ore mines of Michigan for 1940, published by the Geological Survey Division of the Michigan Department of Conservation,[11] shows that the average number of men employed was 6,743 (5,818 in 1939), the average number of days worked 213 (206 in 1939), the average daily wage $7.48 ($7.07 in 1939), the average yearly earning $1,593.82 ($1,457.12 in 1939), and the average tons of ore mined per man per day 5.10 (6.63 in 1939).

The data in the following table on average per-ton costs of mining ore at underground mines and at siliceous open pits have been abstracted from statistics published in much greater detail by the Geological Survey Division of Michigan.

Average costs, per gross ton, of mining iron ore at underground mines and at siliceous open pits in Michigan in 1940

Item	Underground				Siliceous open pits
	Gogebic	Marquette	Dickinson and Iron	Total	
Cost of mining	$1.3829	$1.5555	$1.4986	$1.4827	$0.4740
Deferred mining cost	.1801	.0649	.1556	.1258	.0422
Taxes	.2380	.2187	.1646	.2127	.0430
General overhead	.1863	.2182	.1970	.2021	.0990
Transportation	1.6918	1.4172	1.5562	1.5481	1.4405
Marketing	.0660	.0912	.0744	.0790	.0826
Royalty	.3657	.2245	.2244	.2704	.0912
Interest on borrowed money	.0002	.0113	.0080	.0067	.0036
Total ore cost	4.1110	3.8015	3.8788	3.9275	2.2761
Lake Erie value per ton	4.7432	4.7252	4.4874	4.6757	2.2441
Gross ore profit [1]	.6322	.9237	.6086	.7482	-.0320

[1] This figure does not represent true profit, as much ore is sold below the Lake Erie price.

[11] Eddy, G. E., General Statistics Covering Costs and Production of Michigan Iron Mines: Michigan Dept. of Conservation, Geol. Survey Div., Lansing, 1941.

Minnesota.—Nearly a billion and a quarter gross tons (1,214,170,998, to be exact) of iron ore have been produced in Minnesota. In 1940, the output increased 51 percent over that in 1939 and was only 1.4 percent under the peak established in 1937. Three ranges contribute to Minnesota's production—the Cuyuna, the Mesabi, and the Vermilion. The Mesabi range supplies a large part of the Minnesota total and in 1940 produced 45,483,450 tons. The output from open-pit mines in 1940 furnished 91 percent of the total compared with 88 percent in 1939 and 77 percent in 1938. Of the 15 domestic mines producing more than 1 million tons each in 1940, 11 were in Minnesota; of these 9 were open pits, and 2 used combination open-pit and underground methods. Of the 79 mines in Minnesota active in 1940 (65 in 1939), 52 (45 in 1939) yielded more than 100,000 tons each. The iron content (natural) of the ore mined in 1940 averaged 52.36 percent compared with 52.43 percent in 1939.

According to the annual report of the mine inspector of St. Louis County, the average number of men employed in iron mines in St. Louis County was 5,547 in 1940 (4,589 in 1939), and the average daily wage was \$6.70 (\$6.61 in 1939) for 8 hours. In 1940, 2,728,306 cubic yards of overburden were removed compared with 3,098,991 in 1939.

According to the annual report of the mine inspector of Itasca County, the average number of men employed in iron mines was 3,047 in 1940 (2,567 in 1939), and the average daily wage was \$6.40 (\$6.08 in 1939) for 8 hours. In 1940, 4,395,650 cubic yards of overburden were removed compared with 4,555,471 in 1939.

Unmined iron-ore reserves in Minnesota on May 1, 1940, totaled 1,200,828,105 gross tons, a decrease of 7,219,612 tons from 1939.

Missouri.—An undetermined number of small mines and pits in Bollinger, Butler, Carter, Crawford, Dent, Iron, Madison, Miller, Phelps, St. Francois, Texas, Washington, and Wayne Counties supplied the iron-ore output of Missouri in 1940, which gained 37 percent over 1939. The ore, which averaged 51.66 percent iron, comprised both hematite and brown ore, was mined by open-pit and underground methods, and was shipped to paint and steel plants as well as to nonferrous smelters.

New Jersey.—The output of iron ore in New Jersey increased 65 percent in 1940 over 1939 and totaled 659,425 tons. The ore, all magnetite and all from underground operations, came from three mines in Morris County and one mine in Warren County in the northern part of the State. New Jersey ores are crushed and concentrated before shipment. Most of the concentration is done magnetically, although some nonmagnetic martite is recovered by gravity methods and some hand-sorting is practiced, principally to recover high-grade lump used in open-hearth steel furnaces. The concentrates produced in 1940 averaged (natural) 62.35 percent iron. The largest output came from the Scrub Oaks mine, which produced 806,634 gross tons of crude ore averaging 27.97 percent iron. Concentrates from this ore totaled 292,990 gross tons averaging 66.47 percent iron. Other producers were the Mt. Hope, Richard, and Washington mines.

New York.—The iron ore produced in New York during 1940 was chiefly magnetite from underground operations at the Harmony and Old Bed shafts in Essex County and the Chateaugay mine in Clinton County. Some hematite was mined for paint in Oneida and St. Lawrence Counties. Shipments from New York in 1940 included sinter, averaging 68 percent iron; lump, averaging 62 percent iron; and concentrates, averaging 67 percent iron.

The largest producer was the Republic Steel Corporation, which operates properties at Mineville near Port Henry and Lyon Mountain.

Oklahoma.—The iron ore accredited to Oklahoma in 1940 came from two operations in Johnson County. All was brown ore and was used in the manufacture of cement.

Pennsylvania.—Pennsylvania is the most important source of magnetite in the United States. The output comes from the Cornwall mine in Lebanon County, where the ore is extracted by both open-pit and underground methods. The ore is shipped to Lebanon, Pa., where it is concentrated magnetically. In addition, some carbonate ore for use in paint was mined in Carbon County in 1940. Hickok [12] has summarized the history of iron-ore production in Pennsylvania and the changing economic conditions that affect the industry and control its history; he also discussed the geological environment, mode of origin, and future reserves of the various types of iron ore.

South Dakota.—A small quantity (640 gross tons) of brown ore was mined at a property in Pennington County and shipped to paint plants in 1940.

Tennessee.—The output of iron ore (brown ore and hematite) in Tennessee in 1940 came from three mines (one each in Hickman, Lewis, and Hamilton Counties); it contained 47.24 percent iron and was shipped to blast-furnace and paint plants.

In addition, considerable sintered pyrite ash was made at the plants of the Tennessee Copper Co. in Ducktown Basin. This sinter, which contained 67.5 to 67.6 percent iron and 0.004 to 0.006 percent phosphorus in 1940, moved largely to the blast furnaces in the Birmingham district, where it was added to the blast-furnace burden. Such sinter is not included in iron-ore production or shipment figures for the United States.

Texas.—The output of iron ore from Texas in 1940 (all brown ore) came from one mine in Cass County.

Utah.—Two operators in Iron County supplied the Utah total in 1940. By far the larger output came from the Iron Mountain mine, while a relatively small quantity came from the Great Western. The ore, principally semialtered magnetite, contained (natural) 54.97 percent iron and moved largely to the blast furnace at Provo, Utah, although small quantities went to steel plants.

Virginia.—The output of iron ore in Virginia is small. The entire 1940 production was brown ore from Botetourt and Roanoke Counties and was shipped for use in the manufacture of hydrogen gas and pig iron.

Washington.—Two open-pit mines and one underground mine produced the total output of Washington in 1940. Two mines—the Big Iron mine in Stevens County and the Neutral in Okanogan County—yielded magnetite averaging (natural) about 68 percent iron, which was used in making ferromagnesite, and the Keystone mine in Pend Oreille County yielded hematite averaging (natural) 57 percent iron, which was used in the manufacture of cement.

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[12] Hickok, W. O., IV, Iron Ores of Pennsylvania: Pennsylvania Geol. Survey Bull. M 18-B, 4th ser. 1939, 21 pp.

Iron ore mined in the United States, 1939–40, by States and counties

[Exclusive of ore containing 5 percent or more manganese]

State and county	1939 Active mines	1939 Gross tons	1940 Active mines	1940 Gross tons
Alabama:				
Bibb and Tuscaloosa	3	238,708	4	312,651
Blount	2	40,374	3	30,016
Butler	-----	-----	3	25,765
Crenshaw	2	20,082		
Conecuh			-----	-----
Calhoun	9	34,107	[1] 4	22,557
Cherokee	12	27,186	[1] 10	54,411
Chilton	2	4,651	2	5,982
Cleburne	-----	-----	1	24,790
Colbert	-----	-----	1	48
Coosa	1	1,631	-----	-----
Etowah	1	509	1	2,249
Franklin	2	120,183	[1] 3	235,120
Jefferson	8	5,443,372	11	6,541,407
Lamar	2	494	[1] 1	317
Marshall	1	83	1	609
Pike	1	3,316	2	15,720
St. Clair	6	1,987	-----	-----
Shelby	1	7,583	1	137
Talladega	5	16,241	[1] 3	44,348
	58	5,960,507	[1] 51	7,316,127
California:				
San Bernardino	1		-----	-----
Inyo	2	17,173	2	1,071
Santa Cruz	1		-----	-----
	4	17,173	2	1,071
Georgia:				
Bartow	3	18,129	4	27,262
Chatooga	-----	-----	1	84
Dade	1	42	-----	-----
Floyd	-----	-----	1	89
Haralson	1	247	-----	-----
Polk	1	90	[1] 4	66,688
Walker	4	7,825	4	7,163
	10	26,333	[1] 14	101,286
Michigan:				
Dickinson	3	428,454	3	764,395
Gogebic	9	3,331,323	10	4,508,890
Iron	10	1,493,250	13	1,914,969
Marquette	14	3,906,195	14	5,284,194
	36	9,159,222	40	12,472,448
Minnesota:				
Crow Wing	5	625,138	8	721,397
Itasca	24	7,415,016	29	10,570,746
St. Louis	36	23,507,552	42	36,444,667
	65	31,547,701	79	47,736,810
Mississippi:				
Marshall	-----	-----	1	50
Missouri:				
Butler, Carter, Crawford, Phelps, and Wayne	[1] 7	33,314	[1] 5	43,890
Ripley and Shannon			-----	-----

State and county	1939 Active mines	1939 Gross tons	1940 Active mines	1940 Gross tons
Missouri—Con.				
Bollinger	-----	-----	1	800
Dent	1	1,250	1	400
Franklin	1	1,646	-----	-----
Iron	1	1,360	1	155
Madison	1	985	1	320
Miller	-----	-----	1	6,683
St. Francois	1	684	1	654
Texas	-----	-----	1	28
Washington	-----	-----	2	708
	[1] 12	39,239	[1] 14	53,638
New Jersey:				
Morris	3	399,289	3	659,425
Warren	1		1	
	4	399,289	4	659,425
New York:				
St. Lawrence	-----	-----	1	
Essex	1		1	
Clinton	1		1	
Oneida	1	2,713,141	1	2,899,986
Wayne	1		-----	
Pennsylvania:				
Lebanon	1		1	
Carbon	1	463	1	513
	6	2,713,604	6	2,900,499
South Dakota:				
Pennington	1	300	1	640
Virginia:				
Roanoke	-----	-----	1	
Botetourt	2		2	
Tennessee:				
Hamilton	(2)		1	23,187
Hickman	1		1	
Lewis	1	[3] 34,941	1	
			6	23,187
Texas: Cass	1		1	
	[1] [3] 5	[3] 34,941		5,453
Oklahoma:				
Johnston	-----	-----	2	
	-----	-----	3	5,453
Utah: Iron	2	262,087	2	326,500
Washington:				
Okanogan	1	3,000	1	3,592
Pend Oreille	1	2,431	1	1,444
Stevens	1	5,326	1	350
	3	10,757	3	5,386
Wisconsin:				
Dodge	-----	-----	1	598
Iron	2	972,685	2	1,261,467
	2	972,685	3	1,262,065
Wyoming:				
Platte	1	587,892	1	831,314
	[1] [3] 209	[3] 51,731,730	[1] 230	73,695,899

[1] In addition there is an undetermined number of small pits. The output of these pits is included in the tonnage given.
[2] Undetermined number of small pits. The output of these pits is included in the tonnage given.
[3] Revised figures.

Wisconsin.—The Montreal underground mine in Iron County was the largest producer of iron ore in Wisconsin, contributing 1,015,463 gross tons of the 1,262,065 produced in 1940. The ore—hematite—averaged (natural) 53.52 percent iron, 1.19 percent manganese, and 0.056 percent phosphorus. The Cary underground mine also in Iron County, furnished 264,004 tons of hematite containing (natural) 52.76 percent iron, 1.51 percent manganese, and 0.047 percent phosphorus. Paint ore totaling 598 tons was mined at the Iron Ridge mine in Dodge County. Shipments (exclusive of paint ore) from Wisconsin mines totaled 1,227,840 tons in 1940.

Wyoming.—The output of iron ore from Wyoming in 1940 came from the Sunrise mine and comprised 831,314 gross tons of hematite containing (dry) 54.29 percent iron, 0.08 percent manganese, and 0.062 percent phosphorus. Much of the ore is a red, earthy hematite similar to Mesabi ore. Production came from both open-pit and underground operations.

MEN EMPLOYED AND OUTPUT PER MAN AT MINE

Although complete information on employment at iron-ore mines in 1940 is not yet available, incomplete figures indicate that about 25,000 men working about 49,000,000 man-hours were required to produce 73,695,899 tons of merchantable ore—an average of about 1.5 tons per man-hour, an all-time record. Thus, the total man-hours worked in 1940 advanced 25 percent over 1939, whereas the output of merchantable ore increased 42 percent; in consequence, output per man-hour increased 13 percent. The gain in output per man-hour in 1940 compared with 1939 was due mainly to a further shift in the production of ore from underground to open-pit mines and to nearer-capacity operation of large units. Specifically, about two-thirds of the output came from open-pit mines in 1940 compared with about three-fifths in 1939, and 15 mines produced more than 1 million tons each in 1940 compared with 11 in 1939.

Figure 3 shows trends in employment and output at iron-ore mines in the United States from 1923 to 1939.

During 1939 (the last year for which complete statistics are available) a substantial increase in iron-ore output resulted in an increase in employment at the mines. The average number of men increased, as did the average number of days and total man-hours worked. In 1939, 21,859 men working 39,055,362 man-hours produced 51,731,730 gross tons of merchantable ore—an average output of 1.325 tons per man-hour—whereas in 1938, 19,788 men working 30,625,760 man-hours produced 28,447,282 tons of merchantable ore—an average output of 0.929 ton per man-hour. Thus, although the average number of men employed increased 10 percent from 1938 to 1939 and the number of man-hours gained 28 percent, the output of merchantable ore advanced 82 percent, resulting in a 43-percent increase in the output per man-hour. The labor requirements in 1939 were relatively smaller than in 1938 due to several factors—proportionately larger outputs of open-pit mines and of direct shipping ore, nearer capacity production of operating units, and the stripping of proportionately less overburden in preparation for future mining.

In 1939 the number of man-hours of labor increased over 1938 in all districts, but the increase (20 percent) was relatively less in the

Lake Superior district than in the other chief producing districts. The increases in the Southeastern, Northeastern, and Western districts were 36, 52, and 43 percent, respectively. In the Lake Superior district, the output of merchantable ore per man-hour in 1939 reached 1.715 tons—62 percent more than in 1938 and only 3.6 percent less than in 1937. The large gain (20,371,198 tons or 96 percent) in output in 1939 over 1938 required the employment of only 4.4 percent more men; this, plus a 15-percent increase in the average number of days worked, resulted in a 20-percent rise in the number of man-hours worked. Much of the Lake Superior output comes from Minnesota, where open pits furnished 88 percent of the State total in 1939. Because of this preponderant production from open pits, the output per man-hour in Minnesota is greater than in any other State or district and in 1939 amounted to 2.580 tons—an 86-percent increase over 1938. Although, as was pointed out in Minerals Yearbook, 1934 (p. 322),

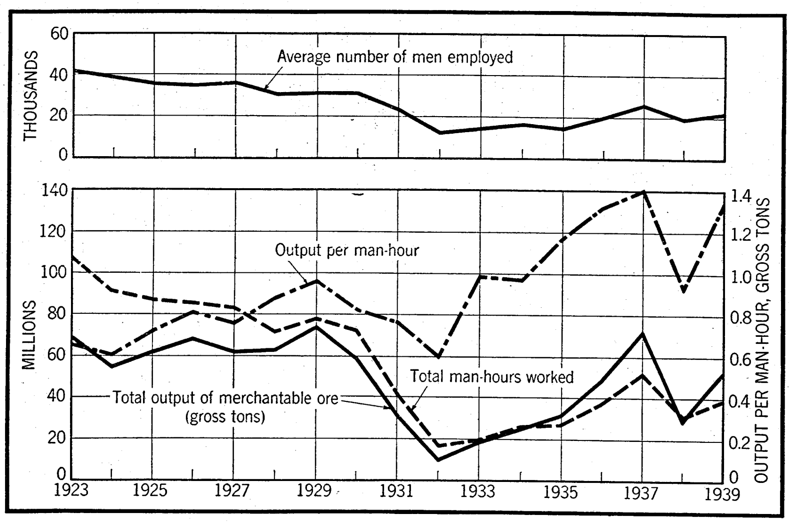

FIGURE 3.—Trends in number of men employed at iron-ore mines, output of merchantable ore, man-hours worked, and output per man-hour in the United States, 1923–39.

the improved performance in mining ore has been closely related to advances in mechanization, better mining methods, operation of larger units, and more efficient management of mines, the gain in the 7-year period 1933–39 compared with the 10-year period 1923–32 was due chiefly to expansion of open-pit operations in Minnesota. For example, although about 75 percent of the merchantable ore produced in Minnesota came from open-pit mines in 1923–32, 85 percent was so produced in 1933–39. The significance of this shift can be appreciated when it is recalled that Minnesota contributed 61 percent of the total merchantable ore produced in 1923–39 and that during this period the output of men at open-pit mines averaged 2.082 tons per man-hour compared with only 0.702 ton per man-hour for workers at underground mines.

The greater output per man-hour in recent years also was due partly to the stripping of proportionately less overburden in preparation for future mining in Minnesota in 1933–39 than in 1923–32, In 1933–39 about one-fourth cubic yard of overburden was removed for each ton of merchantable ore mined in Itasca and St. Louis Counties, Minn., whereas in 1923–32 about one-half cubic yard of overburden was removed for each ton of merchantable ore mined. Any material shift in the labor force used for direct mining of the ore at the expense of that used in stripping will result in a much higher output per man-hour for any year. This is illustrated strikingly in figure 4, which shows that in 1926, 1933, 1935, 1936, 1937, and 1939,

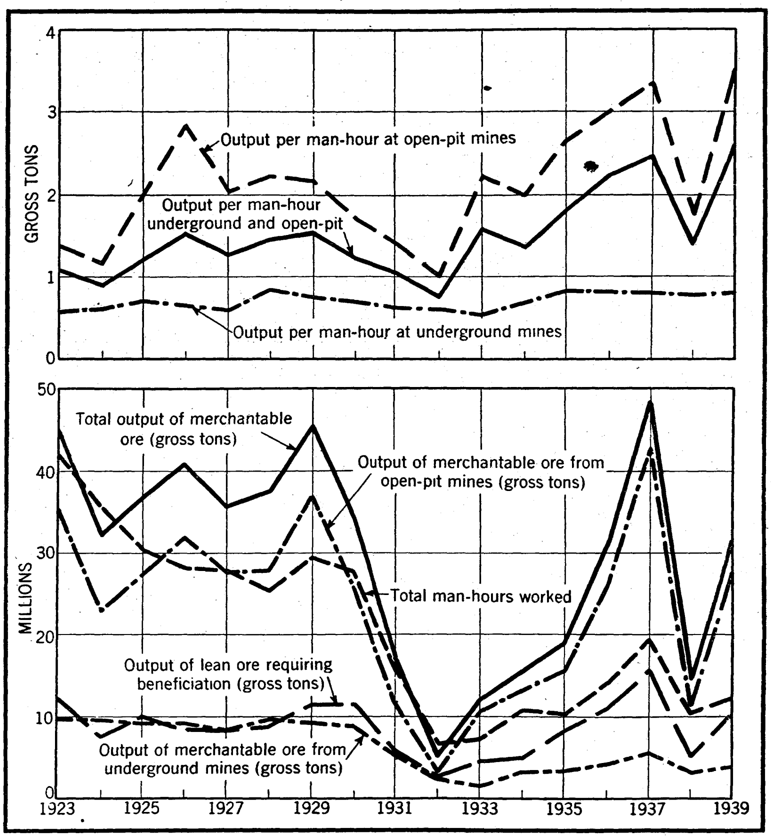

FIGURE 4.—Trends in output of merchantable iron ore per man-hour at open-pit mines in Minnesota compared with production of merchantable and lean ore and total man-hours worked, 1923–39.

when only about one-fourth cubic yard of overburden was removed for each ton of merchantable ore mined at both open-pit and underground mines, the output per worker increased substantially, whereas in the other years, when one-third to four-fifths cubic yard of overburden was removed for each ton of ore mined, the ore output per worker was lower.

Another factor that affects the output per man-hour is the tendency to mine leaner ore. Proportionately more lean ore requiring beneficiation has been mined in Minnesota in recent years than in 1923–32. In 1933–39, for instance, beneficiated ore represented 21 percent of the total merchantable ore compared with an average of only 16 percent in 1923–32.

Most of the ore mined in the Southeastern district—the second largest producing region—is obtained from underground operations. The output of merchantable ore per man-hour in this area increased slightly to 0.644 ton in 1939 from 0.631 ton in 1938. The largest and most consistent producing mines in the Southeastern district are in Jefferson County, Ala., where 4,102 men working 7,608,440 man-hours in 1939 produced 5,443,372 tons of merchantable ore, equivalent to an average output of 0.715 ton per man-hour. Virtually all ore produced in Jefferson County comes from underground mines. In comparing the man-hour cost of mining ore in Jefferson County, Ala., with that at underground mines in the Lake Superior district one should remember that, whereas the ore in the Lake Superior district is much richer in iron, the ore from the Jefferson County mines contains enough or

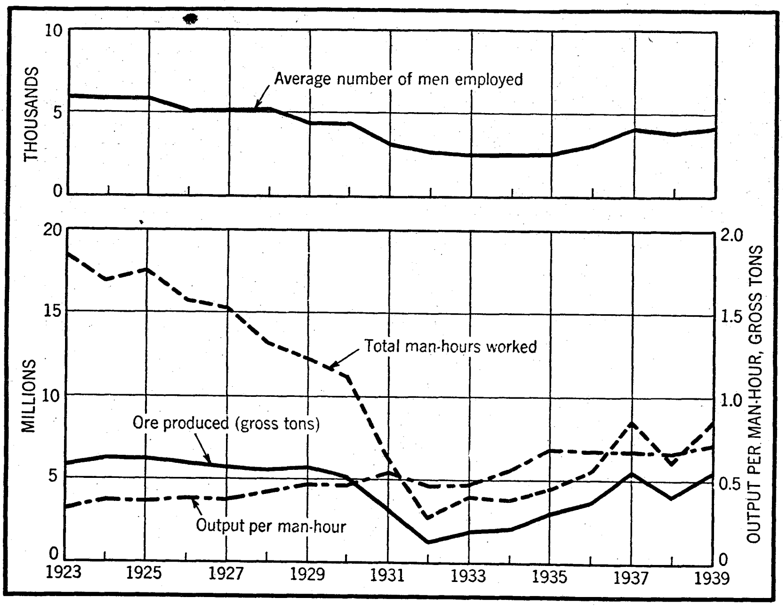

FIGURE 5.—Trends in production, man-hours worked, output per man-hour, and number of men employed at iron-ore mines in Jefferson County, Ala., 1923–39

almost enough lime to make it self-fluxing. Thus, the lower iron content is partly offset by the self-fluxing nature of the ore, although it is impossible to show this important characteristic in the productivity figures.

Figure 5 shows trends in production and employment at iron-ore mines in Jefferson County, Ala., 1923–39.

In the Northeastern district the average output of merchantable ore per man-hour decreased to 0.654 ton in 1939 from 0.735 ton in 1938. The drop in productivity was due in part to proportionately larger output from mines in New Jersey and New York, where virtually the entire output came from underground operations, resulting in a relatively higher expenditure of labor than in Pennsylvania, where output is predominantly from the open pit at Cornwall and productivity is higher.

Employment at iron-ore mines and beneficiating plants, quantity and tenor of ore produced, and average output per man in 1939, by districts and States

[Exclusive of ore containing 5 percent or more manganese]

District and State	Employment					Production				Average per man (gross tons)					
	Average number of men employed	Time employed				Crude ore (partly estimated), gross tons	Merchantable ore			Crude ore (partly estimated)		Merchantable ore			
		Average number of days	Total man-shifts	Man-hours			Gross tons	Iron contained						Iron contained	
				Average per shift	Total			Gross tons	Percent natural	Per shift	Per hour	Per shift	Per hour	Per shift	Per hour
Lake Superior:															
Michigan	6,243	216	1,349,278	8.0	10,825,174	9,159,222	9,159,222	4,733,283	51.68	6.788	0.846	6.788	0.846	3.508	0.437
Minnesota	7,091	216	1,529,758	8.0	12,227,712	35,570,113	31,547,701	16,540,821	52.43	23.252	2.909	20.623	2.580	10.813	1.353
Wisconsin	634	248	157,027	8.0	1,256,218	972,685	972,685	516,511	53.10	6.194	.774	6.194	.774	3.289	.411
	13,968	217	3,036,063	8.0	24,309,104	45,702,020	41,679,608	21,790,615	52.28	15.053	1.880	13.728	1.715	7.177	.896
Southeastern:															
Alabama	4,902	228	1,119,317	8.1	9,094,637	6,298,273	5,960,507	2,170,795	36.42	5.627	.693	5.325	.655	1.939	.239
Georgia	} 192	155	29,803	8.5	253,517	40,393	26,333	12,615	47.91	} 4.605	.541	2.056	.242	0.986	.116
Tennessee						} 96,852	34,941	16,774	46.41						
Texas									51.32						
Virginia									53.28						
	5,094	226	1,149,120	8.1	9,348,154	6,435,518	6,021,781	2,200,184	36.54	5.600	.688	5.240	.644	1.915	.235
Northeastern:															
New Jersey	664	230	152,425	8.0	1,217,268	897,059	399,289	252,813	63.32	5.885	.737	2.620	.328	1.659	.208
New York	} 1,743	255	443,875	8.0	3,545,867	3,400,137	2,713,604	1,280,581	66.85	} 7.660	.959	6.113	.765	2.885	.361
Pennsylvania									40.15						
	2,407	248	596,300	8.0	4,763,135	4,297,196	3,112,893	1,533,394	49.26	7.206	.902	5.220	.654	2.572	.322
Western:															
California	} 201	182	36,656	7.9	291,041	17,873	17,173	9,685	56.40	} 9.010	1.135	8.991	1.132	4.763	.600
Missouri						39,239	39,239	20,606	52.51						
South Dakota						300	300	138	46.0						
Utah						262,087	262,087	139,372	53.18						
Washington						10,757	10,757	4,785	44.48						
Wyoming	189	227	42,991	8.0	343,928	587,892	587,892	312,876	53.22	13.675	1.709	13.675	1.709	7.278	.910
	390	204	79,647	8.0	634,969	918,148	917,448	487,462	53.13	11.528	1.446	11.519	1.445	6.120	.768
	21,859	222	4,861,130	8.0	39,055,362	57,352,882	51,731,730	26,011,655	50.28	11.798	1.469	10.642	1.325	5.351	.666

Trends in the technology, employment, and output per man in iron-ore mining over the past half century are covered in a recent report by Yaworski, Kiessling, and others.[13]

The accompanying table shows employment at iron mines and beneficiating plants, quantity and tenor of ore produced, and average output per man by districts and States in 1939. Corresponding statistics and supplementary data are given in Minerals Yearbook, 1934 to 1940, inclusive.

WORLD PRODUCTION

The following table shows the production of iron ore, by countries, from 1936 to 1940, insofar as statistics are available. Although complete returns for 1940 are not yet available it is evident that world production was much greater than in 1939.

World production of iron ore, 1936–40, by countries, in metric tons

[Compiled by L. P. Lounsbery]

Country [1]	1936	1937	1938	1939	1940
North America:					
Cuba (shipments)	456,827	496,258	154,540	283,613	213,440
Guatemala		101			
Mexico	123,121	136,018	118,251	(2)	110,783
Newfoundland	907,646	1,635,554	1,707,180	1,679,625	1,532,990
United States	49,571,804	73,250,649	28,903,861	52,562,024	74,878,718
South America:					
Brazil (exports)	110,997	209,715	359,115	396,938	255,548
Chile [3]	1,347,831	1,489,637	1,608,399	1,626,490	1,749,840
Europe:					
Belgium	190,660	265,540	180,920	(2)	(2)
Bulgaria	6,498	11,920	16,771	20,115	(2)
Czechoslovakia	1,089,623	1,836,495	(4)	(2)	(2)
France	33,301,620	37,839,000	33,137,000	(2)	(2)
Germany [5]	7,339,836	9,575,234	10,938,650	(2)	(2)
Austria	1,024,288	1,884,694	2,600,063	(2)	(2)
Greece	280,271	300,498	348,613	307,284	(2)
Hungary	279,673	290,044	369,935	370,000	(2)
Italy	838,833	997,805	990,043	(2)	(2)
Luxemburg	4,895,992	7,766,254	5,140,632	(2)	(2)
Norway	846,809	1,008,225	1,425,297	(2)	(2)
Poland	466,659	780,152	872,591	(2)	(2)
Portugal	6,539	7,700	2,519	418	285
Rumania	108,549	129,060	139,185	131,992	(2)
Spain	2,045,890	990,783	2,513,827	[6] 2,300,000	[6] 2,900,000
Sweden	11,249,605	14,952,549	13,928,023	13,787,202	(2)
Switzerland (exports)	31,833	148,578	133,998	171,279	(2)
U. S. S. R.[7]	27,918,000	26,000,000	26,529,700	(2)	(2)
United Kingdom: Great Britain[8]	12,905,243	14,443,146	12,049,531	(2)	(2)
Yugoslavia	450,859	629,172	606,884	666,816	(2)
Asia:					
Burma	26,738	25,834	18,340	(2)	(2)
Chosen	234,400	207,500	(4)	(2)	(2)
India, British	2,567,488	2,883,548	2,787,711	3,116,087	(2)
Indochina	10,017	33,285	130,298	136,000	32,861
Japan	754,400	(4)	(4)	(2)	(2)
Malay States:					
Federated Malay States	457	1,165	938	780	972
Unfederated Malay States	1,681,102	1,686,990	1,606,289	1,991,173	1,872,903
Philippine Islands (exports)	654,458	601,190	910,952	1,154,738	1,191,641
Turkey			71,375	239,035	(2)
U. S. S. R	(7)	(7)	(7)	(7)	(7)
Africa:					
Algeria	1,884,281	2,427,230	3,105,037	[6] 2,750,000	(2)
Belgian Congo			2,650	(2)	(2)
Morocco:					
French		66,864	266,100	(2)	(2)
Spanish	1,047,041	1,424,737	1,341,658	(2)	(2)
Northern Rhodesia	2	528	208	138	(2)
Sierra Leone	575,689	644,160	875,789	(2)	(2)
South-West Africa		14,280	23,861	19,500	(2)
Tunisia	750,000	943,763	822,053	764,731	(2)
Union of South Africa	364,981	461,796	505,314	490,136	638,757

See footnotes at end of table.

[13] Yaworski, N., Kiessling, O. E., and others, Technology, Employment, and Output Per Man in Iron Mining: W. P. A. Nat. Research Project, in cooperation with Bureau of Mines, U. S. Department of Interior, June 1940, 264 pp.

World production of iron ore, 1936–40, by countries, in metric tons—Continued

Country	1936	1937	1938	1939	1040
Oceania:					
Australia:					
Queensland	2,338	4,551	5,207	4,003	(2)
South Australia	1,917,589	1,896,370	2,281,404	2,613,036	(2)
Tasmania		62		(2)	(2)
New Caledonia			36,279	83,567	176,600
New Zealand		580	1,238	1,611	(2)
	170,000,000	211,000,000	162,000,000	(2)	(2)

1 In addition to the countries listed, China, Egypt, Finland, Madagascar, and New South Wales report production of iron ore, but complete data are not available.
2 Data not available.
3 Production of Tofo Mines.
4 Estimate included in total.
5 Exclusive of manganiferous iron ore carrying 12 to 30 percent manganese.
6 Estimated.
7 U. S. S. R. in Asia included with U. S. S. R. in Europe.
8 Exclusive of bog ore, which is used mainly for purification of gas.

PIG IRON

Production and shipments.—Domestic production of pig iron, exclusive of ferro-alloys, increased 33 percent in 1940 over 1939 and was only 1.2 percent under the record established in 1929. The output in 1940 comprised 46,117,296 net tons using coke and 86,671 tons using charcoal as fuel. Pennsylvania was the largest producer of pig iron in 1940, with 31 percent of the total; Ohio ranked second, with 22 percent. Of the pig iron manufactured in 1940, it is calculated that 1,445,583 tons valued at $22,229,706 were made from 2,443,115 tons of foreign ores, including ore from Africa, Australia, Brazil, Canada, Chile, Cuba, Newfoundland, Norway, Palestine, Spain, Sweden, and the U. S. S. R., indicating an average yield of 59.17 percent from imported ore. Domestic ore (77,905,808 tons) and cinder, scale, and purchased scrap (6,300,311 tons) totaling 84,206,119 tons were reported as used in the manufacture of 44,758,384 tons of pig

Pig iron produced and shipped in the United States, 1939–40, by States

State	Produced		Shipped from furnaces			
	1939	1940	1939		1940	
	Net tons	Net tons	Net tons	Value	Net tons	Value
Alabama	2,935,820	3,423,296	3,043,602	$43,902,681	3,476,072	$49,706,851
Colorado	(1)	(1)	(1)	(1)	(1)	(1)
Illinois	2,968,606	4,047,376	3,203,846	57,718,814	4,093,623	73,882,065
Indiana	3,707,091	5,337,935	3,780,364	68,164,618	5,333,915	97,407,801
Iowa	(1)	(1)	(1)	(1)	(1)	(1)
Kentucky	259,273	290,514	259,273	(1)	290,610	(1)
Maryland	1,999,154	2,342,519	2,021,690	(1)	2,350,773	(1)
Massachusetts	(1)	(1)	(1)	(1)	(1)	(1)
Michigan	1,079,620	1,349,775	1,275,640	18,872,150	1,340,402	18,472,588
Minnesota	197,903	277,069	188,013	(1)	282,728	(1)
New York	2,292,021	3,009,567	2,475,450	45,275,716	3,206,162	54,150,107
Ohio	8,082,232	10,094,448	8,119,073	147,154,864	10,275,696	193,283,920
Pennsylvania	9,777,732	14,294,453	10,057,207	186,302,533	14,571,517	282,666,561
Tennessee	(1)	(1)	(1)	(1)	(1)	(1)
Utah	(1)	(1)	(1)	(1)	(1)	(1)
Virginia		(1)	(1)	(1)	(1)	(1)
West Virginia	840,018	921,812	853,229	(1)	941,299	(1)
Undistributed	2 665,554	2 815,203	2 665,076	2 59,433,314	2 796,132	2 70,872,139
	34,805,024	46,203,967	35,942,463	626,824,690	46,958,929	840,442,032

1 Included under "Undistributed."
2 Includes statistics for States entered as "(1)."

iron, indicating an average pig-iron yield of 53.15 percent from domestic materials. In addition, 1,286,985 tons of home scrap and 2,674,000 tons of flue dust were consumed in making pig iron in 1940.

Shipments of pig iron, exclusive of ferro-alloys, increased 31 percent in quantity and 34 percent in value in 1940 over 1939. The values given represent the approximate amounts received for the iron f. o. b. furnaces and do not include freight costs, selling commissions, and other items that are figured in some of the market prices for pig iron published by trade journals.

Pig iron shipped from blast furnaces in the United States, 1939–40, by grades

Grade	1939			1940		
	Net tons	Value		Net tons	Value	
		Total	Average		Total	Average
Charcoal	64,711	$1,404,719	$21.71	72,461	$1,755,735	$24.23
Foundry	2,414,579	40,820,296	16.91	2,737,224	48,600,640	17.76
Basic	26,386,348	448,263,976	16.99	35,004,116	606,481,057	17.33
Bessemer	5,172,653	98,823,031	19.10	6,657,388	130,929,263	19.67
Low-phosphorus	329,589	6,838,917	20.75	443,088	11,156,558	25.18
Malleable	1,438,583	27,775,986	19.31	1,778,770	35,713,749	20.08
Forge	6,440	110,009	17.08	3,943	89,309	22.65
All other (not ferro-alloys)	129,560	2,787,756	21.52	261,939	5,715,721	21.82
	35,942,463	626,824,690	17.44	46,958,929	840,442,032	17.90

The number of furnaces in blast on June 30 and December 31 and the total number of stacks recorded for 1939 and 1940, exclusive of electric reduction furnaces, were as follows:

Blast furnaces (including ferro-alloy blast furnaces) in the United States, 1939–40 [1]

State	In blast June 30, 1939	Dec. 31, 1939			In blast June 30, 1940	Dec. 31, 1940		
		In	Out	Total		In	Out	Total
Alabama	14	18	1	19	17	17	2	19
Colorado	1	3		3	3	3		3
Illinois	8	14	9	23	11	15	8	23
Indiana	9	17	2	19	16	18	1	19
Kentucky	2	2		2	2	2		2
Maryland	6	6		6	6	6		6
Massachusetts	1	1		1		1		1
Michigan	5	7	1	8	8	8		8
Minnesota	1	2		2	2	2		2
New York	8	11	4	15	11	13	2	15
Ohio	28	43	5	48	40	46	2	48
Pennsylvania	32	65	13	78	61	68	9	77
Tennessee	1	1	2	3	2	2	1	3
Utah	1	1		1	1	1		1
Virginia	1	1		1	1	1		1
West Virginia	3	3		3	3	3		3
	121	195	37	232	184	206	25	231

[1] American Iron and Steel Institute.

Value at blast furnaces.—The average value of all kinds of pig iron given in the accompanying table is based upon reports of manufacturers to the Bureau of Mines. The figures represent the approximate values f. o. b. blast furnaces and do not include the values of ferro-alloys. The general average value for all grades of pig iron at the furnaces was $17.90 a net ton in 1940—46 cents more than in 1939.

Average value per net ton of pig iron at blast furnaces in the United States, 1936–40, by States

State	1936	1937	1938	1939	1940
Alabama	$13.40	$14.89	$13.10	$14.42	$14.30
Illinois	16.29	18.85	18.15	18.02	18.05
Indiana	16.20	18.85	18.29	18.03	18.26
Michigan	13.89	15.17	15.67	14.79	13.78
New York	14.17	18.44	18.58	18.29	16.89
Ohio	15.20	19.31	18.17	18.12	18.81
Pennsylvania	16.80	19.40	19.30	18.52	19.40
Other States [1]	15.63	16.89	15.21	14.91	15.20
Average for United States	15.71	18.54	17.51	17.44	17.90

[1] Colorado, Iowa, Kentucky, Maryland, Massachusetts, Minnesota, Tennessee, Utah, Virginia, and West Virginia.

Commercial quotations.—The average monthly prices of foundry, basic, and bessemer pig iron at Valley furnaces and of foundry pig iron at Birmingham furnaces, according to published market quotations, are summarized in the following table:

Average monthly prices per net ton of chief grades of pig iron, 1939–40 [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	
	1939	1940	1939	1940	1939	1940	1939	1940
January	$18.75	$20.54	$15.52	$17.30	$19.20	$20.98	$18.30	$20.09
February	18.75	20.54	15.52	17.30	19.20	20.98	18.30	20.09
March	18.75	20.54	15.52	17.30	19.20	20.98	18.30	20.09
April	18.75	20.54	15.52	17.30	19.20	20.98	18.30	20.09
May	18.75	20.54	15.52	17.30	19.20	20.98	18.30	20.09
June	18.75	20.54	15.52	17.30	19.20	20.98	18.30	20.09
July	18.75	20.54	15.52	17.30	19.20	20.98	18.30	20.09
August	18.75	20.54	15.52	17.30	19.20	20.98	18.30	20.09
September	19.82	20.54	16.52	17.30	20.27	20.98	19.37	20.09
October	20.54	20.54	17.30	17.30	20.98	20.98	20.09	20.09
November	20.54	20.54	17.30	17.30	20.98	20.98	20.09	20.09
December	20.54	20.54	17.30	17.30	20.98	20.98	20.09	20.09
Average	19.29	20.54	16.04	17.30	19.73	20.98	18.84	20.09

[1] Metal Statistics, 1941.

Foreign trade.—Imports of pig iron for consumption in 1940 decreased 73 percent from 1939, the only sources being Canada and British India, which supplied 33 and 67 percent, respectively.

Pig iron imported for consumption in the United States, 1939–40, by countries, in net tons

Country	1936	1937	1938	1939	1940
North America: Canada	12,995	7,434	2,975	7,685	3,826
South America: Brazil				174	
Europe:					
Belgium	1,090				
Czechoslovakia	41				
Denmark				1	
Germany	5,319	571			
Netherlands	67,607	32,225	15,944	7,250	
Norway	2,967	980	952		
Sweden	772	672	230	292	
U. S. S. R.	27,503	5,131			
United Kingdom	4,876	112	47		
Asia:					
Hong Kong	224				
India, British	62,077	77,976	13,900	27,821	7,645
Kwantung	234				
	185,705	125,101	34,048	43,223	11,471
Value	$2,336,236	$1,701,304	$598,461	$663,091	$189,379

Exports of pig iron from the United States increased 213 percent over 1939 to a total of 620,336 net tons compared with 198,267 net tons in 1939. United Kingdom with 515,061 net tons and Canada with 30,497 tons together took 88 percent of the total.

Pig iron exported from the United States, 1939–40, by countries, in net tons

Country	1939	1940	Country	1939	1940
North America:			Europe—Continued.		
Canada	3,834	30,497	United Kingdom	72,541	515,061
Other North America	1,197	1,315	Other Europe	1,878	6,815
South America:			Asia:		
Argentina	1,551	1,543	British Malaya	6	1,792
Chile	1,413	2,465	China	10,247	8,290
Colombia	687	279	Hong Kong	1,435	224
Peru	893	731	Japan	10,990	6,368
Uruguay		1,191	Netherlands Indies	224	1,760
Other South America	157	347	Philippine Islands	547	537
Europe:			Other Asia	743	984
Belgium	1,166	3,537	Africa:		
Greece	1,910	2,500	Gold Coast		300
Hungary	728	4,299	Union of South Africa		10,372
Italy	5,869	336	Other Africa		77
Netherlands	196	252	Oceania: New Zealand		22
Norway	7,393	2,184			
Portugal	123	3,471		198,267	620,336
Sweden	72,539	11,883	Value	$3,435,739	$13,057,901
Switzerland		904			

Consumption.—Consumption of pig iron rose 31 percent in 1940 over 1939. Pig iron, a product of the blast furnace, is a semiraw material and, except for the small quantity used in direct castings, moves to other-type furnaces for further refining or mixture with other required ingredients. In general, it goes to steel-making or iron-making furnaces. By far the larger part is taken to steel-making furnaces (open-hearth, bessemer, and electric) for refining and processing into steel. In 1940, 87.0 percent of the pig iron was consumed in steel-making. Direct castings took 3.2 percent of the 1940 total, and the remaining 9.8 percent was consumed in iron-making furnaces, of which the cupola is by far the most important. The consumption of pig iron, by types of furnace, for 1937 to 1940 is shown in the following table. Typically, the quantities of pig iron used in these furnaces are supplemented by the addition of ferrous scrap. The proportion of pig iron to scrap used in steel furnaces increased in 1940 compared with 1939, whereas the proportion of pig iron in cupola furnaces decreased.

Consumption of pig iron in the United States, 1937–40, by type of furnace

Type of furnace or equipment	1937		1938		1939		1940	
	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total
Open hearth	28,132,402	73.8	15,376,896	74.2	26,826,172	76.2	36,297,250	78.6
Bessemer	4,130,935	10.8	2,179,574	10.5	3,603,199	10.2	3,828,978	8.3
Electric	50,081	.1	17,800	.1	30,542	.1	46,506	.1
Cupola [1]	4,698,662	12.3	2,693,193	13.0	3,349,198	9.5	4,106,119	8.9
Air / Brackelsberg	498,387	1.3	207,776	1.0	329,317	.9	374,187	.8
Crucible	48	(2)	244	(2)	92	(2)	184	(2)
Puddling	35,267	.1	5,984	(2)	27,959	.1	28,293	.1
Direct castings [1]	597,528	1.6	243,404	1.2	1,066,220	3.0	1,504,311	3.2
	38,143,310	100.0	20,724,871	100.0	35,232,699	100.0	46,185,828	100.0

[1] Some pig iron used in making direct castings included in cupola. [2] Less than 0.05 percent.

The consumption of pig iron in this country is widespread, and plants using pig iron are situated in all 48 States, the District of Columbia, and Alaska. As expected from the nature of its use, con-

Consumption of pig iron in the United States, 1937–40, by States and districts

State and district	1937		1938		1939		1940	
	Consumers	Net tons	Consumers	Net tons	Consumers	Net tons	Consumers	Net tons
Connecticut	58	98,461	57	53,476	59	82,886	60	96,574
Maine	16	9,883	16	4,538	15	6,720	15	8,392
New Hampshire	13	2,442	14	1,398	15	1,826	14	2,479
Massachusetts	103	110,216	98	66,947	97	115,534	104	146,886
Rhode Island	14	39,357	13	16,085	12	26,257	11	37,308
Vermont	14	7,936	13	3,381	12	6,530	12	10,358
Total New England	218	268,295	211	145,825	210	239,753	216	301,997
Delaware	7	346,153 (Delaware and New Jersey)	7	223,937 (Delaware and New Jersey)	7	281,000 (Delaware and New Jersey)	7	362,758 (Delaware and New Jersey)
New Jersey	81		80		79		81	
New York	192	2,008,632	194	1,038,632	193	1,817,251	190	2,403,248
Pennsylvania	348	11,847,980	345	5,355,260	365	10,152,661	348	14,634,036
Total Middle Atlantic	628	14,202,765	626	6,617,829	644	12,250,912	626	17,400,042
Alabama	59	2,018,271	59	1,562,813	57	2,378,774	59	2,809,064
District of Columbia	1	497	1	1,515,824 (District of Columbia, Kentucky, and Maryland)	2	2,365,534 (District of Columbia, Kentucky, and Maryland)	1	2,825,324 (District of Columbia, Kentucky, and Maryland)
Kentucky	22	1,931,656 (Kentucky and Maryland)	21		24		24	
Maryland	25		26		26		25	
West Virginia	22	835,537	22	562,151	23	880,062	23	1,016,445
Florida	11	72,080 (Florida and Georgia)	10	38,041 (Florida and Georgia)	12	61,655 (Florida and Georgia)	13	73,045 (Florida and Georgia)
Georgia	40		40		40		40	
Mississippi	7	337	6	366	7	362	9	365
North Carolina	27	12,357	30	12,240	32	13,853	33	15,901
South Carolina	12	2,336	13	1,717	13	2,251	14	2,355
Tennessee	53	160,767 (Tennessee and Virginia)	53	133,981 (Tennessee and Virginia)	52	150,564 (Tennessee and Virginia)	50	162,936 (Tennessee and Virginia)
Virginia	45		44		46		44	
Total Southeastern	324	5,033,838	325	3,827,133	334	5,853,055	335	6,905,435
Arkansas	6	5,300 (Arkansas, Oklahoma, and Louisiana)	5	2,013 (Arkansas, Oklahoma, and Louisiana)	6	2,003 (Arkansas, Oklahoma, and Louisiana)	6	2,107 (Arkansas, Oklahoma, and Louisiana)
Oklahoma	9		7		6		8	
Louisiana	8		8		8		8	
Texas	22	21,471	23	3,014	24	2,572	23	2,327
Total Southwestern	45	26,771	43	5,027	44	4,575	45	4,434
Illinois	193	3,447,177	182	1,645,013	179	2,770,693	183	3,764,275
Indiana	116	4,100,469	120	2,118,178	124	3,830,053	126	5,522,177
Iowa	51	90,600	51	43,920	49	54,834	52	63,834
Minnesota	49	231,732	52	147,412	53	185,976	51	214,340
Missouri	54	58,111	50	28,357	53	37,760	53	45,486
Kansas	17	5,721 (Kansas and Nebraska)	15	2,832 (Kansas and Nebraska)	14	3,513 (Kansas and Nebraska)	13	3,742 (Kansas and Nebraska)
Nebraska	9		8		7		8	
Michigan	165	2,048,334 (Michigan and Wisconsin)	158	1,098,431 (Michigan and Wisconsin)	168	1,849,622 (Michigan and Wisconsin)	173	2,232,069 (Michigan and Wisconsin)
Wisconsin	118		116		118		115	
South Dakota	----	----	----	----	2	148	2	106
Ohio	278	8,034,797	276	4,787,342	290	7,558,466	285	9,080,242
Total North Central	1,050	18,016,941	1,028	9,871,485	1,057	16,291,065	1,061	20,926,271
Arizona	2 (Arizona, Nevada, and New Mexico)	48 (Arizona, Nevada, and New Mexico)	1 (Arizona, Nevada, and New Mexico)	25 (Arizona, Nevada, and New Mexico)	1 (Arizona, Nevada, and New Mexico)	36 (Arizona, Nevada, and New Mexico)	1	35 (Arizona, Nevada, and New Mexico)
Nevada							1	
New Mexico							1	
Colorado	15 (Colorado and Utah)	416,291 (Colorado and Utah)	17 (Colorado and Utah)	152,729 (Colorado and Utah)	19 (Colorado and Utah)	412,220 (Colorado and Utah)	10	457,487 (Colorado and Utah)
Utah							7	
Idaho	5 (Idaho, Wyoming, and Montana)	540 (Idaho, Wyoming, and Montana)	4 (Idaho, Wyoming, and Montana)	220 (Idaho, Wyoming, and Montana)	5 (Idaho, Wyoming, and Montana)	308 (Idaho, Wyoming, and Montana)	1	687 (Idaho, Wyoming, and Montana)
Wyoming							1	
Montana							3	
Total Rocky Mountain	22	416,879	22	152,974	25	412,564	25	458,209
Oregon	18	7,627 (Oregon and Washington)	18	5,518 (Oregon and Washington)	19	6,312 (Oregon and Washington)	19	7,519 (Oregon and Washington)
Washington	41		33		37		36	
California	94	170,194	90	99,080	95	174,463	93	181,921
Total Pacific Coast	153	177,821	141	104,598	151	180,775	148	189,440
Total United States	2,440	38,143,310	2,396	20,724,871	2,465	35,232,699	2,456	46,185,828

sumption is concentrated largely in the iron- and steel-making centers of the North Central, Middle Atlantic, and Southeastern States. These areas in 1940 used 98 percent of the pig iron, Pennsylvania (the leading consumer) taking nearly 32 percent of the total and Ohio (the second largest consumer) nearly 20 percent. Of the chief consuming areas in 1940, the Middle Atlantic district made the largest gain over 1939—42 percent, compared with 28 percent in the North Central district and 18 percent in the Southeastern district (including the Birmingham district of Alabama). The preceding table shows the distribution of pig-iron consumption by States from 1937 to 1940.

World production.—The following table shows the production of pig iron (including ferro-alloys) by countries from 1936 to 1940, insofar as statistics are available. Although many of the leading world producers have been operating at capacity or virtual capacity through 1939 and 1940, the probable increase in world production during the year was due largely to the rise in United States production, which increased 33 percent over 1939.

World production of pig iron (including ferro-alloys), 1936–40, by countries, in metric tons

[Compiled by L. P. Lounsbery]

Country [1]	1936	1937	1938	1939	1940
Australia [2]	795,804	963,163	941,551	[3] 1,100,000	(4)
Belgian Congo	------	565	[5] 600	[5] 600	[5] 600
Belgium	3,161,340	3,803,750	2,426,130	3,068,200	(4)
Brazil	78,418	98,108	118,580	160,016	189,300
Canada	766,625	996,671	773,573	844,760	[5] 1,200,000
China (Manchuria)	647,402	[5] 650,000	[5] 700,000	[5] 700,000	[5] 700,000
Chosen	216,752	168,344	[5] 200,000	[5] 200,000	[5] 200,000
Czechoslovakia	1,139,886	1.675,064	1,233,987	[3] 1,000,000	(4)
Finland	13,107	11,258	27,000	[5] 30,000	(4)
France	6,230,420	7,916,000	6,0o1,322	[3] 7,900,000	(4)
Germany [6]	15,302,477	15,959,806	18,596,000	[3] 20,300,000	(4)
Austria	248,111	389,118			
Hungary	306,290	357,935	335,016	[3] 460,000	(4)
India, British	1,568.089	1,655,457	1,583,284	1,785,242	2,015,116
Italy	815,490	865,305	928,847	[3] 1,000,000	(4)
Japan	2,072,445	2,750,000	[5] 2,800,000	[5] 3,000,000	(4)
Luxemburg	1,986,604	2,512,495	1,500,000	[3] 1,800,000	(4)
Mexico	88,032	89,717	98,376	141,335	70,159
Netherlands	274,883	311,773	266,956	284,004	(4)
Norway	167,357	181,238	173,748	[5] 175,000	(4)
Poland	581,869	724,296	967,668	[3] 1,000,000	(4)
Rumania	97,096	127,234	130,388	[5] 140,000	(4)
Spain	220,815	128,000	439,897	[3] 500.000	(4)
Sweden	631,736	692,865	713,579	691,402	(4)
Union of South Africa	202,186	276,236	294,406	300,227	303,923
U. S. S. R.	14,546,077	14,520,000	15,179,856	[3] 15,200.000	(4)
United Kingdom	7,844,922	8,629,313	6,871,546	[3] 8,300,000	(4)
United States	31,571,224	37,749,575	19,474,677	32,321,653	43,026,030
Yugoslavia	44,453	41,006	58,458	61,106	(4)
	91,620,000	104,200,000	82,895,000	102,464,000	(4)

[1] Pig iron is produced in Chile, New Zealand, and the Philippine Islands in addition to countries listed, but production figures are not available.
[2] Year ended June 30.
[3] Approximate production as published by Steel, vol. 196, No. 1, January 1940, p. 269.
[4] Data not available.
[5] Estimated production.
[6] Beginning with March 1935, production of the Saar is included with that of Germany.

FERRO-ALLOYS

Production and shipments.—The production of ferro-alloys totaled 1,224,360 net tons in 1940 compared with 823,392 tons in 1939—an increase of 49 percent. In 1940 ferro-alloys were made at 14 blast-furnace plants, 18 electric furnace plants, and 3 aluminothermic plants; in addition, 3 plants made ferrophosphorus and 2 plants made ferrosilicon as a byproduct. Of the 1940 total, 790,430 tons were made in blast furnaces and 420,363 tons in electric furnaces.

Shipments of all classes of ferro-alloys in 1940 rose 37 percent in quantity and 68 percent in total value over 1939. Compared with the 5-year average for 1925–29 (801,080 net tons), shipments in 1940 increased 61 percent.

Ferro-alloys shipped from furnaces in the United States, 1939–40, by varieties

Variety of alloy	1939		1940	
	Net tons	Value	Net tons	Value
Ferromanganese	332,226	$24,137,211	503,291	$42,755,485
Spiegeleisen	94,908	2,484,042	119,512	3,487,565
Ferrosilicon (7 percent or more silicon)	385,081	16,850,356	481,033	24,027,652
Ferrophosphorus	14,918	898,471	11,593	726,344
Ferrotungsten	1,802	4,846,386	3,587	10,010,498
Other varieties [1]	113,166	26,940,122	173,644	47,120,266
	942,101	76,156,588	1,292,660	128,127,810

[1] Ferroboron, ferrochromium, ferrocolumbium, ferromolybdenum and calcium-molybdenum compounds, ferrotitanium, ferrovanadium, ferrozirconium, silicomanganese, silicospiegeleisen, and zirconium ferrosilicon.

Ferromanganese.—Shipments of ferromanganese in 1940 increased 51 percent over 1939 and were 48 percent above the 5-year average for 1925–29 (340,349 net tons). The average value per net ton, f. o. b. furnaces, reported for ferromanganese was $84.95 in 1940 compared with $72.65 in 1939.

The production of ferromanganese in 1940 (an all-time high) increased 70 percent over 1939 and was made at 10 blast-furnace plants and 1 electric-furnace plant compared with 7 blast-furnace plants and 1 electric-furnace plant in 1939. In both years most of the output was made in blast furnaces.

Ferromanganese produced in the United States and metalliferous materials consumed in its manufacture, 1936–40

Year	Ferromanganese produced			Materials consumed (net tons)				Manganese ore used per ton of ferromanganese made (net tons)
	Net tons	Mn contained		Manganese ore (35 percent or more Mn, natural)		Iron and manganiferous iron ores	Cinder, scale, and purchased scrap	
		Percent	Net tons	Foreign	Domestic			
1936	353,920	79.09	279,925	666,528	6,705	13,963	3,160	1.902
1937	421,616	79.54	335,356	781,818	10,577	19,612	6,739	1.879
1938	272,153	78.65	214,036	466,747	25,254	10,860	9,477	1.808
1939	302,524	79.24	239,725	563,344		9,323	7,000	1.862
1940	514,682	79.45	408,903	976,332	13,419	5,889	8,868	1.923

The tenor of the manganese ore utilized in 1940 was lower than in 1939, and as a consequence the tonnage of manganese ore used per ton of ferromanganese produced increased slightly. As shown in the preceding table, nearly 99 percent of the manganese ore used in making ferromanganese in 1940 came from foreign sources.

Quantity and tenor of manganese ore used in manufacture of ferromanganese in the United States, 1939–40

Source of ore	1939		1940	
	Net tons	Manganese content (percent, natural)	Net tons	Manganese content (percent, natural)
Africa	144,734	48.14	233,370	45.89
Brazil	65,278	43.75	189,389	42.39
Chile	959	48.16	6,076	46.13
Cuba	66,079	48.16	112,859	48.59
India	96,666	49.84	188,079	49.73
Philippine Islands			12,768	47.16
U. S. S. R	189,628	47.54	187,286	47.85
United States			13,419	55.89
Undistributed			46,505	38.75
	563,344	47.72	989,751	46.45

Spiegeleisen.—Shipments of spiegeleisen from domestic furnaces in 1940 rose 26 percent over 1939. The average value per net ton at the furnaces was $29.18 in 1940 compared with $26.17 in 1939. The entire production, which increased to 114,119 net tons in 1940 from 102,470 tons in 1939, was made in blast furnaces. Output in 1940 averaged 20.42 percent manganese. Most of the spiegeleisen was manufactured from domestic ores in 1940, as only 33 tons of foreign manganese ore were used.

Ferrosilicon.—Shipments of ferrosilicon in 1940 increased 25 percent over 1939. The production of ferrosilicon in 1940 totaled 409,699 net tons, including 190,310 tons made by blast furnaces, 219,141 tons by electric furnaces, and 248 tons as a byproduct in the manufacture of artificial abrasives in electric furnaces. The silicon content of the production in 1940 ranged from 7 to 95 percent but averaged 28 percent. Most of the raw materials used in making ferrosilicon were of domestic origin.

Ferrophosphorus.—Production of ferrophosphorus increased slightly to 17,969 net tons containing 24.35 percent phosphorus in 1940 from 17,321 tons containing 24.37 percent phosphorus in 1939, but shipments from furnaces decreased 22 percent. All the 1940 output was made in electric furnaces and was manufactured from domestic materials.

Ferrotungsten.—Shipments of ferrotungsten gained 99 percent in quantity and 107 percent in total value over 1939. The 1940 shipments contained 77.70 percent (5,573,680 pounds) tungsten and were valued at $1.80 per pound of contained tungsten. Production totaled 3,604 net tons containing 77.70 percent tungsten (5,600,688 pounds). In addition to domestic ores (chiefly from California, Colorado, and Nevada), foreign ores (chiefly from Australia, China, Portugal, and South America) were used. All ferrotungsten was made in electric furnaces.

Foreign trade.—Imports of all alloys of the rarer metals are not recorded separately but are grouped as shown in the following table. Ferromanganese and spiegeleisen comprised most of the imports in both 1939 and 1940. Imports of ferromanganese for consumption (all from Norway and the Netherlands) were 11,613 net tons—75 percent less than in 1939. Imports of spiegeleisen for consumption (all from Canada) were 17,455 net tons—a decrease of 59 percent over 1939.

Exports of ferro-alloys, which have been relatively unimportant in tonnage, rose substantially in 1940 over 1939. Exports of ferromanganese and spiegeleisen in 1940 were 14,600 net tons and of other ferro-alloys 27,401 tons.

Ferro-alloys and ferro-alloy metals imported for consumption in the United States, 1939–40, by varieties

Variety of alloy	1939			1940		
	Gross weight (net tons)	Content (net (tons)	Value	Gross weight (net tons)	Content (net tons)	Value
Ferromanganese:						
Containing over 1 percent carbon	45,035	36,473	$2,815,465	10,035	8,281	$1,121,133
Containing not over 1 percent carbon	1,140	951	119,749	1,578	1,322	200,236
Manganese silicon (manganese content)	(1)	19	1,240			
Manganese boron, manganese metal, and spiegeleisen not more than 1 percent carbon (manganese content)	(1)	24	9,247	(1)	66	16,737
Spiegeleisen	42,856	(1)	1,329,814	17,455	(1)	638,732
Ferrochrome or ferrochromium:						
Containing 3 percent or more carbon	7	3	646	(2)	(3)	92
Containing less than 3 percent carbon	210	142	38,558			
Ferrosilicon	9,187	1,160	237,543	10,257	1,235	262,397
Chrome or chromium metal	63	(1)	59,520	(4)	(1)	566
Chromium and zirconium silicon and calcium silicide	1,986	(1)	225,312	1,234	(1)	186,432
Ferromolybdenum, molybdenum metal and powder, calcium molybdate, and other compounds and alloys of molybdenum (molybdenum content)	(1)	13	32,327			
Ferrotitanium	(1)	(5)	77			
Tungsten and combinations, in lumps, grains, or powder:						
Tungsten metal (tungsten content)	(1)	20	41,440	(1)	18	41,041
Combinations containing tungsten or tungsten carbide (tungsten content)	(1)	(6)	1,430			
Tungsten acid and other compounds of tungsten, n. s. p. f. (tungsten content)	(1)	(7)	4,424			

1 Not recorded.
2 1,400 pounds.
3 1,020 pounds.
4 1,000 pounds.
5 350 pounds.
6 251 pounds.
7 700 pounds.

Ferromanganese and ferrosilicon imported for consumption in the United States, 1939–40, by countries

Country	Ferromanganese (manganese content)				Ferrosilicon (silicon content)			
	1939		1940		1939		1940	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Canada	(1)	$50			1,160	$237,543	1,235	$262,397
Czechoslovakia 2	2,296	162,091						
France	948	100,905						
Germany 2	438	24,622						
Japan			39	$2,349				
Netherlands	8,931	561,509						
Norway	21,911	1,909,610	9,562	1,319,020				
Poland and Danzig 2	1,789	118,015						
Sweden	25	3,356						
Yugoslavia	1,086	55,056						
	37,424	2,935,214	9,601	1,321,369	1,160	237,543	1,235	262,397

1 Less than 1 ton.
2 For statistical purposes, trade with the Sudeten area, as far as ascertainable, is included with Germany, while trade with the other Czechoslovak Provinces occupied by Germany and Poland has been included with these countries since March 18 or 19, 1939. After November 16, 1939, trade with Danzig and that part of Poland occupied by Germany has been included with Germany.

Ferro-alloys and ferro-alloy metals exported from the United States, 1939–40, by varieties

Variety of alloy	1939		1940	
	Net tons	Value	Net tons	Value
Ferromanganese and spiegeleisen	3,274	$247,798	14,600	$1,366,087
Other ferro-alloys [1]	4,527	1,024,826	27,401	7,064,823

[1] Includes ferrosilicon, ferrotungsten, ferrovanadium, and other ferro-alloys.

STEEL

Production.—The domestic steel industry operated at 72.4 percent of capacity during the first half of 1940—a rate slightly less than during the second half of 1939. During the second half of 1940, however, the operating rate increased progressively from 83 percent of capacity in July to 96.6 percent in November but dropped slightly to 94.1 percent in December. About 29 percent of the 1940 output of steel was made in the final 3 months, when the production rate rose to an all-time high. The average operating rate was 82 percent in 1940 compared with 64 percent in 1939. The following figures covering the output of steel were compiled by the American Iron and Steel Institute. The production of steel ingots and castings in 1940 established a new record and totaled 66,982,686 net tons—21 percent above the 1925–29 average, 27 percent over 1939, and 6 percent over the previous record made in 1929.

Of the 1940 total, 91.9 percent was made in the open hearth, 5.5 percent in bessemer converters, 2.6 percent in electric furnaces, and only 1,024 tons in crucible furnaces. The bulk (60,882,840 tons) of the total open-hearth output in 1940 was made in basic furnaces.

Of the total output of steel ingots and castings, 66,649,864 net tons were ingots in 1940 compared with 52,537,439 tons in 1939.

A large part of the steel production comes from the contiguous States Pennsylvania and Ohio. In 1940 these States produced about 50 percent of the total steel, 49 percent of the open-hearth steel, and 76 percent of the bessemer steel.

Open-hearth steel ingots and castings manufactured in the United States, 1936–40, by States, in net tons

[Includes only that portion of the steel for castings produced in foundries operated by companies manufacturing steel ingots]

State	1936	1937	1938	1939	1940
New England States	337,300	309,143	183,297	286,850	322,753
New York and New Jersey	2,363,140	3,124,143	1,509,538	2,627,910	3,618,444
Pennsylvania	14,463,571	16,309,104	7,920,816	13,622,272	18,469,170
Ohio	10,964,783	10,156,097	6,016,902	9,913,454	11,769,780
Indiana	6,679,121	6,661,052	3,847,603	6,486,502	8,421,956
Illinois	4,102,572	4,382,916	2,184,251	3,687,874	4,963,457
Other States	9,849,976	10,882,524	7,417,609	11,784,938	14,007,523
	48,760,463	51,824,979	29,080,016	48,409,800	61,573,083

Bessemer-steel ingots and castings manufactured in the United States, 1936–40, by States, in net tons

[Includes only that portion of the steel for castings produced in foundries operated by companies manufacturing steel ingots]

State	1936	1937	1938	1939	1940
Ohio	1,836,048	1,957,435	1,202,916	1,439,629	1,459,807
Pennsylvania	1,067,328	930,093	389,827	1,109,081	1,366,017
Other States	970,096	976,390	513,597	810,206	882,749
	3,873,472	3,863,918	2,106,340	3,358,916	3,708,573

Steel electrically manufactured in the United States, 1936–40, in net tons

[Includes only that portion of the steel for castings produced in foundries operated by companies manufacturing steel ingots]

Year	Ingots	Castings	Total	Year	Ingots	Castings	Total
1936	788,718	76,432	865,150	1939	951,522	77,545	1,029,067
1937	912,027	34,975	947,002	1940	1,608,032	91,974	1,700,006
1938	524,843	40,784	565,627				

The steel output for 1940 includes 4,965,887 net tons of alloy-steel ingots and castings, which represent 7 percent of the total. This figure includes steels in which the minimum of the range specified in any of the elements named exceeds the following percentages: Nickel, 0.40 percent; chromium, 0.30 percent; copper, 0.50 percent; manganese, 1.65 percent; silicon, 0.50 percent; molybdenum, 0.10 percent; vanadium, tungsten, cobalt, titanium, and zirconium, any percent. The output of alloy steels in 1940 increased 55 percent and that of total steel 27 percent over 1939. Of the total alloy-steel output in 1940, 69 percent came from basic open hearths, 5 percent from acid open hearths, 26 percent from electric furnaces, 255 tons from crucible furnaces, and 3,990 tons from bessemer furnaces.

Production of alloy-steel ingots and castings, 1936–40, by processes, in net tons

[Includes only that portion of the steel for castings produced in foundries operated by companies manufacturing steel ingots]

Process	1936	1937	1938	1939	1940
Open hearth, basic	2,508,671	2,559,200	1,179,031	2,302,273	3,421,961
Open hearth, acid	129,658	164,455	102,089	156,581	252,965
Bessemer	----------	----------	13	3,486	3,990
Crucible	234	270	5	231	255
Electric	591,094	672,616	372,372	749,384	1,286,716
	3,229,657	3,396,541	1,653,510	3,211,955	4,965,887

From the foregoing tables it will be seen that most of the steel made in electric furnaces (76 percent in 1940) is alloy steel. Typically, steels with higher alloy content are made in electric furnaces, and steels with lower alloy content by the open-hearth process.

Foreign trade.—Exports of iron and steel products (excluding scrap) in 1940 broke all records and increased 211 percent over 1939. Because of unsettled conditions and expanded armament activities, foreign producers have been unable to meet demands in their own

Iron and steel exported from the United States, 1939–40

Article	1939		1940	
	Net tons	Value	Net tons	Value
Semimanufactures:				
Steel ingots, blooms, billets, slabs, and sheet bars	241,672	$8,124,327	2,822,428	$98,542,659
Iron and steel bars and rods:				
Iron bars	970	89,298	16,191	1,026,268
Concrete reinforcement bars	52,926	2,267,422	155,329	7,458,760
Other steel bars	179,700	12,897,431	649,151	41,741,271
Wire rods	35,224	1,330,141	320,622	14,060,723
Iron and steel plates, sheets, skelp, and strips:				
Boiler plates	10,391	536,366	12,510	803,521
Other plates, not fabricated	274,176	11,479,538	629,671	29,334,244
Skelp iron or steel	91,461	3,359,890	167,309	6,368,968
Iron and steel sheets, galvanized	124,284	9,594,599	184,020	14,160,612
Steel sheets, black, ungalvanized	301,308	19,698,555	533,671	34,530,127
Iron sheets, black	11,702	812,392	29,621	2,264,642
Strip band, and scroll iron or steel:				
Cold-rolled	29,392	2,811,861	72,803	6,552,171
Hot-rolled	70,235	3,740,975	150,203	8,594,550
Tin plate, terneplate, and taggers' tin	348,338	33,032,832	429,328	44,374,895
Manufactures—steel-mill products:				
Structural iron and steel:				
Water, oil, gas, and other storage tanks complete and knocked-down material	32,183	2,646,797	42,712	3,350,242
Structural shapes:				
Not fabricated	129,321	5,549,454	456,015	19,701,320
Fabricated	41,612	3,505,595	80,960	7,379,656
Plates fabricated, punched, or shaped	7,505	505,833	30,818	2,044,620
Metal lath	1,855	303,258	1,901	326,881
Frames, sashes, and sheet piling	9,944	797,021	15,769	1,097,112
Railway track material:				
Rails for railways	66,183	2,375,481	289,020	11,364,737
Rail joints, splice bars, fishplates, and tieplates	9,872	618,666	11,596	870,524
Switches, frogs, and crossings	2,250	365,830	3,269	500,109
Railroad spikes	3,935	253,848	5,617	398,211
Railroad bolts, nuts, washers, and nut locks	2,184	221,653	3,724	430,637
Tubular products:				
Boiler tubes	16,990	1,959,587	30,117	3,961,676
Casing and oil-line pipe	98,453	8,717,000	203,447	18,165,437
Seamless black pipe, other than casing and oil line	11,445	1,355,699	34,025	4,411,354
Welded black pipe	26,832	2,279,376	57,968	5,077,148
Welded galvanized pipe	37,405	3,245,345	76,826	6,302,473
Malleable-iron screwed pipe fiittings	5,161	1,440,524	5,023	1,463,394
Cast-iron screwed pipe fittings	2,648	582,190	2,816	530,478
Cast-iron pressure pipe and fittings	35,621	1,618,952	56,836	2,903,643
Cast-iron soil pipe and fittings	13,415	744,917	18,716	1,057,872
Riveted-steel or iron pipe and fittings	8,483	2,115,909	19,263	4,581,615
Wire and manufactures:				
Barbed	59,721	3,743,725	49,510	3,523,089
Galvanized wire	31,651	2,098,188	74,009	5,582,899
Iron or steel wire, uncoated	36,103	2,417,065	97,552	7,325,759
Wire rope, and strand	6,785	1,514,691	14,962	3,383,803
Woven-wire fencing and screen cloth	5,929	1,155,051	9,051	2,129,381
All other	13,327	2,491,593	23,497	3,990,240
Nails and bolts (except railroad):				
Wire nails	28,892	1,697,071	54,496	3,726,608
Horsehoe nails	1,043	208,364	1,650	382,574
All other nails, including tacks and staples	6,191	610,143	7,092	904,371
Bolts, nuts, rivets, and washers (except railroad)	9,919	2,349,658	37,387	7,087,062
Castings and forgings:				
Horseshoes and calks	251	29,576	398	48,185
Iron and steel, including car wheels and axles	58,077	7,033,534	70,224	10,806,824
Advanced manufactures:				
House heating boilers and radiators		279,432		340,004
Oil burners and parts		1,085,111		1,467,276
Tools:				
Axes		607,445		477,483
Shovels and spades		316,817		292,229
Hammers and hatchets		303,707		336,037
Saws, wood and metal cutting		1,754,048		2,138,253
All other tools		11,923,674		15,631,262

countries, and buyers have turned to the United States for supplies. Shortage of necessary raw materials, inadequate smelting capacity, and finishing and fabricating facilities in other nations, insufficient to meet their expanded demands, have called for abnormal exports from this country of a wide range of semimanufactured and manufactured products. Although the search for and development of

Iron and steel imported for consumption in the United States, 1939–40, by commodities

Commodity	1939		1940	
	Net tons	Value	Net tons	Value
Semimanufactures:				
Steel bars:				
Concrete reinforcement	2,648	$74,289	9	$227
Solid or hollow, n. e. s.	19,108	906,873	2,074	257,435
Hollow and hollow drill steel	1,519	198,753	977	129,216
Bar iron	1,042	76,488	222	22,276
Wire rods, nail rods, and flat rods up to 6 inches in width	11,975	928,639	4,465	452,428
Boiler or other plate iron or steel, except crucibles and saw-plate steel	20	967	(1)	11
Sheets or plates of iron or steel	11	13,017	16	16,951
Steel ingots, blooms, and slabs	20	4,009	4	179
Billets, solid or hollow	814	90,907	491	54,094
Die blocks or blanks; shafting, etc.	99	7,847	13	3,102
Circular saw plates	58	23,659	21	10,062
Sheets of iron or steel, common or black and boiler or other plate iron or steel	840	31,287	2	254
Sheets and plates and steel, n. s. p. f.	677	39,528	114	20,179
Tin plate, terneplate, and tagger's tin	111	24,809	153	39,422
Manufactures:				
Structural iron and steel	44,277	1,351,831	859	38,358
Rails for railways	7,862	175,814	1,467	32,132
Rail braces, bars, fishplates or splice bars, and tie plates	857	29,800	312	18,421
Pipes and tubes:				
Cast-iron pipe and fittings	2,062	69,732	502	15,619
Other pipes and tubes	34,258	2,621,288	3,444	432,003
Wire:				
Barbed	17,079	926,511	959	7,441
Round iron and steel	2,588	497,233	985	219,741
Baling	226	13,231	10	709
Telegraph, telephone, etc., except copper, covered with cotton jute, etc.	9	3,241	1	1,260
Flat and steel strips not thicker than ¼-inch and not over 16 inches wide	3,532	1,727,657	1,958	1,208,036
Rope and strand	1,863	291,361	587	96,861
Galvanized fencing wire and wire fencing	1,651	89,382	1	30
Hoop or band iron or steel for baling	26,014	855,545	694	21,570
Hoop, band, strips, or scroll iron or steel, n. s. p. f.	497	52,876	10	4,889
Nails	8,162	557,898	126	44,910
Castings and forgings, n. e. s.	1,286	159,370	685	124,830

1 Less than 1 ton.

sources of raw materials and the construction and equipment of new plants are under way, the demand for these products has reached heights far above expectations only a year ago. No information is available regarding the extent of these operations abroad, but it is doubtful that demand will decrease even if they are successful.

Exports of iron ore, pig iron, and ferro-alloys are covered in other sections of this report. All important items in the 1940 movement of iron and steel products gained. Exports of iron and steel scrap (including tin-plate scrap) dropped 21 percent from 1939 and amounted to 3,159,285 net tons. Of the 1940 scrap exports, 93 percent went to four countries—United Kingdom (35 percent), Japan (34 percent), Canada (13 percent), and Italy (11 percent).

Although exports of American iron and steel products in 1940 reached most of the world markets, six countries took 72 percent of the total—United Kingdom, 44.8 percent; Canada, 11.4 percent; Japan, 5.0 percent; Argentina, 4.7 percent; Brazil, 3.3 percent; and Union of South Africa 2.8 percent.

Imports for consumption of iron and steel (exclusive of scrap) in 1940 were 81 percent below those in 1939. The import trade was much lower than the export trade. Leading commodities in the 1940 trade, in point of tonnage, were spiegeleisen (17,455 net tons imported against 42,856 tons in 1939), pig iron (receipts of which dropped to 11,471 net tons from 43,223 tons), and ferromanganese (of which only 11,613 tons were received in contrast with 46,175 tons in 1939). Imports came principally from Canada, Sweden, Norway, and British India. Imports of scrap in 1940 were small, totaling only 2,199 net tons (93 percent below 1939), and came largely from Mexico, Canada, and Sweden.

MANGANESE AND MANGANIFEROUS ORES

By Robert H. Ridgway, H. W. Davis, and Allan F. Matthews [1]

SUMMARY OUTLINE

War in Europe, a 27-percent increase in American steel production, and the stock-piling of strategic minerals by the United States Government exercised an outstanding influence on the manganese industry in 1940. The U. S. S. R., British India, Union of South Africa, Gold Coast, and Brazil in 1940 probably continued to produce over 85 percent of the world supply. The Union of South Africa diverted a large proportion of its output from Europe to the United States. Cuba and the Philippine Islands, whose ores have the advantage of entering the United States duty free, stepped up their yield to meet American demands. Shipping restrictions were felt in 1940, and ocean-freight and war-risk-insurance rates increased sharply. Except for this, the controlled price of manganese ore in the United Kingdom remained throughout 1940 at pre-war levels; the basis for ferro-grade Indian ore was about 1s. 2d. per unit c. i. f.[2] Quoted prices of foreign manganese ore at United States ports increased 3 to 7 cents per long-ton unit during 1940, but those of Cuban ore decreased 4 cents per unit. American ferromanganese and spiegeleisen prices increased $20 and $4, respectively, in the middle of 1940. Most of the large manganese-consuming countries in the world exercised tight control over their supplies of the strategic metal, but there were no restrictions on manganese consumption in the United States during 1940.

Manganese mining in the United States improved somewhat in 1940 but supplied only 3 percent of the apparent domestic consumption and less than 1 percent of the world output. Mine shipments totaled 40,123 long tons of manganese ore (35 percent or more Mn) in 1940 compared with the high of 305,869 tons in 1918. Between 1906 and 1940, inclusive, domestic mines shipped 1,433,669 long tons of manganese ore. Manganese deposits in the United States and methods of beneficiating ores were studied intensively during 1940, and the results are expected to be evidenced in greatly increased production during the next few years. Imports from Latin America and the Philippine Islands were encouraged during 1940. Brazilian manganese deposits will be far more accessible after railroad service from the mines to the coast is rehabilitated as planned. Bonded

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.
[2] Metal Bulletin (Lond.), No. 2549, December 10, 1940, p. 11.

stocks of manganese ore in the United States were greater at the end of 1940 than at any time in history. Estimated supplies of manganese on hand, afloat, or readily available to the United States at the end of 1940 were equal to 2 years' supply at maximum requirements as then foreseen. Shipments from furnaces in the United States of ferromanganese and spiegeleisen increased 51 percent and 26 percent, respectively, in 1940 compared with 1939. Manganese products exported from the United States on and after July 5, 1940, were subjected to licensing requirements; such commodities were stated to include "manganese ores or concentrates containing 45 percent or more of metallic manganese and alloys containing in excess of 10 percent metallic manganese."

Salient statistics of the manganese industry in the United States, 1925–29 (average) and 1936–40, in long tons

	1925–29 (average)	1936	1937	1938	1939	1940
Manganese ore:						
Total shipments containing 35 percent or more Mn	59,312	32,119	40,241	25,321	29,307	40,123
Shipments of metallurgical ore	[1] 41,892	18,557	26,419	16,989	18,580	27,158
Shipments of battery ore	17,420	7,747	6,447	4,959	7,767	9,271
Imports for consumption	600,000	813,362	911,919	483,586	627,131	1,282,079
Stocks in bonded warehouses at end of year	304,000	366,381	681,290	842,048	903,561	913,016
Indicated consumption (35 percent or more Mn)	659,000	848,491	954,503	509,930	656,438	1,322,202
Ferro-alloys:						
Production of ferromanganese	306,360	316,000	376,443	242,994	270,111	459,538
Imports of ferromanganese [2] [3]	[4] 50,590	30,593	23,888	21,118	33,414	8,573
Production of spiegeleisen	95,463	95,137	([5])	11,311	91,491	101,892
Imports of spiegeleisen [2]	7,298	52,011	16,841	17,248	38,264	15,585
Exports of spiegeleisen and ferromanganese	3,769	466	1,725	247	2,923	13,036
Stocks of ferromanganese in bonded warehouses	[3] [4] 7,765	9,902	11,788	8,392	4,253	1,514

[1] Includes small quantity of miscellaneous ore.
[2] Imports for consumption.
[3] Manganese content.
[4] Includes small quantity of other manganese alloys.
[5] Bureau of Mines not at liberty to publish figures.

Strategic aspects of manganese.—Manganese is one of the most vital strategic metals as far as this country is concerned because about 12.5 pounds are needed to desulfurize and deoxidize every short ton of steel, because 97 percent of the present supply must be imported (fig. 1), and because substitution would be extremely difficult. Only high-grade ore (48 percent or more Mn) is generally used in the manufacture of standard "ferro" grades, the form in which manganese is usually added in steel manufacture, so only high-grade ore is considered strategic. Although there are large quantities of low-grade manganese ore in the United States, domestic supplies of high-grade ore are small because few such deposits exist and because the capacity of plants to beneficiate the low-grade ores remains insignificant.

The strategic aspects of manganese in the national defense program are under the constant surveillance of R. C. Allen, consultant, ferrous minerals and alloys, Office of Production Management, but priorities on manganese ores or alloys were not instituted during 1940. Acting in an advisory capacity is the Technologic Committee on Manganese of the National Academy of Sciences and the National Research Council, an organization appointed on July 25, 1940, to review projects for developing new processes for recovery of manganese from low-grade domestic ores and to study conservation of manganese for the Office of

Production Management. The committee is composed of nine eminent scientists and engineers from Government and industry. During 1940, the committee issued two reports [3] showing how ferromanganese requirements in the United States during an emergency period could be reduced at least 40 percent. An abstract of these reports follows:

Under emergency conditions spiegeleisen could be substituted for at least 20 percent of the required ferromanganese. This substitution could be facilitated and even further extended by the manufacture of spiegeleisen with a higher manganese content than the usual 20 percent Mn, and this could be done using domestic ores. Another 20-percent saving in ferromanganese requirements could be ob-

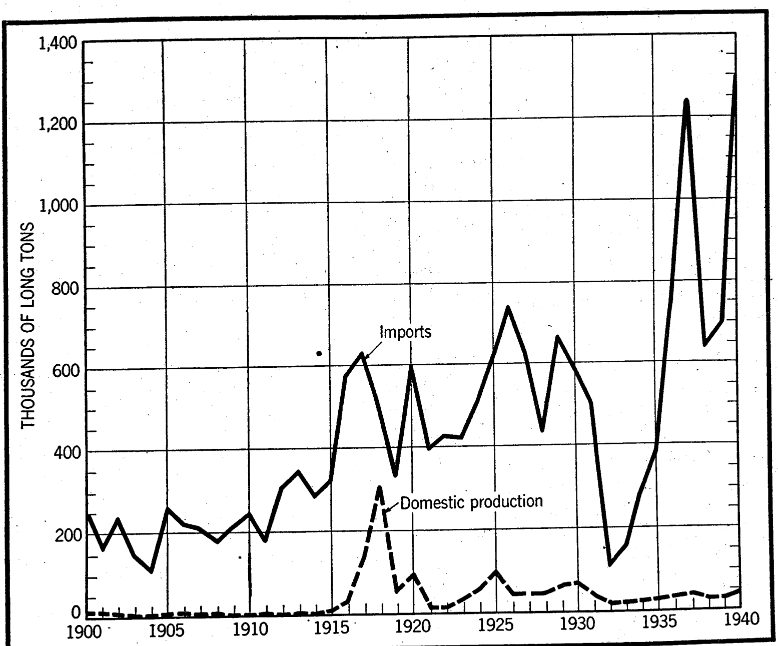

FIGURE 1.—Imports and domestic production (mine shipments) of manganese ore, 1900–1940. Statistics on imports shown in the graph represent "general imports" for the period 1900–1933; beginning with 1934, data classified as "general imports" were not available, and the figures plotted for 1934–40 represent imports for consumption adjusted for changes in stocks in bonded warehouses and are closely comparable with the record for earlier years.

tained by following these practices: (a) Where the maximum permissible content of phosphorus could be raised, a greater proportion of basic open hearth slag could be returned to the blast furnace. (b) The slag volume in the open-hearth furnace could be lowered by decreasing the silicon content of the pig iron and keeping silica from other sources to a minimum. (c) Ladle additions of manganese rather than furnace additions should be used to the fullest practicable extent. Use of a preliminary deoxidizing addition (such as 10- to 15-percent ferrosilicon) is recommended where feasible. (d) Equivalent physical properties may be obtained by substituting other (more expensive) metals for manganese in many of the higher-manganese steels.

Government stock pile.—The Strategic Materials Act (Public, No. 117, 76th Cong., 1st sess., ch. 190), which was signed by the President June 7, 1939, authorized the expenditure of $100,000,000 over a

[3] Office of Production Management, Technologic Committee on Manganese, Emergency Conservation of Manganese. The use of Spiegel as a Substitute for Ferromanganese: PM 89, February 21, 1941, pp. 1–11.

4-year period for the purchase of strategic materials. Of all strategic mineral commodities, manganese ore is required in the largest quantities. Two agencies of the United States Government—the Metals Reserve Co. (a subsidiary of the Reconstruction Finance Corporation) and the Procurement Division of the Treasury Department—are signing contracts with domestic producers and with importers for the delivery of ferro-grade manganese ore to Government stock piles over a period of years. The following table, which shows the status of this activity in 1940, is based upon data courteously supplied by the respective agencies.

Contracts and deliveries of manganese ore to the United States Government, 1940, by States and countries of origin, in long tons

Origin	Metals Reserve Co.		Treasury Department		Total deliveries
	Contracted	Deliveries	Contracted	Deliveries	
United States:					
California	80,000				
Colorado	20,000				
Montana	400,000				
Nevada	150,000		7,500		
New Mexico	240,000				
Pennsylvania	180,000				
Tennessee	15,000				
Virginia	100,000				
West Virginia	150,000				
Total domestic	1,335,000		7,500		
Other countries:					
Brazil	18,000				
Chile	2,000	2,000			2,000
Cuba	248,000		2,500		
India, British	283,700	14,700	7,918	7,952	22,652
Mexico	10,000				
Philippine Islands	53,000	3,500	31,500	27,155	30,655
Union of South Africa	199,500	8,600	13,882	14,046	22,646
U. S. S. R.	1,000	1,000			1,000
Total foreign	815,200	29,800	55,800	49,153	78,953
Total	2,150,200	29,800	63,300	49,153	78,953

One of the largest contracts was with the Anaconda Copper Mining Co., Butte, Mont., which is to supply 80,000 long tons of nodulized rhodochrosite ore containing at least 55 percent Mn annually for 3 years. The ore will come from the Emma mine and adjacent property in Butte and will be treated at a plant expected to be finished in May 1941. The Cuban purchases are also particularly significant because delivery is virtually assured in contrast to the uncertainty attached to shipments from other overseas sources.

Government exploration.—Under section 7 of the Strategic Materials Act, the Bureau of Mines and the Geological Survey are searching for and appraising ore deposits containing strategic metals. The bill authorized the expenditure of $500,000 a year ($350,000 by the Bureau of Mines and $150,000 by the Geological Survey) for each of the fiscal years ending June 30, 1940, 1941, 1942, and 1943.

By the end of the spring of 1941, 375 selected manganese deposits in Alabama, Arizona, Arkansas, California, Colorado, Georgia, Montana, Nevada, New Mexico, North Carolina, Tennessee, Texas, Utah, Virginia, Washington, and West Virginia had been examined by Bureau of Mines engineers. About 1 property in 10 of these more-or-less-selected properties probably would warrant exploration projects of various kinds, chiefly by trenching and diamond drilling, if adequate funds should be available. Detailed prospecting had been undertaken by the Bureau on 19 of the deposits examined by April 1941.[4] The results are summarized in the following paragraph. It is essential to bear in mind, when considering this appraisal, that almost all of the ore developed is of subcommercial grade and would require concentration or processing of some sort to make it usable for metallurgical purposes.

The existence in *Arizona* of several million tons of manganiferous ore containing 761,000 tons of metallic manganese in previously known deposits was substantiated by diamond drilling. Elsewhere in the State are estimated to be 121,000 tons of manganiferous material containing 28,000 tons of metallic manganese and 150,000,000 tons of 3½-to 5-percent material carrying 5,000,000 tons of manganese. In the Batesville-Cushman district of *Arkansas* 350,000 tons of wad ore estimated to contain 80,000 tons of metallic manganese have been revealed to date. It is expected that further exploration will indicate about three times that tonnage. One deposit in *California* has 57,500 tons of manganiferous ore with a metal content of 16,000 tons, and 13 other properties in the State account for 225,000 tons of ore containing 63,000 tons of metallic manganese. Known reserves in *Nevada's* Las Vegas district have been increased to 1,280,000 tons of ore equivalent to 312,500 tons of manganese metal. Reserves in the Virgin River area of Nevada are estimated at 100,000 tons of metallic manganese and in Lander and Pershing Counties at 300,000 tons of ore carrying 60,000 tons of metallic manganese. In *New Mexico*, work on one deposit has indicated 220,000 tons of manganiferous ore containing 46,000 tons of metal. In the Drum Mountains of *Utah* are reserves of 200,000 tons of ore carrying 30,000 tons of metallic manganese and elsewhere in the State at least 33,000 tons of ore containing 7,400 tons of manganese. In *Washington* a small, high-grade deposit now being worked has an estimated reserve of 11,000 tons of ore containing 5,500 tons of metallic manganese. Three other properties in the State are believed to aggregate 25,000 tons of ore or 6,500 tons of metallic manganese.

The possibilities of manganese production at Leadville, Colo., were studied by Hedges,[5] who states that the district contains over 2,000,000 tons of ore carrying 16 to 25 percent Mn but that the ore has mineralogical associations that would make recovery of the manganese very expensive. Furthermore, most of the mines are under water and a million dollars and 2 years' time would be needed for rehabilitation.

The Geological Survey examined many manganese deposits during 1940. Reports were published on those in the Little Florida Mountains, New Mexico,[6] and the Philipsburg district, Mont.[7]

Government beneficiation tests.—Since it has been ascertained that the tonnage of high-grade manganese ore in the United States is relatively small, it is apparent that large-scale production of manganese is possible only through beneficiation of low-grade material. With this in mind, a $2,000,000 Government appropriation, authorized by Public, No. 667, 76th Congress, in the summer of 1940, was made available in the fall of 1940 to the Bureau of Mines for the construction and operation of pilot plants to beneficiate low-grade manganese ores (1 to 30 percent Mn), for the production of metallic manganese from such ores, and for the development of manganiferous deposits.

[4] Mining Division Staff, Exploration and Sampling of Domestic Deposits of Strategic Minerals by the Mining Division, Bureau of Mines. Report of Progress as of May 1, 1941: Bureau of Mines Rept. of Investigations 3574, 1941, pp. 1–6.
Jackson, Chas. F., Annual Report of the Mining Division: Bureau of Mines Rept. of Investigations 3536, 1940, pp. 7–12.

[5] Hedges, J. H., Mineral Industries Survey of the United States. Colorado-Lake County. Possibilities of Manganese Production at Leadville, Colo.: Bureau of Mines Inf. Circ. 7125, 1940, pp. 1–23.

[6] Lasky, S. G., Manganese Deposits in the Little Florida Mountains, Luna County, N. Mex.: Geol. Surv. Bull 922–C, 1940, pp. 55–73.

[7] Goddard, E. N., Manganese Deposits at Philipsburg, Granite County, Mont.: Geol. Surv. Bull. 922–G, 1940, pp. 157–204.

Microscopic studies of the physical characteristics of some low-grade manganese ores were made by Head,[8] who found that many of the low-grade manganese ores will require fine-grinding to 65-mesh or smaller to liberate the included gangue particles. Ore-dressing tests were made in 1940 on low-grade manganese ores from Idaho, Nevada, and Utah; in most instances, by using a combination of methods, plus-48-percent Mn concentrates resulted. Experiments on matte smelting of manganiferous ores from Colorado, Idaho, Minnesota, South Dakota, and Utah are under way.[9] Preliminary results indicate that a matte containing 50 to 55 percent Mn, 5 to 8 percent iron, and 33 to 35 percent sulfur (which would be suitable for the manufacture of ferromanganese) can be produced. In 1940 the Bureau of Mines began to build several pilot plants near Boulder Dam in Clark County, Nev. Ore from the Three Kids mine in Nevada and from the Artillery Peak district in Arizona will be used first. Funds were also set aside for building a pilot plant at Chamberlain, S. Dak., to test the low-grade ores along the Missouri River in South Dakota.[10] Testing has shown that low-grade ores from Arizona, Minnesota, New Mexico, and Tennessee could be beneficiated to meet specifications for ferromanganese.[11] Methods and costs of mining and beneficiating ores in eastern Tennessee and other Appalachian districts were described by Newton.[12] Concentration tests were run on the ferruginous manganese ore associated with the lead-zinc veins at Leadville, Colo.[13]

DOMESTIC PRODUCTION [14]

The domestic production (shipments from domestic mines) of manganese ore in 1940 increased 37 percent over 1939. Of the manganese ore shipped to metallurgical plants in 1940, 8,333 long tons contained (natural) 48 percent or more Mn; essentially all of this came from Montana.

Manganiferous raw materials shipped by producers in the United States, 1936–40, in long tons

Year	Metallurgical ore (ferrous metallurgy only)				Battery ore	Miscellaneous manganese ore
	Manganese ore (35 percent or more Mn)	Ferruginous manganese ore (10 to 35 percent Mn)	Manganiferous iron ore (5 to 10 percent Mn)	Manganiferous zinc residuum		
1936	18,557	98,962	841,557	124,288	7,747	5,815
1937	26,419	151,955	1,189,017	115,998	6,447	7,375
1938	16,989	33,620	275,240	39,079	4,959	3,373
1939	18,580	239,544	469,703	129,238	7,767	2,960
1940	27,158	320,006	816,541	154,455	9,271	3,694

[8] Head, R. E., Progress Reports—Metallurgical Division. 44. Microscopic Studies. Physical Characteristics of Some Low-Grade Manganese Ores: Bureau of Mines Rept. of Investigations 3560, 1941, pp. 1-12.

[9] Wood, C. E., Barrett, E. P., and Porath, P. R., Progress Reports—Metallurgical Division. 41. Matte Smelting of Manganese: Bureau of Mines Rept. of Investigations 3545, 1940, pp. 1-15.

[10] Gries, J. P., and E. P. Rothrock, Manganese Deposits of the Lower Missouri Valley in South Dakota: South Dakota State Geological Survey Rept. of Investigations 38, 1941, pp. 1-96.

[11] Dean, R. S., Progress Reports—Metallurgical Division. 42. Annual Report of the Metallurgical Division, Fiscal Year 1940: Bureau of Mines Rept. of Investigations 3547, 1941, pp. 50-51, 54. Davis, E. W., and Firth, C. V., Ferro-grade Manganese Ore from the Cuyuna Range, Minnesota: University of Minnesota, Mines Experiment Station, December 1, 1940, pp. 1-101.

[12] Newton, Edmund, Mining and Beneficiation of Appalachian Manganese Ores: Bureau of Mines Inf. Circ. 7145, 1941, pp. 1-46.

[13] De Vaney, F. O., and Shelton, S. M., Concentration of Manganosiderite Ore from Leadville, Colo.: Bureau of Mines Rept. of Investigations 3513, 1940, pp. 1-6.

[14] Throughout this chapter, unless otherwise indicated, percentages expressing the manganese content of ores refer to ores in the natural (undried) state.

Shipments of the various grades of manganese ore during the last 5 years are given, by States, in the following tables. In addition, battery-grade ores were produced in Montana; manganiferous zinc residuum was produced from New Jersey zinc ores; and miscellaneous manganese ores came from Alabama, Arizona, Montana, Tennessee, and Virginia.

Metallurgical manganese ore shipped from mines in the United States, 1936–40, by States, in long tons

State	1936	1937	1938	1939	1940	State	1936	1937	1938	1939	1940
Alabama	377	31	111	103	57	North Carolina				43	
Arizona					311	Tennessee	2,679	1,214	3,603	7,306	6,983
Arkansas	4,557	3,931	2,987	5,365	6,079	Texas		38			
California					158	Utah	1,635	32		50	27
Colorado					224	Virginia	196	952	1,314	475	1,043
Georgia	3,821	689	3,058	2,646	3,572	Washington				10	
Montana	5,154	16,854	5,300	2,243	8,230	West Virginia	138	1,800	56		219
Nevada					210						
New Mexico		878	560	339	45		18,557	26,419	16,989	18,580	27,158

Ferruginous manganese ore shipped from mines in the United States, 1936–40, by States, in long tons

State	1936	1937	1938	1939	1940	State	1936	1937	1938	1939	1940
Alabama	540	279	356	519	342	Montana	20,307	19,660	452	2,121	3,617
Arkansas	3,285	7,509	3,477	1,970	1,075	Nevada		533			4,613
California					87	New Mexico	170	18,581	6,093	31,999	36,835
Colorado	10,568	11,577	655	7,516	3,303	North Carolina				51	190
Georgia	2,717	4,045	2,807	7,156	10,088	Tennessee	104	902	456	294	2,327
Idaho				163	313	Utah	2,974	3,436		262	2,102
Massachusetts			230	649	1,900	Virginia	874	1,170	1,670	4,584	4,482
Michigan	9,627										
Minnesota	47,796	84,263	17,424	182,260	248,732		98,962	151,955	33,620	239,544	320,006

Manganiferous iron ore shipped from mines in the United States, 1936–40, by States, in long tons

State	1936	1937	1938	1939	1940
Alabama		149			
Georgia	427	5,492			205
Michigan		9,739	16,057		18,617
Minnesota	840,725	1,173,637	259,183	469,703	797,642
Virginia					77
Wisconsin	405				
	841,557	1,189,017	275,240	469,703	816,541

Alabama.—Manganese ore was shipped in 1940 from Walnut Grove, Etowah County, by J. B. Bynum and by R. F. Jefferies, F. C. Curvin, and Dorris Mars. Shipments were also made by the Manganese Corporation, which buys ore from numerous small operators in Alabama and Georgia and mills it at Anniston, Ala. Shipments comprised 57 long tons averaging 43.9 percent Mn to metallurgical plants and 186 tons averaging 37.6 percent Mn for miscellaneous uses. Shipments of ferruginous manganese ore were made from Calhoun and Cherokee Counties and averaged 30.7 percent Mn.

Manganese and manganiferous ores shipped by mines in the United States in 1940, by States

	Ore containing 35 percent or more Mn			Ore containing 10 to 35 percent Mn			Ore containing 5 to 10 percent Mn		
	Shippers	Long tons	Value	Shippers	Long tons	Value	Shippers	Long tons	Value
Metallurgical:									
Alabama	1	57	(1)	2	342	(1)			
Arizona	3	311	$4,027						
Arkansas	2	6,079	(1)	1	1,075	(1)			
California	2	158	(1)	1	87	(1)			
Colorado	1	224	(1)	1	3,303	(1)			
Georgia	5	3,572	68,508	10	10,088	$63,218	1	205	(1)
Idaho				1	313	(1)			
Massachusetts				1	1,900	(1)			
Michigan							1	18,617	$2,002,673
Minnesota				3	248,732	935,679	4	797,642	
Montana	[2] 1	8,230	(1)	1	3,617	(1)			
Nevada	1	210	(1)	1	4,613	(1)			
New Mexico	1	45	(1)	2	36,835	(1)			
North Carolina				1	190	(1)			
Tennessee	[2] 6	6,983	105,022	2	2,327	(1)			
Utah	1	27	(1)	7	2,102	13,134			
Virginia	[2] 9	1,043	16,583	5	4,482	29,903	2	77	(1)
West Virginia	1	219	(1)						
Undistributed			423,532			302,726			709
Total metallurgical	34	27,158	617,672	39	320,006	1,344,660	8	816,541	2,003,382
Battery: Montana	[3] 2	9,271	458,966						
Miscellaneous:									
Alabama	2	186							
Arizona	1	58	51,969						
Montana	[2] 2	1,842							
Tennessee	[2] 10	435	15,714						
Virginia	[2] 9	1,173	24,703						
Total miscellaneous	24	3,694	92,386						
	51	40,123	1,169,024	39	320,006	1,344,660	8	816,541	2,003,382

[1] Included under "Undistributed."
[2] 1 producer in Montana, 3 in Tennessee, and 5 in Virginia shipped both metallurgical and miscellaneous ore.
[3] Mills through which all ore was shipped; producers not counted.

Arizona.—Shipments of manganese ore were made in 1940 by R. B. Silverman, Tombstone, Cochise County; W. W. Linesba, Winslow, Coconino County; Norman W. McGregor, Artillery Peak district, Mohave County; and Bradley & Ekstrom, Mayer, Yavapai County. Of this ore, 311 tons averaging 43.7 percent Mn went to metallurgical plants, and 58 tons averaging 52.1 percent Mn was for miscellaneous uses.

Arkansas.—Two shippers—Walter H. Denison Manganese & Contracting Co., Inc., and Arkansas Manganese Co.—supplied the Arkansas total of 6,079 long tons of manganese ore in 1940 from operations in the Batesville-Cushman district of Independence County. The ore averaged 44.2 percent Mn. In addition, the former company shipped ferruginous manganese ore averaging 23.7 percent Mn. Late in 1940 the North American Manganese Corporation opened a mine in northern Pike County near Glenwood and stockpiled 500 tons of ore.

California.—S. F. Brock, at Baker, San Bernardino County, and West Coast Chrome Co., Patterson, Stanislaus County, produced California's 1940 output of manganese ore, which averaged 41.8 percent Mn. From Silver Lake and Yermo in San Bernardino

County, Natural Resources, Inc., shipped ferruginous manganese ore averaging 31.0 percent Mn.

Colorado.—In 1940 J. D. Thomas shipped manganese ore averaging 39.7 percent Mn from the Paymaster mine in Gunnison County. From the All Right mine in Leadville the Chrysolite Co. shipped ferruginous manganese ore averaging 15.6 percent Mn, but operations ceased after March 31, 1940.

Georgia.—The White Manganese Corporation (purchased at the close of 1940 by J. M. Neel) and the Knight & Beatty Mining Co. made most of the 1940 shipments of manganese ore, which averaged 41.1 percent Mn and came chiefly from the Cartersville district, Bartow County. Shipments of ferruginous manganese ore averaging 18.6 percent Mn and of manganiferous iron ore averaging 6.4 percent Mn came from Bartow and other counties. Between 1886 and 1940, inclusive, the Cartersville district has produced about 175,000 long tons of manganese ore, 225,000 of ferruginous manganese ore, and 51,000 of manganiferous iron ore. The geology of these deposits was described by Kesler of the Geological Survey.[15]

Idaho.—The Lava Manganese Mining Co., operating the Vanza mine in Bannock County, shipped ferruginous manganese ore containing 31.8 percent Mn in 1940.

Massachusetts.—Anson G. Betts shipped ferruginous manganese ore averaging 25 percent Mn in 1940 from the Taconic mine in Hampshire County.

Michigan.—The Castile Mining Co. in 1940 shipped ferruginous iron ore averaging 6.04 percent Mn and 46.27 percent iron from the Eureka mine in Iron County.

Minnesota.—All 1940 shipments of manganese-bearing ore (that is, ore containing 5 percent or more Mn), came from the Cuyuna range in Crow Wing County. The ferruginous manganese ore averaged 13.02 percent Mn and 33.68 percent iron and came from the Alstead-Hillcrest, Louise, and Merritt mines. The manganiferous iron ore contained 7.34 percent Mn and 38.28 percent iron and came from the Louise, Mahnomen, Sagamore, Merritt, Armour No. 1, and Hopkins mines.

Montana.—Shipments of manganese ore in 1940 from Montana, the largest producing State, totaled 19,343 long tons—a 74-percent gain over 1939. The portion of this shipment destined for metallurgical plants was nodulized rhodochrosite averaging 58.8 percent Mn from the Emma mine near Butte. This mine also supplied the tonnage of selected crude rhodochrosite containing 39.9 percent Mn going to miscellaneous consumers. All the battery-grade ore, except for a single ton, came from the Philipsburg district and averaged about 70 percent MnO_2. Shipments of ferruginous manganese ore comprised 2,686 long tons of ore and 931 of tailings from operations at the Trout mine in the Philipsburg district.

Nevada.—Manganese ore averaging 35.8 percent Mn was shipped in 1940 by Hollis E. Chatwin and R. H. Richards from the Black Diabalo mine in Humboldt County. Shipments of ferruginous manganese ore carrying 27.9 percent Mn were made from the same mine.

New Mexico.—A little manganese ore averaging 48.2 percent Mn was shipped in 1940 from the Black Mask mine by the Newalpitt

[15] Kesler, Thomas L., Structure and Ore Deposition at Cartersville, Ga.: Am. Inst. Min. and Met. Eng. Tech. Pub. 1226, Mining Technol., September 1940, pp. 1–18.

Corporation. Shipments of ferruginous manganese ore averaged 13.2 percent Mn and were made almost exclusively by the Luck Mining & Construction Co. from the Boston Hill mine near Silver City, Grant County.

North Carolina.—Weber, Magann & Co. in 1940 shipped ferruginous manganese ore averaging about 33 percent Mn from the North Cove mine in McDowell County.

Tennessee.—Shipments of manganese ore in 1940 from Tennessee (the second largest producing State) averaged 36.3 percent Mn for the tonnage going to metallurgical plants and 43.9 percent Mn for that sold to other consumers. The principal producers were the Embree Iron Co., Embreeville, Unicoi County, and the East Tennessee Manganese Co., Neva, Johnson County. Ferruginous iron ore shipped averaged 31.5 percent Mn. The mining of manganese in the Embreeville district was described by Reichert.[16]

Utah.—A small quantity of manganese ore, containing 37.3 percent Mn, was shipped by J. E. Stafford from a mine near Floy and was the only shipment of such ore from Utah in 1940. Shipments of ferruginous manganese ores averaged 28.4 percent Mn and for the most part were made by the Chief Consolidated Mining Co., Eureka, Utah County, and by the Ward Leasing Co., Delta, Juab County.

Virginia.—In 1940, shipments of manganese ore to metallurgical plants averaged 41.0 percent Mn and to miscellaneous industries 44.5 percent Mn. It was mined in Appomattox, Bland, Campbell, Craig, Page, and Smyth Counties. Shipments of ferruginous manganese averaged 19.9 percent Mn and came from Augusta, Bland, and Smyth Counties. A little manganiferous iron ore containing about 6.5 percent Mn and 36 percent iron was shipped from Augusta and Smyth Counties.

Washington.—No manganese-bearing ore was shipped from Washington in 1940.

West Virginia.—Some manganese ore averaging 44 percent Mn was shipped in 1940 by the Appalachian Ores Co. from the Sweet Springs mine in Monroe County.

IMPORTS OF MANGANESE ORE

Imports for consumption of manganese ore containing 35 percent or more Mn increased 104 percent in 1940 over 1939, and comprised 1,254,674 long tons of metallurgical ore containing 601,943 tons of manganese valued at $17,635,455 and 27,405 tons of battery-grade ore containing 15,158 tons of manganese valued at $596,432. All contributing countries made larger shipments, but especially large increases were noted from the Union of South Africa, the Philippine Islands, and Brazil. The U. S. S. R., Gold Coast, and British India—the three largest sources in 1940—supplied 58 percent of the total. Of the battery-grade ore, 20,271 tons came from the Gold Coast, 4,297 tons from the Union of South Africa, 2,799 tons from British India, and 38 tons from France.

General imports (containing 35 percent or more Mn), which represent the movement of ore into this country, exceeded imports for consumption and totaled 1,294,316 long tons containing 615,943 tons of manganese. Of this quantity of ore, 241,014 tons came from Gold

[16] Reichert, Stanley, Manganese Ores of the Embreeville District of East Tennessee: Am. Inst. Min. and Met. Eng. Contrib. 117, New York Meeting, February 1941, pp. 1–11.

Manganese ore (35 percent or more Mn) imported for consumption in the United States, 1938–40, by countries

Country	Manganese ore (long tons)			Mn content (long tons)			Value		
	1938	1939	1940	1938	1939	1940	1938	1939	1940
Brazil	29,698	42,713	168,241	13,307	19,499	75,060	$220,328	$366,597	$1,678,395
Chile		49	7,849		23	3,718		300	155,680
Cuba	131,422	105,936	130,646	61,534	51,718	64,175	2,242,425	1,689,547	3,059,735
Gold Coast	126,857	242,923	246,983	63,890	122,769	124,221	1,500,813	3,019,368	4,468,383
India, British	25,480	89,545	189,473	13,121	45,556	95,100	236,945	1,054,718	2,323,880
Netherlands Indies			5,245			2,753			144,131
Philippine Islands	4,002	6,966	43,515	1,600	3,483	21,824	44,075	89,784	627,243
Union of South Africa		3,401	177,739		1,697	78,508		45,716	1,802,537
U. S. S. R.	166,042	135,243	311,748	80,673	68,881	151,367	2,661,557	2,204,304	3,947,766
Other countries	85	353	640	43	184	375	13,254	27,716	24,137
	483,586	627,129	1,282,079	234,168	313,810	617,101	6,919,397	8,498,050	18,231,887

Coast, 238,400 from the Union of South Africa, 221,851 from Brazil, 215,740 from British India, 179,251 from the U. S. S. R., 130,646 from Cuba, 43,515 from the Philippine Islands, and 23,899 from nine other countries. These imports include 26,125 tons of battery-grade ore containing 14,045 tons of manganese, principally from the Gold Coast in the fall of the year.

In addition to the 1940 imports shown in the above table and listed in the preceding paragraph, there were imports of 38,883 long tons of ore (28 percent Mn) containing 11,074 long tons of manganese and valued at $116,758. Of this amount of ore, 14,640 long tons came from Egypt, 14,090 tons from the Union of South Africa, 7,750 from Brazil, 2,400 from Chile, 2 from Canada, and 1 ton from Peru.

STOCKS

Stocks of manganese ore in bonded warehouses rose for the fourth consecutive year and, according to figures of the Bureau of Foreign and Domestic Commerce, reached a peak of 913,016 long tons containing 439,303 tons of metallic manganese at the end of 1940.

PRICES

Prices of manganese ore (except battery ore) are on a unit basis, the unit being 1 percent of a long ton or 22.4 pounds of contained manganese. Prices of battery-grade ore are quoted on a per-ton basis, with a minimum requirement of manganese dioxide.

Prices for domestic metallurgical manganese ore are not quoted, but in 1940 the average value of ores reported to the Bureau was about 50 cents per long-ton unit for ore containing 35 percent or more Mn. Quotations on imported ore in the following table are from Engineering and Mining Journal. A duty of one-half cent per pound of contained manganese is imposed on all imported manganese ore except that from Cuba and the Philippine Islands, which enters duty free.

According to Engineering and Mining Journal, the prices for chemical (battery-grade) ores per long ton in carloads at the end of 1940 were as follows: Domestic, containing 70 to 72 percent MnO_2, f. o. b. mines, $45 to $50; Brazilian or Cuban, 80 percent MnO_2, $50 to $60; Javan or Caucasian, 85 percent MnO_2, nominal.

Domestic prices of metallurgical manganese ore in 1940, in cents per long-ton unit

[C. i. f. North Atlantic ports, cargo lots, exclusive of duty]

	Beginning of year	End of year		Beginning of year	End of year
Brazilian, 46–48 percent Mn	$0.45	$0.48–$0.50	Cuban (not dutiable):		
Chilean, 47–48 percent Mn	.45	.52	50–52 percent Mn	----------	$0.65
South African, 50–52 percent Mn	.49	.55	45–47 percent Mn	$0.59	.55

CONSUMPTION OF MANGANIFEROUS RAW MATERIALS

The following table shows the indicated consumption of manganiferous raw materials in the United States in 1940. 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 figures used in the table are those for imports for consumption only, it is believed that the change in stocks was not great. Imported manganese ore usually is kept in bond until withdrawn for consumption, when the duty is paid and the ore is reported as imports for consumption.

Indicated consumption of manganiferous raw materials in the United States in 1940

	Ore containing 35 percent or more Mn		Ore and residuum containing 10 to 35 percent Mn		Ore containing 5 to 10 percent Mn	
	Long tons	Mn content (percent)	Long tons	Mn content (percent)	Long tons	Mn content (percent)
Domestic shipments	40,123	45	474,461	14	816,541	7.3
Imports for consumption	1,282,079	48	38,883	28	[1] 12,428	6.5
Total available for consumption	1,322,202	48	513,344	15	828,969	7.3

[1] Estimated.

Besides the material shown in the foregoing table, 737,400 long tons of domestic ore containing 2 to 5 percent Mn were used in 1940, presumably in the manufacture of manganiferous pig iron, compared with 652,900 tons in 1939 and 358,200 in 1938. Figures for imports of ore of this class are not available.

METALLURGICAL INDUSTRY

Although some manganese is used in both the ferrous and nonferrous metallurgical industries, the bulk is consumed in the manufacture of iron and steel. Most of the ore entering this industry is used in the manufacture of ferromanganese and spiegeleisen, the forms in which manganese usually is added to steel.

Ferromanganese.—The domestic output of ferromanganese in 1940, which increased 70 percent over 1939, was produced at the following plants:

Bethlehem Steel Co., Johnstown, Pa.
Carnegie-Illinois Steel Corporation, Etna and Duquesne, Pa.
Colorado Fuel & Iron Corporation, Pueblo, Colo.
Electro Metallurgical Co., Alloy, W. Va.
Jones & Laughlin Steel Corporation, Aliquippa, Pa.
E. J. Lavino & Co., Reusens, Va., and Sheridan, Pa.
Sloss-Sheffield Steel & Iron Co., North Birmingham, Ala.
Tennessee Coal, Iron & Railroad Co., Ensley, Ala.
Tennessee Products Corporation, Rockdale, Tenn.

Chief manganese alloys imported into and made from domestic and imported ores in the United States, 1939–40, in long tons

	1939		1940	
	Alloy	Manganese	Alloy	Manganese
Ferromanganese:				
Imported	41,227	33,414	10,369	8,573
Domestic production	270,111	214,040	459,538	365,092
From domestic ore [1]	104	83	7,306	5,773
From imported ore [1]	270,007	213,957	452,232	359,319
Total	311,338	247,454	469,907	373,665
Ratio (percent) of Mn in ferromanganese of domestic origin to total Mn in ferromanganese made and imported		.03		1.54
Number of plants making ferromanganese	8		11	
Spiegeleisen:				
Imported	38,264	[1] 7,653	15,585	[1] 3,117
Domestic production	91,491	18,463	101,892	20,805
From domestic ore [1]	91,114	18,388	101,820	20,794
From imported ore [1]	377	75	72	11
Total	129,755	26,116	117,477	23,922
Ratio (percent) of Mn in spiegeleisen of domestic origin to total Mn in spiegeleisen made and imported		70.41		86.92
Number of plants making spiegeleisen	5		5	
Total available supply of metallic manganese as alloys		273,570		397,587
Percent of available supply of manganese in—				
Ferromanganese and spiegeleisen imported		15.01		2.94
Ferromanganese made from imported ore		78.21		90.38
Spiegeleisen made from imported ore		.03		(2)
Ferromanganese made from domestic ore		.03		1.45
Speigeleisen made from domestic ore		6.72		5.23
Ferromanganese and spiegeleisen made from domestic ore		6.75		6.68
Spiegeleisen made and imported		9.55		6.02
Total open-hearth and Bessemer steel	46,222,068		58,287,193	

[1] Estimated.
[2] Less than 0.01 percent.

In addition to the above plants, shipments were made by the Pittsburgh Metallurgical Co., Niagara Falls, N. Y.

The larger part of the ferromanganese produced in this country is made from foreign ores, as shown in the following table:

Ferromanganese produced in the United States and metalliferous materials consumed in its manufacture, 1936–40

Year	Ferromanganese produced			Materials consumed (long tons)				Manganese ore used per ton of ferromanganese made (long tons)
	Long tons	Manganese contained		Manganese ore (35 percent or more Mn, natural)		Iron and manganiferous iron ores	Cinder, scale, and purchase scrap	
		Percent	Long tons	Foreign	Domestic			
1936	316,000	79.09	249,933	595,114	5,987	12,467	2,821	1.902
1937	376,443	79.54	299,425	698,052	9,444	17,511	6,017	1.879
1938	242,994	78.65	191,104	416,738	22,548	9,696	8,462	1.808
1939	270,111	79.24	214,040	502,986		8,324	6,250	1,862
1940	459,538	79.45	365,092	871,725	11,981	5,258	6,918	1.923

Foreign manganese ore used in manufacture of ferromanganese in the United States, 1936–40, in long tons

Source of ore	1936	1937	1938	1939	1940
Africa	199,143	150,112	152,698	129,227	208,366
Brazil	86,032	112,238	64,060	58,284	169,097
Chile	832	186		856	5,425
Cuba	32,317	60,012	36,295	58,999	100,767
India	105,289	62,199	55,965	86,309	167,928
Philippine Islands					11,400
U. S. S. R.	171,501	313,305	107,720	169,311	167,220
Undistributed					41,522
	595,114	698,052	416,738	502,986	871,725

Shipments of ferromanganese in 1940 increased 51 percent over 1939. The record of shipments during the past 5 years is as follows:

Ferromanganese shipped from furnaces in the United States, 1936–40

Year	Long tons	Value	Year	Long tons	Value
1936	322,353	$24,088,298	1939	296,631	$24,137,211
1937	359,842	30,696,748	1940	449,367	42,755,485
1938	223,720	19,144,884			

There was such a decrease in imports of ferromanganese and such a rise in exports during 1940 that the latter exceeded the former. Ferromanganese imported for consumption in 1940 included 1,409 long tons containing not over 1 percent carbon, 7,254 tons containing over 1 and less than 4 percent carbon, and 1,706 tons containing not less than 4 percent carbon.

Ferromanganese imported into and exported from the United States, 1936–40

Year	Imports for consumption			Exports [1]	
	Gross weight (long tons)	Mn content (long tons)	Value	Gross weight (long tons)	Value
1936	37,953	30,594	$2,251,951	466	$26,540
1937	29,559	23,888	2,163,616	1,725	72,502
1938	26,258	21,118	1,770,948	247	18,799
1939	41,227	33,414	2,935,214	2,923	247,798
1940	10,369	8,573	1,321,369	13,036	1,366,087

[1] Includes spiegeleisen; not separately classified.

Norway supplied virtually all of the imports in 1940. Distribution of imports, by countries, is shown in the following table.

Ferromanganese imported for consumption in the United States, 1939–40, by countries

Country	1939		1940	
	Mn content (long tons)	Value	Mn content (long tons)	Value
Canada	(1)	$50		
Czechoslovakia	2,050	162,091		
France	846	100,905		
Germany [2]	391	24,622		
Japan			35	$2,349
Netherlands	7,974	561,509		
Norway	19,563	1,909,610	8,538	1,319,020
Poland snd Danzig [2]	1,598	118,015		
Sweden	22	3,356		
Yugoslavia	970	55,056		
	33,414	2,935,214	8,573	1,321,369

[1] Less than 1 ton.
[2] For statistical purposes, trade with the Sudeten area, as far as ascertainable, is included with Germany, while trade with the other Czechoslovak Provinces occupied by Germany and Poland has been included with these countries since March 18 or 19, 1939. After November 16, 1939, trade with Danzig and that part of Poland occupied by Germany has been included with Germany.

Customs districts through which imported ferromanganese entered in 1939 and 1940 are as follows:

Manganese content of ferromanganese imported for consumption in the United States, 1939–40, by customs districts, in long tons

Customs district	1939	1940	Customs district	1939	1940
Buffalo	892	992	New York	934	529
Chicago	3,434		Ohio	2,497	
Connecticut	362		Oregon	249	38
Galveston	425		Philadelphia	2,773	
Los Angeles	257	79	San Francisco	296	
Maryland	18,079	6,731	Washington (State)	118	47
Massachusetts	243				
Michigan	1,773			33,414	8,573
New Orleans	1,082	157			

Stocks of ferromanganese in bonded warehouses at the end of 1940 were 1,514 long tons containing 754 tons of Mn compared with 4,253 tons containing 3,603 tons of Mn at the end of 1939.

The quoted price of ferromanganese increased $20 a long ton in July 1940, as shown in the following table.

Prices per long ton of ferromanganese in the United States, 1938–40 [1]

[80 percent—delivered at Pittsburgh]

Month	1938	1939	1940	Month	1938	1939	1940
January	$107.49	$91.58	$105.33	July	$97.77	$85.33	$125.33
February	107.49	85.33	105.33	August	97.77	85.33	125.33
March	107.49	85.33	105.33	September	97.77	95.33	125.33
April	107.49	85.33	105.33	October	97.77	105.33	125.33
May	107.77	85.33	105.33	November	97.83	105.33	125.33
June	107.77	85.33	105.33	December	97.83	105.33	125.33

[1] Steel, vol. 108, January 6, 1941.

Spiegeleisen.—Shipments of spiegeleisen in 1940 increased 26 percent over 1939 and 328 percent over 1938.

Spiegeleisen produced and shipped in the United States, 1936–40

Year	Produced (long tons)	Shipped from furnaces		Year	Produced (long tons)	Shipped from furnaces	
		Long tons	Value			Long tons	Value
1936	95,137	92,336	$2,249,217	1939	91,491	84,739	$2,484,042
1937	(1)	134,983	3,969,822	1940	101,892	106,707	3,487,565
1938	11,311	24,939	728,830				

1 Bureau of Mines not at liberty to publish figures.

Spiegeleisen was manufactured at the following plants in 1940:

Carnegie-Illinois Steel Corporation, Duquesne, Pa.
E. J. Lavino & Co., Reusens, Va.
New Jersey Zinc Co., Palmerton, Pa.
Sloss-Sheffield Steel & Iron Co., North Birmingham, Ala.
Tennessee Coal, Iron & Railroad Co., Ensley, Ala.

Most of the spiegeleisen produced in the United States in recent years has been made from domestic raw materials, but 33 long tons of Cuban ore containing 50.2 percent Mn were consumed in 1940 in the manufacture of spiegeleisen. Imports of spiegeleisen for consumption in 1940 decreased 59 percent compared with 1939. The total supply came from Canada.

Spiegeleisen imported for consumption in the United States, 1936–40

Year	Long tons	Value	Year	Long tons	Value
1936	52,011	$1,404,983	1939	38,264	$1,329,814
1937	16,841	589,766	1940	15,585	638,732
1938	17,248	625,480			

The prices of spiegeleisen (20 percent) at producers' furnaces as quoted by Steel increased $4 a long ton in mid-year to $36.00 a ton.

Manganiferous pig iron.—Precise data on the consumption of manganiferous ores in the production of manganiferous pig iron are not available; however, 816,541 long tons of domestic ore containing 5 to 10 percent Mn and 737,400 tons containing 2 to 5 percent Mn were shipped in 1940. Foreign manganiferous iron ore (12,428 tons) also was consumed in the manufacture of pig iron.

Foreign ferruginous manganese ore and manganiferous iron ore consumed in the United States, 1938–40, in long tons

Source of ore	Ferruginous manganese ore			Manganiferous iron ore		
	1938	1939	1940	1938	1939	1940
Africa	11,753	1,184	184			
Asia:						
Palestine		1,133	36,069			
Philippine Islands	2,887					
Australia				61,473	54,941	11,905
Brazil	2,829		746	9,597	6,831	
Sweden				4,215	985	523
Undistributed	6,005	582				
	23,474	2,899	36,999	75,285	62,757	12,428

Nonferrous manganese alloys.—Production of manganese metal by the electrolytic process developed and patented by the Bureau of Mines was begun late in 1939 at a small commercial plant in Knoxville, Tenn., by the Electro Manganese Corporation of Minneapolis, Minn. Production to the end of 1940 is estimated at 225 metric tons of 99.9+ percent manganese metal, all of which was consumed in nonferrous alloys.[17] The electrolytic process was described by Shelton [18] and Dean.[19]

BATTERY INDUSTRY

Shipments of manganese ore to battery makers by domestic producers in 1940 totaled 9,271 long tons, all from Montana. Imports for consumption of battery-grade ore were 27,405 long tons containing 15,158 tons of manganese.

MISCELLANEOUS INDUSTRIES

The chemical, pottery, and glass industries utilize ores containing about 85 percent MnO_2 and not more than 1 percent iron.

WORLD PRODUCTION

Brazil.—Production of manganese ore in Brazil was at a higher rate in 1940 (especially in the latter half of the year) than in 1939. Exports totaled 217,342 metric tons in 1940 compared with 192,077 tons in 1939 (the low was 2,337 tons in 1934 and the high 541,519 tons in 1917). Nearly all of the 1940 exports went to the United States. Stocks on hand in Rio de Janeiro on December 31, 1940, were 68,212 metric tons compared with 44,275 tons at the end of 1939.

Chile.—During 1940, Chile exported 19,518 metric tons of manganese ore; 19,308 tons went to the United States and 210 tons to the Netherlands.

Cuba.—Exports of manganese ore from Cuba to the United States in 1940 were 132,745 metric tons—23 percent more than in 1939 and less than 1 percent below the record of 1938. All the manganese ore from Cuba is mined in the Province of Oriente, and the principal producer is the Cuban-American Manganese Corporation, operating at Cristo near Santiago.

Gold Coast.—Exports of manganese ore during the first 4 months of 1940 are estimated at 190,000 tons.

Japan.—In 1940 the discovery was announced of deposits estimated to contain 10,000,000 tons of manganese ore at Hsihsien, Chinchow Province, Manchukuo.

Philippine Islands.—Exports of manganese ore averaging 45 to 50 percent Mn totaled 58,038 metric tons in 1940—a 61-percent gain over 1939 and an 18-percent gain over 1938. In 1940 the proportion of exports of manganese ore to the United States rose to 89 percent compared with 32 percent in 1939 and those to Japan dropped to 10 percent from 65 percent in the earlier year. The economics of Philippine manganese was discussed by Boericke.[20]

[17] Leute, K. M., Manganese of High Purity: Metal Progress, vol. 38, No. 4, October 1940, p. 531.
[18] Shelton, S. M., Progress in the Production of Electrolytic Manganese: Bureau of Mines Conference on Metallurgical Research, Salt Lake City, Utah, May 21, 1940, pp. 28–37.
[19] Dean, R. S., Electrolytic Manganese and Its Potential Metallurgical Uses: Min. and Met., vol. 22, No. 409, January 1941, pp. 5–8.
[20] Boericke, W. F., Some Economic Aspects of Philippine Manganese: Eng. and Min. Jour., vol. 141, No. 7, July 1940, pp. 54–57.

Manganese ore produced in principal countries of the world, 1936–40, in metric tons

[Compiled by L. P. Lounsbery]

Country [1]	Percent Mn	1936	1937	1938	1939	1940
North America:						
Canada (shipments)	----------	200	77	----------	359	([2])
Costa Rica	----------	----------	100	304	([2])	([2])
Cuba	36–50+	48,471	131,299	123,844	102,415	119,852
Mexico	40+	3,377	17	117	27	307
United States:						
Continental (shipments)	35+	32,635	40,887	25,727	29,777	40,767
Puerto Rico (exports)	48–51	3,058	2,381	1,039	----------	----------
South America:						
Argentina	35–38	[3] 443	606	437	651	([2])
Bolivia (exports)	50	----------	----------	----------	500	([2])
Brazil	38–50	156,201	253,661	221,961	192,956	([2])
Chile	40–50	5,180	13,014	19,319	12,550	([2])
Peru	----------	----------	157	24	96	([2])
Europe:						
Bulgaria	30–45	1,500	3,000	1,887	944	([2])
Germany	30+	242	226	163	([2])	([2])
Greece	30+	1,680	6,952	7,075	11,178	([2])
Hungary	35–48	27,228	25,088	22,221	([2])	([2])
Italy	34–37	24,132	33,532	48,282	([2])	([2])
Portugal	40+	290	317	557	225	([2])
Rumania	30–36	33,856	50,749	60,256	41,546	([2])
Sweden	30–50	5,943	5,845	5,347	5,934	([2])
U. S. S. R.	41–48	3,002,000	2,752,000	2,272,800	([2])	([2])
Yugoslavia	32–38	2,739	4,420	3,759	5,655	([2])
Asia:						
China (exports)	45–46	23,794	51,446	1,247	1	----------
India:						
British	47–52	826,498	1,068,472	983,464	858,220	([2])
Portuguese	42–50+	2,662	4,077	9,478	8,204	6,525
Indochina	----------	3,430	5,287	2,214	2,440	([2])
Japan	49–51	67,753	([4])	([4])	([2])	([2])
Netherlands Indies	50–55	8,619	11,083	9,687	12,074	([2])
Philippine Islands (exports)	45–50	255	12,206	49,359	35,998	58,038
Turkey	30–50	4,600	530	2,186	3,339	([2])
Unfederated Malay States	30	37,366	33,319	32,483	31,952	([2])
Africa:						
Belgian Congo	56	----------	27,471	7,725	([2])	([2])
Egypt	30+	134,072	186,320	153,112	119,882	([2])
Gold Coast (exports)	50+	417,621	535,495	329,411	341,710	([2])
Morocco:						
French	40–50+	39,360	76,460	86,597	([2])	([2])
Spanish	38	----------	660	152	([2])	([2])
Northern Rhodesia	30–48	3,071	2,379	2,779	3,018	([2])
Union of South Africa	30–51	258,244	631,194	551,739	419,697	412,071
Oceania:						
Australia:						
New South Wales	----------	73	109	221	([2])	([2])
Queensland	----------	----------	1,052	382	([2])	([2])
South Australia	----------	----------	----------	----------	7	([2])
New Zealand	----------	----------	5	91	494	([2])
	----------	5,177,000	6,039,000	5,107,000	([2])	([2])

[1] In addition to countries listed, Belgium and Spain produce manganese ore, but data of output are not available. Czechoslovakia reports a production of manganese ore, but as it has been ascertained that the product so reported averages less than 30 percent Mn and therefore would be considered ferruginous manganese ore under the classification used in this report, the output has not been included in the table.

[2] Data not available.

[3] Shipments by rail and river.

[4] Estimate included in total.

CHROMITE

By Robert H. Ridgway and N. B. Melcher

SUMMARY OUTLINE

Greatly increased steel production resulting from war conditions abroad created unusual demands for chromite in 1940. Although the effect of this higher demand was offset somewhat by the scarcity of ship bottoms and high ocean-freight and war-risk-insurance rates, the world output of chromite may have exceeded the 1937 peak.

The strategic nature of chromite was emphasized during 1940. Germany acquired the smelting facilities of France and Norway and a considerable stock of chromite, but no producing area was occupied. Despite these acquisitions, it is believed that the Axis Powers were short of this valuable raw material. England, on the other hand, bought the entire Turkish output, contracted for a substantial tonnage of Greek ore, and deflected much of the Yugoslav output to friendly channels. These achievements plus dominance of the seas, gave England virtual control of chromite supplies.

Although a number of the principal consuming countries, notably Germany, France, and Norway, were unable to procure chromite during all or part of the year, movement to other important consuming nations increased appreciably. Thus, imports into the United States doubled the 1939 figure in 1940, and were greater than in any other year. This heavy movement into the United States was prompted by a program initiated by the Government and industry to increase stocks as insurance against a more stringent shipping situation. At the end of the year all ore offered was being moved as rapidly as ships were available.

Aside from the enlarged domestic demand for products made from chromite, in connection with this country's defense efforts, there was a heavy demand for chromium alloys and chemicals in export trade. This obtained for two reasons: (1) Necessity of supplying Britain with ferro-alloys, particularly after the fall of Norway, and (2) efforts to supply chromium chemicals to Latin American and British Empire countries that formerly had obtained supplies from the European Continent, principally Germany. The actual outbound movement, however, was restricted somewhat by export licensing the latter part of the year. All these factors lifted the demand for chromite during the closing months of 1940 to an annual rate of over 600,000 tons—somewhat less than the total imports for the year.

Higher prices accompanied the greater demand but were related mostly to increased transportation costs and did not revert to the producers.

Unsettled world conditions and higher prices continued to focus attention on the development of domestic production. Although output was small (less than 3,000 tons), known deposits and promising areas were being examined by private concerns and Government agencies. Alaska, California, Oregon, Montana, Washington, and Wyoming were the scene of much of this activity. So far, however, with the exception of Alaska, exploration has revealed no extensive deposits of high-grade metallurgical ore but has developed deposits suitable for the refractory and chemical industries. The largest output in 1940 came from California, where the principal producer was the Pilliken mine in El Dorado County.

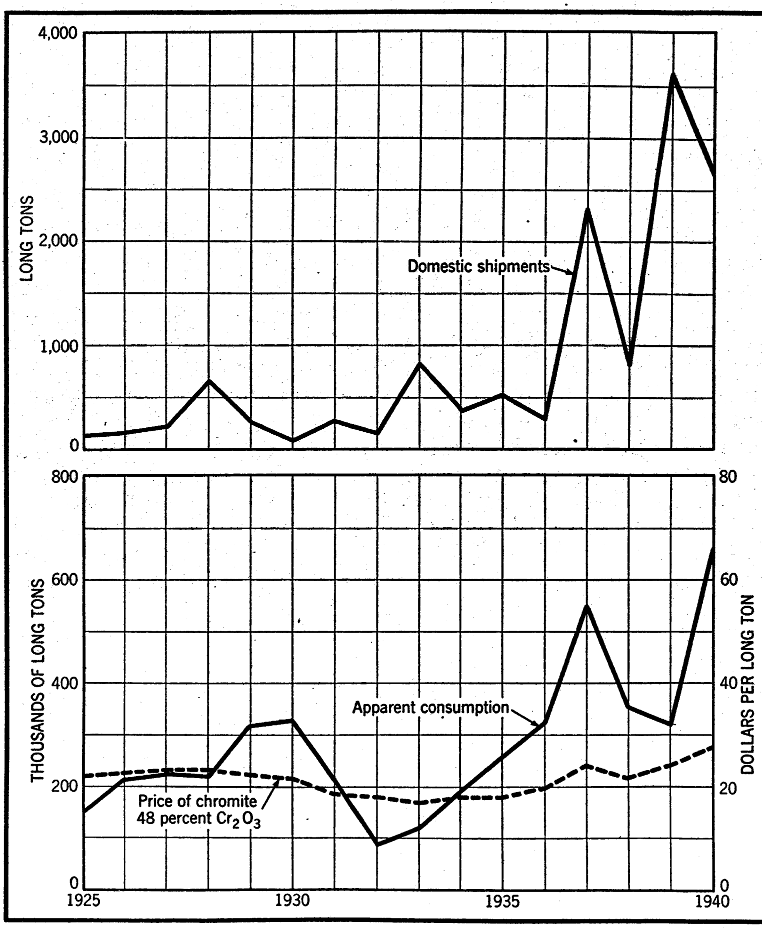

FIGURE 1.—Trends in shipments, domestic prices, and consumption of chromite, 1925–40.

Figure 1 shows trends in domestic shipments, consumption, and prices, during the past 16 years.

The following table compares the salient statistics of the chromite industry during the last 5 years with the yearly average from 1925 to 1929.

Salient statistics of the chromite industry in the United States, 1925–29 (average) and 1936–40

	1925–29 (average)	1936	1937	1938	1939	1940
Apparent available supply:						
Imports......long tons..	224,357	324,258	553,916	352,085	317,511	657,689
Shipments from domestic mines long tons..	276	269	2,321	812	3,614	2,662
	224,633	324,527	556,237	352,897	321,125	660,351
Imports:						
Africa [1]......percent of total..	63	37	50	48	37	43
Cuba......do....	15	22	17	11	21	8
Greece......do....	9	8	5	3	3	2
New Caledonia......do....	6	20	9	8	5	6
Philippine Islands......do....	....	2	8	22	23	24
Turkey......do....	....	6	7	6	5	11
Other countries......do....	7	5	4	2	6	6
World production......long tons..	428,000	1,051,000	1,260,000	1,115,000	1,149,000	(2)

[1] Originated in Southern Rhodesia and Union of South Africa.
[2] Data not available.

Emergency stock pile.—Purchases under the Strategic Materials Act (Public, No. 117, 76th Cong., ch. 190, 1st sess.) continued during 1940. Purchases were restricted largely to the high-priority mineral commodities on the strategic list. Chromite is one of the four mineral commodities comprising the first priority class for stock-pile reserves. Its importance is appreciated more readily when it is realized that the steel industry is charged with three-fourths of the domestic consumption.

The following specifications were drawn for high-grade metallurgical lump ore:

Cr_2O_3 (minimum)	48 percent
Fe (maximum)	⅓ of Cr content
S (maximum)	0.50 percent
P (maximum)	0.20 percent

The specifications also provided that all lumps shall pass a 6-inch screen and that not more than 10 percent shall pass a ½-inch sieve.

On October 31, 1940, the specification on metallurgical lump ore was reduced to 45 percent Cr_2O_3.

During 1940 the Procurement Division of the Treasury Department awarded contracts for the purchase of chrome ore totaling 97,200 gross tons. Deliveries under these contracts totaled 57,254 gross tons during the year. The following table shows contracts and deliveries, by countries, during 1940 in gross tons:

Source:	*Contract quantity*	*Delivery, 1940*
Rhodesia	62,000	29,794
Turkey	28,700	27,460
New Caledonia	6,500	None

Purchases to December 31, 1940, by this agency totaled 182,200 long tons, of which 78,350 tons have been delivered. All chromite delivered is of foreign origin; the contract for ore from Kenai Peninsula, Alaska, was canceled because of nondelivery.

Purchases of refractory and chemical grades of chromite were inaugurated late in the year by the Metals Reserve Co. upon recommendation of the Advisory Commission to the Council of National Defense; 200,000 tons (100,000 tons of refractory from the Philippine Islands and 100,000 tons of chemical from the Union of South Africa) have been purchased, but movement to this country has been delayed by shortage of bottoms.

Government exploration.—Under section 7 of the Strategic Materials Act the Geological Survey and the Bureau of Mines undertook to search for and appraise ore deposits containing metals that have been designated as strategic by the Secretaries of War, Navy, and the Interior upon advice of the Army and Navy Munitions Board. The bill authorized the expenditure of $500,000 a year—$350,000 by the Bureau of Mines and $150,000 by the Geological Survey—for each of the four fiscal years ending June 30, 1940, 1941, 1942, and 1943. The two Bureaus are cooperating closely in order to facilitate accomplishment of the objectives of the act.

The Bureau of Mines, in carrying out its part[1] of the program, seeks to determine (1) the extent and quality of the ore, (2) the most suitable method of mining and beneficiating it, and (3) the cost at which it may be produced.

Chromite deposits in Stillwater County, Mont., which Bureau of Mines surface exploration by trenching and large-scale sampling during 1939 had demonstrated to be extensive, were diamond-drilled during 1940. Although the drilling campaign had to be recessed before its completion because of weather conditions, enough work was done on one group of claims to indicate that the continuity, size, and grade of the deposit down the dip were of the same order as along the strike and that over 1 million tons of ores in workable widths could be estimated to a depth of 300 feet below the outcrop; this depth was the maximum reached by the drilling.

Drilling on another group of claims at high altitude had to be discontinued on account of extreme weather conditions before the downward extension of ore uncovered at surface during 1939 was reached.

Chromite deposits in Siskiyou, Shasta, and Eldorado Counties, Calif., and Chester and Lancaster Counties, Pa., were examined and plans formulated for conducting exploratory projects during 1941 on deposits in Siskiyou and Shasta Counties, Calif., and in Pennsylvania.

The following reports were published by the Geological Survey during 1940 on field work in connection with the strategic minerals investigation:

PEOPLES, J. W., AND HOWLAND, A. L. Chromite Deposits of the Eastern part of the Stillwater Complex, Stillwater County, Mont.
RYNEARSON, G. A., AND SMITH, C. T. Chromite Deposits in the Seiad Quadrangle, Siskiyou County, Calif.
THAYER, T. P. Chromite Deposits of Grant County, Oreg. (a preliminary report).
WELLS, F. G., PAGE, L. R., AND JAMES, H. L. Chromite Deposits of the Pilliken Area, Eldorado County, Calif.
————. Chromite Deposits in the Sourdough Area, Curry County, and the Briggs Creek Area, Josephine County, Oreg.

In line with meeting domestic chromium requirements, investigations of methods for the recovery of chromium from domestic ores have been stressed by the Metallurgical Division of the Bureau of Mines during 1940.[2]

[1] Finch, John W., Strategic Minerals Investigations—Procedure Followed by the Bureau of Mines: Bureau of Mines Inf. Circ. 7097, 1939, pp. 1–5.
[2] Dean, R. S., Progress Reports—Metallurgical Division, 42. Annual Report of the Metallurgical Division Fiscal Year 1940: Bureau of Mines Rept. of Investigations 3547, 1941, pp. 23–25.

To expedite solution of the chromium problem, several methods of attack were followed: (1) Electrolysis in fused baths, (2) electrolysis in aqueous baths, (3) matte smelting, and (4) electrothermal smelting.

Electrolysis of chromium metal from molten baths offered no practical solution. Chromium metal and ferrochromium metal could be formed in a powder, which was difficult to handle. The consumption of energy was about 15 kilowatt-hours per pound of metal. This method was soon abandoned.

Studies of the chromium-iron-sodium-sulfur system were made to determine whether separations similar to those of the Orford nickel process would occur. It was concluded, however, that no Orford-type separations were possible and that no appreciable concentration of chromium could be realized in either the metal or matte layers.

The electrothermal smelting process gives good indication of success and could be used on off-grade domestic chrome ores in times of emergency.

The production of Electrolytic chromium from an aqueous solution of trivalent salts has been the subject of an intensive research campaign. This technique requires only half the energy used for ordinary chromic acid baths.

The electrolysis of chromic sulfate solutions, using insoluble anodes, has been worked out to a point that permits the announcement of laboratory-scale production of electrolytic chromium from trivalent chromium salts at efficiencies of current as high as 63 percent. It is believed that a 45-percent efficiency of current could be obtained in operation on a commercial scale.

DOMESTIC PRODUCTION

Domestic production, as measured by shipments from the mines, decreased to 2,662 long tons in 1940 from 3,614 tons in 1939. Except for a small quantity from Oregon, the entire output was from California. The bulk of the chromite came from the Pilliken mine, where operations during 1940 were conducted by the Rustless Mining Co. The concentrates, all of which were shipped for consumption, contained about 43 percent Cr_2O_3, 22 percent FeO, and 6 percent SiO_2. When the Rustless Mining Co. took over the Pilliken mine on November 1, 1939, it immediately dismantled the mill to install new equipment; plans for increased production have been delayed pending development of new mill practice. Much smaller shipments came from Fresno, Del Norte, Placer, Plumas, Siskiyou, and Shasta Counties, Calif., and from Grant County, Oreg.

The Oregon Department of Geology and Mineral Industries has been studying the commercial possibilities of the chrome content of the black sands along the coast line of southern Oregon. These sands have long attracted miners and investors, usually with little success, but may eventually be developed commercially as a source of chromite.[3] However, this work has not advanced beyond the experimental stage, and no statements as to future production can be made.

[3] Nixon, Earl K., Chromite Recovery from Black Sands May Prove Commercial: Min. World, vol. 4, No. 4, April 1940, p. 22.

Chromite (ores and concentrates) shipped from mines in the United States, 1936–40

[All from California in 1936 and 1938]

Year	Ore containing 45 percent or more chromic oxide		Ore containing 35 to 45 percent chromic oxide		Total	
	Long tons	Value	Long tons	Value	Long tons	Value
1936	(1)	(1)	[1] 269	[1] $2,978	269	$2,978
1937	[2,3] 2,006	[2,3] $11,568	[3,4] 315	[3,4] 3,320	[2,4] 2,321	[2,4] 14,888
1938	[3] 812	[3] 10,730	(3)	(3)	812	10,730
1939	3,056	(5)	[6] 558	(5)	[6] 3,614	46,892
1940	238	2,230	[4] 2,424	[4] 26,554	[4] 2,662	[4] 28,784

[1] Ore containing 45 percent or more chromic oxide included with ore containing 35 to 45 percent.
[2] Includes 288 long tons of ore valued at $880 shipped from mines in Oregon, a small part of which contained 35 to 45 percent chromic oxide.
[3] A small quantity of ore containing 35 to 45 percent chromic oxide included with ore containing 45 percent or more.
[4] Includes a small quantity of ore containing less than 35 percent chromic oxide from California in 1937 and from Oregon in 1940.
[5] Included in total value: Bureau of Mines not at liberty to publish figures separately.
[6] Includes 100 tons of ore from Oregon.

IMPORTS [4]

Imports of chromite in 1940 increased 107 percent from the 1939 total and 19 percent from the previous record year of 1937. Substantial improvement in business conditions and the national defense program created a heavy demand for imports of chromite, which was offset by high shipping and ocean freight rates and scarcity of ship bottoms. The chromite imported in 1940 contained on an average 46 percent Cr_2O_3—a 10-percent increase over 1939, due to larger receipts from Africa; its chromite, particularly that from Rhodesia, is high-grade. Of the principal imports in 1940, those from New Caledonia had the highest content of chromic oxide (53 percent) and those from Cuba the lowest (33 percent). All countries showed a substantial increase in shipments except Cuba, which showed a slight decrease.

Crude chromite imported into the United States, 1936–40, by countries

Country	1936 (long tons)	1937 (long tons)	1938 (long tons)	1939 (long tons)	1940		
					Long tons		Value
					Gross weight	Chromic oxide content	
Africa [1]	120,011	277,420	168,299	118,233	285,559	136,831	$3,969,559
Cuba	69,963	93,098	39,529	66,002	51,955	16,995	345,180
Greece	26,688	24,583	10,000	11,000	14,041	6,174	174,687
India, British	14,795	23,939	4,051	16,468	32,644	16,671	548,045
New Caledonia	65,450	51,831	28,520	14,359	42,861	22,594	599,020
Philippine Islands	4,986	43,648	78,233	71,914	156,566	66,849	1,265,400
Turkey	19,490	39,391	20,392	16,632	70,081	33,638	1,799,861
U. S. S. R.	2,310						
Other countries	565	6	3,061	2,903	3,982	1,920	53,018
	324,258	553,916	352,085	317,511	657,689	301,672	8,754,770

[1] Originated in Southern Rhodesia and Union of South Africa; recorded by Foreign and Domestic Commerce as imported from Union of South Africa, Other British South Africa, Other British West Africa, and Mozambique.

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

The following tables give imports of chromium compounds and alloys into the United States from 1936 to 1940.

Chromium compounds imported for consumption in the United States, 1936–40

Year	Chromic acid		Chromate and dichromate of potash		Chromate and dichromate of soda	
	Pounds	Value	Pounds	Value	Pounds	Value
1936	2,685	$1,225	1,653	$469	909	$198
1937	2,310	1,184	672	330		
1938	525	614	551	163		
1939	1,155	614				
1940						

Ferrochrome or ferrochromium and chrome or chromium metal imported for consumption in the United States, 1936–40, in long tons

Class	1936	1937	1938	1939	1940
Ferrochrome or ferrochromium—					
Containing 3 percent or more carbon (chromium content)	4	96	(1)	3	(2)
Containing less than 3 percent carbon (chromium content)	66	164	121	127	
Chrome or chromium metal	57	78	39	56	(3)

1 60 pounds.
2 1,020 pounds.
3 1,000 pounds.

CONSUMPTION

Owing to lack of published data on consumers' stocks, statistics on actual consumption of chromite in the United States in 1940 cannot be given. However, toward the end of 1940 consumers were using chromite at a rate approaching 600,000 tons per annum. The apparent available supply increased in 1940 in comparison with 1939 because imports were higher even after movement into the Government stock pile was deducted.

Domestic sales, imports, and apparent available supply of crude chromite in the United States, 1936–40 in long tons

Year	Sales from domestic mines	Imports	Apparent available supply	Year	Sales from domestic mines	Imports	Apparent available supply
1936	269	324,258	324,527	1939	3,614	317,511	321,125
1937	2,321	553,916	556,237	1940	2,662	657,689	660,351
1938	812	352,085	352,897				

The steel industry consumes more than three-fourths of the supply of chromite either in refractories or as a source of an important alloying element. The improvement in the steel industry during the entire year increased the demand for chromite and resulted in a rise in price. The domestic automobile industry—one of the important users of alloy steel and chromium plating—expanded its output from 3,577,058 units in 1939 to 4,469,354 in 1940. The construction industry uses stainless steel for decorative purposes and large quantities of chromium-plated plumbing fixtures. Activity in this field, which has been increasing since 1933, improved over 1939 but was only about three-fourths of the average volume of the peak years 1926 to 1929, inclusive.

USES

Industrial uses of chromite fall into three groups—metallurgical, refractory, and chemical.

Metallurgical.—Chromium is one of the principal elements used in the manufacture of alloy steel. For this purpose most of the chromite is converted into ferrochromium in the electric furnace before it is added to the steel bath, although one domestic concern makes chromium-alloy steels in the electric furnace directly from alloy-steel scrap, mild-steel scrap, and chromite. Standard grades of ferrochromium contain 60 to 70 percent chromium, and a lower content generally is not acceptable. Ferrochromium is made in two grades, depending on the carbon content; the high-carbon grade contains 4 to 6 percent carbon, while the low-carbon grade contains less than 2 percent. High carbon ferrochromium is made by smelting chromite in a single-phase electric furnace with coke as a reducing agent. Recovery is approximately 65 percent.[5] Low-carbon grades are produced by smelting the high-carbon alloy with SiO_2 and coke to produce a ferro-chrome-silicon low in carbon, which is then smelted in a Heroult-type furnace. Ores containing 48 to 50 percent Cr_2O_3 and as little iron as possible are required in this process; the chromium-iron ratio should be at least 3:1 as, if the ratio is less, the melt will not yield a 60- to 70-percent chromium content in the ferro even if the ore contains as much as 50 percent Cr_2O_3.

Although chromium is used in many alloy steels, its largest and best-known use is in the manufacture of stainless steels. Increasing quantities are being used also in the field of low-alloy, high-strength steels, where chromium imparts strength and adds to corrosion resistance. In recent years chromium plating has had a wide field of uses and become important industrially, but the amount of raw material consumed is small owing to the thinness of the layer of metal deposited. The nature of hard-chromium deposits and the many uses for hard-chromium plating, including files, gages, bearing surfaces, cutting tools, and molds, have been described by Goodsell.[6]

Refractory.—Chromite with certain physical and chemical properties is used for refractories. Lump and ground chromite and chromite cements are used in bricks and in building and patching furnaces. The possible use of chromite in open-hearth roofs continued to attract attention in 1940.

During 1940 domestic trade-journal quotations for chromite brick rose from $47 to $50 a short ton at producers' plants.

Chemical.—In addition to the chromite used in the manufacture of chromic acid for electroplating, considerable chromite is consumed in chemicals employed principally in the dyeing, tanning, and pigment industries. In recent years increasing quantities of chromium chemicals have also been used in pickling solutions in the nonferrous-metals industry.

The entire domestic production of chromium chemicals, made by only five companies, is from foreign ores. The results of a study conducted by the Federal Bureau of Mines and the State College of Washington of methods for producing chromates and dichromates

[5] Udy, Marvin J., The Utilization of High-iron Chrome Ores: Trans. Canadian Inst. Min. and Met., vol. 41, 1938, p. 204.

[6] Goodsell, R. M., The Application of Hard Chromium Plating: Met. Ind., vol. 37, No. 9, September 1939, pp. 415–419.

from domestic ores and estimates of the economic possibilities of the methods have been given by Doerner [7] and others.

PRICES

Prices of chromite quoted in the domestic trade journals cover imported ore and are given in dollars per long ton, c. i. f. North Atlantic ports. The quotations are largely nominal, and the market was strong at the beginning of 1940. During the year the continued rise in steel operations increased the demand for chromite; and although imports reached an unprecedented high, the price of chromite moved upward. Shortage of ship bottoms during the latter part of 1940 tended to increase prices but was offset somewhat by the knowledge that industry stocks were abnormally large. According to Engineering and Mining Journal Metal and Mineral Markets, chromite containing 48 percent Cr_2O_3 opened the year at $26 to $28 a gross ton. In December the quotation rose to $28 to $30 a gross ton.

WORLD PRODUCTION AND TRADE

Complete data are not yet available on world output of chromite in 1940. The large increase of imports into the United States indicates a probable increase over 1939 in world production. Available data indicate that, excluding the U. S. S. R., the largest producer in 1940 was Turkey, followed by Southern Rhodesia and the Union of South Africa.

World production of crude chromite, 1936–40, by countries, in metric tons [1]

[Compiled by L. P. Lounsbery]

Country	1936	1937	1938	1939	1940
Australia (New South Wales)	422	466	967	(2)	(2)
Brazil (exports)	3,890	2,980	934	3,554	4,572
Bulgaria	270	2,350	1,745	4,251	(2)
Canada (shipments)	837	3,876	----	----	(2)
Cuba [3]	71,086	94,592	40,163	67,061	52,789
Cyprus (shipments)	508	1,641	5,667	(2)	(2)
Greece	47,347	52,620	42,464	57,091	(2)
Guatemala [3]	----	----	----	1,933	----
India, British	50,280	63,307	44,858	49,925	(2)
Japan	39,039	(4)	(4)	(4)	(2)
Levant	----	----	500	(2)	(2)
New Caledonia	47,840	48,022	52,216	52,000	55,790
Norway	----	176	508	(2)	(2)
Philippine Islands (exports)	11,891	69,856	66,911	126,749	(2)
Sierra Leone	----	741	505	10,755	(2)
Southern Rhodesia	183,395	275,617	186,019	139,083	(2)
Turkey (Asia Minor)	163,880	192,508	213,630	191,644	(2)
Union of South Africa	175,669	168,620	176,561	160,014	163,646
U. S. S. R.	217,000	(4)	(4)	(4)	(2)
United Kingdom	----	305	473	(2)	(2)
United States (shipments)	273	2,358	825	3,672	2,705
Yugoslavia	54,044	59,932	58,470	59,527	(2)
	1,068,000	1,280,000	1,133,000	1,167,000	(2)

[1] In addition to countries listed, chromite mining was reported in Albania in 1938; no production figures are available.
[2] Data not yet available.
[3] Imports into the United States.
[4] Estimate included in total.

Except for the U. S. S. R., the principal producing countries consume only small quantities of chromite, and the major consuming countries

[7] Doerner, H. A., and others, A Study of the Methods for Producing Chromate Salts from Domestic Ores: State College of Washington Bull. 5, 1939, pp. 1-51.

produce only a small fraction of their requirements. Most of the chromite output thus enters international trade. Turkey, Southern Rhodesia, and the Union of South Africa were the principal exporters in 1940.

Figures on imports of chromite into consuming countries are not yet complete. The United States is by far the outstanding importing country.

A brief summary of the activities in the principal chromite producing and consuming countries follows:

Albania.—It was reported during 1940 that the tonnage of chrome ore so far discovered in Albania amounts to 500,000 metric tons and that further prospecting is giving good results. The ore is said to contain 50 percent Cr_2O_3; consequently, enough chrome ore has already been discovered to satisfy Italy's present annual consumption of 20,000 to 25,000 tons for several years. The deposits are being developed by the Azienda Minerali Metallici Italiani (Italian Metallic Minerals Concern), of Rome. The first shipment of 1,000 metric tons of chromite from Albania reached Genoa April 10, 1940.

Canada.—Chromite production in Canada is small and is confined to the Thetford-Black Lake area in the Eastern Township of Quebec. No information is available on output in 1940. It was reported that what is believed to be an important discovery of chrome iron ore was made recently on Fox Island by two prospectors employed by the Newfoundland Government.

Cuba.—The entire Cuban production is shipped to the United States; imports into the United States from Cuba in 1940 were 52,789 metric tons compared with 67,061 in 1939. Cuban ores have a low content of Cr_2O_3 and are used in the refractory industry.

Germany.—Germany does not produce chromite. A large share of its chromite (62 percent in 1939) has been imported from Turkey. Under terms of a new trade agreement with Turkey concluded on July 25, 1940, one of the most important products to be shipped to Germany was chromite. Many sources of large quantities of chromite were cut off from Germany during 1940, including Greece, the Union of South Africa, and the British Mediterranean. The extent to which these supplies are being replaced by those from Russia is not known.

Greece.—Deposits of chrome ore in Greece are small in extent but cover a wide area; some of the ore is of high grade. The principal mines are the Donokos northwest of Lamia and that at Tsagli west of Volos.

India.—The State of Mysore is one of the principal sources of Indian chromite and contributes nearly 50 percent of the total production and export. Virtually all of the output is exported—15,000 to 30,000 long tons annually. Export licenses have been required on chromite shipped from India since September 1939.

Italy.—No chromite has been producedin Italy, and imports are not shown in the official statistics. The first shipment of 1,000 metric tons of chromite from Albania reached Genoa on April 10, 1940.

New Caledonia.—Exports of chromite from New Caledonia in 1940 were 66,382 metric tons compared with 39,394 in 1939. A large part of the New Caledonia ore comes from two mines—the Tiebaghi operated by British interests and the Fantouche operated by American interests. New Caledonia ores are high-grade, the Tiebaghi ore running 55 to 56 percent Cr_2O_3. An armament tax on the export of chromite amounting to 12½ percent of the official valuation was established November 1, 1939, for a period of 2 years.

Norway.—Imports of chromite into Norway in 1940 were heavy during the first 3 months, when 12,646 metric tons were received. Only 19,579 metric tons were imported during all of 1939. No information is available regarding imports of chromite after March 1940.

Philippine Islands.—The largest deposit of chrome ore in the Philippines is that of Consolidated Mines at Masinloc, Zambales. The property, which is managed by Benguet Consolidated Mining Co., was discovered in 1933 and is estimated to contain 10,000,000 tons of ore. It has been developed to handle 1,000 tons a day. Production was begun in 1937; in 1940, 79,450 tons valued at 972,226 pesos were shipped. The chromite is low-grade (about 34 percent Cr_2O_3) and is used principally for refractories. Shipments move to the United States.

The Acoje Mining Co. started shipments from its property at Santa Cruz, Zambales Province, in 1937 and in 1940 production was 67,784 tons valued at 1,069,855 pesos. Ore reserves are estimated at 150,000 tons of 48- to 51-percent Cr_2O_3 ore.

Development work of the Tagobomar Development Co., Inc., property on Dinagat Island, a little north of Mindanao, was begun in 1938. Production in 1940 was 1,239 tons valued at 20,726 pesos. Ore reserves are said to be low.

The Zambales Chromite Mining Co., under the management of the Union Management Co., is at Santa Cruz, Zambales. Development work was begun in 1936, and shipments were commenced in 1939. Production for 1940 was 15,243 tons valued at 216,072 pesos. The ore is high-grade (about 49 percent Cr_2O_3), and ore reserves are reported at 100,000 tons.

Dinagat Mines, Inc., produced 5,859 tons in 1940 valued at 86,540 pesos, and Filipinas Mines Corporation produced 18,377 tons valued at 285,112 pesos.

Southern Rhodesia.—Export of chromite from Southern Rhodesia decreased in 1939 to 107,708 metric tons from 204,905 tons in 1938. The output of chromite in Southern Rhodesia comes from two districts—deposits in the Selukwe district and the Great Dike seams extending north from Darwendale approximately 70 miles. The Rhodesian Corporation owns the chrome-ore deposit of the Selukwe district, with a current production of approximately 300,000 tons per annum. Chrome Producers (Rhodesia), Ltd., is an association of five leading independent producers of chromite in Southern Rhodesia which obtains its supply from the Great Dike seams. The output of Chrome Producers is said to be of the metallurgical grade required—3 parts chrome to 1 part iron. The concern guarantees the minimum of 48 percent Cr_2O_3, although at times the chrome content rises as high as 51 percent, with an FeO content around 14 percent. Production from the independent producers is limited to about 1,000 tons a month because of labor-supply difficulties.

Turkey.—Exports from Turkey during 1940 were 110,037 metric tons compared with 192,842 tons in 1939.

Upon request of the Turkish Ministry of Finance, the Council of Ministers on July 4, 1940, approved a decree whereby the sum of

300,000 Turkish pounds allotted to the Eti Bank by decree effective May 20, 1940, to be used in facilitating the sale and export of chromite produced in the country, is increased to 1,000,000 pounds to enable the bank to extend its administration of the production and export of chromite under present war conditions.

Union of South Africa.—Production of chromite in the Union of South Africa in 1940 was 163,646 metric tons; in 1939 production was 160,014 tons. Exports were 107,658 metric tons in 1940 compared with 169,037 tons in 1939.

The monthly production of chromite concentrates (averaging 50 to 53 percent Cr_2O_3) in the Union of South Africa has increased from 5,000 to 10,000 long tons. The African Mining & Trust Co., Ltd., is the only producer and works through its subsidiary company, The Ore & Metal Co., Ltd. The company is said to own large chromite deposits and could greatly increase production provided the necessary machinery could be obtained.

U. S. S. R.—The U. S. S. R. is one of the largest producers of chromite, but data on output are not available for recent years.

United Kingdom.—Imports of chromite into the United Kingdom in 1939 were 51,432 metric tons, of which 74 percent came from countries of the British Empire; no data are available for 1940. The imports are used in the chemical and refractory industries, as no ferrochrome is made in the United Kingdom. Imports of ferrochromium, largely from Norway and Sweden, were 14,953 tons in 1939 compared with 10,654 tons in 1938.

Yugoslavia.—Data on 1940 production of chromite in Yugoslavia are not yet available. New chromite deposits were reported located west of Skoplje during 1940.

NICKEL AND COBALT

By H. W. Davis [1]

SUMMARY OUTLINE

NICKEL

A greater volume of nickel was produced and sold in 1940 than in any previous year, chiefly as a result of marked increases in consumption in the British Empire and the United States. The consumption of nickel during 1940, including that for war and defense requirements, was well-distributed among the principal consuming industries—steel and nonferrous mills; iron, steel, and nonferrous foundries; manufacture of alloys; and electroplating and chemical industries. Steel mills, which took more than half of the deliveries of nickel in 1940, absorbed a larger proportion of the total than in 1939 because of British war requirements and the United States defense program. However, foundries and copper and brass mills consumed more nickel than in 1939. To assure an adequate supply of nickel the International Nickel Co. of Canada, Ltd., installed additional facilities in Canada to enable it to refine not only the increasing output of its mines but also the

Salient statistics for nickel, 1938–40

	1938	1939	1940
United States:			
Production (all byproduct of copper refining) short tons	416	394	554
Secondary production do	2,300	2,920	(1)
Imports [2] do	29,546	64,796	92,468
Exports [3] do	6,581	10,167	11,994
Price per pound [4] cents	35	35	35
Canada:			
Production short tons	105,286	113,053	(1)
Imports do	491	697	(1)
Exports do	98,852	117,391	(1)
World production (approximate) do	127,000	(1)	(1)

[1] Figures not yet available.
[2] Excludes "All other manufactures of nickel"; weight not recorded.
[3] Excludes "Manufactures"; weight not recorded.
[4] Price quoted by International Nickel Co. of Canada, Ltd., for electrolytic nickel at New York, in 2-ton minimum lots.

[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.

accumulated matte stock and the current matte production of Falconbridge Nickel Mines, Ltd.; and thus making this source of supply available will help to counteract that lost as a result of the invasion of Norway. Furthermore, emergency adaptation of existing equipment in the United States and alterations and extensions thereto now under way will provide for the treatment of intermediate products and furnish additional nickel during this period.

Despite the record importation of nickel in 1940, the pressure for delivery of the metal to meet not only the requirements of the defense program but for regular commercial uses resulted in frequent reports that a tight situation existed in United States supply. The situation was believed to be due partly to the disposition of some domestic consumers to acquire unnecessarily large inventories and partly to the fact that when plants employing nickel or nickel products are accelerating production the volume of nickel contained in their process inventories usually must be increased. "It is not uncommon to find in the case of metal mills, for example, that for each pound of nickel delivered out of a plant per month during such periods, 2 or even more pounds may have to be retained 'in process' in order to support the increased production." [2] To provide a statistical basis for whatever action might be deemed appropriate a comprehensive survey of the requirements and stocks of nickel of rolled and forged alloy-steel makers was undertaken on February 21, 1941, by the Bureau of Mines at the request of the Office of Production Management. On March 8, 1941, a similar survey of the requirements and stocks of nickel of nonferrous rolling mills was made by the Bureau. The survey of makers of rolled and forged alloy steel showed that they had not acquired large inventories of primary nickel but, on the contrary, had smaller stocks on January 31 and February 28, 1941, than on June 30 and December 31, 1940. However, the nickel content of "in process" inventories had increased substantially. The survey of nonferrous mills showed a similar trend. Meanwhile, because of the accelerated needs of the national defense program, the President issued a proclamation placing nickel under the export-licensing system, effective February 3, 1941. On March 7, 1941, all supplies of nickel were put under priority control by the Priorities Division of the Office of Production Management, which made it possible for the Priorities Division and the industry to facilitate the prompt flow of the metal into defense industries working on both British and Canadian orders and orders for the Army and Navy.

As usual, the domestic production of primary nickel was insignificant (554 short tons). Figures on the output of secondary nickel are not yet available for 1940; however, such production is small, averaging only 2,300 tons annually during the 5 years 1935–39. Domestic quotations for electrolytic nickel remained unchanged at 35 cents a pound throughout 1940.

Although figures are not available, Canada undoubtedly furnished a larger proportion of the world nickel supply than in 1939.

Search for commercial deposits of nickel in the United States was continued in 1940. In connection with the Strategic Materials Act, the Bureau of Mines and the Geological Survey have cooperated to investigate a number of showings of nickel, and projects have been

[2] Office of Production Management, The Current Nickel Situation: 1941, pp. 1–20.

conducted on one each in Nevada and Montana. The Nevada deposit was found to be small and the ore of low grade; the work on the Montana project is being continued. The Cobalt Gold Mining Co. reported doing 160 feet of drifting at its property near Gold Hill, Colo. The ore body was said to be about 22 feet wide and the ore to average 3 percent nickel with lesser amounts of cobalt and copper. Since July 1940 the company has been constructing a smelter with which it expects to produce a matte containing 45 to 55 percent nickel and 3 to 10 percent each cobalt and copper. The Eastern Magnesia Talc Co., Inc., reported the production of a small quantity of concentrate containing 20 percent nickel and 2 percent cobalt in 1940; none was sold, however. The concentrate is recovered at a froth-flotation plant at Johnson, Vt. The plant, which has been described in detail by Trauffer,[3] makes possible the recovery of talc formerly wasted because of the difficulty of removing magnesite, nickel, cobalt, and other impurities; about 150 pounds of nickel concentrate are recovered daily.

The recovery of nickel from nickel-containing iron ores is the subject of United States Patent 2,212,459. According to this patent,

> * * * The process * * * is particularly applicable to certain ores found in large quantities in Cuba, although it is applicable to other similar ores. The Cuban ores referred to occur in the eastern portion of that island. These deposits are of great extent and large tonnages of iron ore exist carrying from 0.05 to 1.75 percent nickel and from 0.05 to 0.2 percent cobalt. The nickel in these ores occurs as an oxide or a hydroxide, * * * The nickel is in d microscopic state of division such that very little grinding of the ore is requirea before removing the nickel. * * *

PRODUCTION

Domestic production of nickel includes only minor quantities of secondary metals recovered from scrap-nickel anodes, nickel-silver, and copper-nickel alloys (including Monel metal) and small quantities of primary metal recovered in copper refining, as listed in the following table. In addition, a small quantity of nickel concentrate was produced (but not sold) as a byproduct of talc production. Further details on the production of secondary nickel will be found in the chapter on Secondary Metals.

Nickel produced in the United States, 1936–40

Year	Primary [1]		Secondary [2]	
	Short tons	Value	Short tons	Value
1936	107	(3)	1,965	$1,375,000
1937	219	(3)	2,400	1,680,000
1938	416	(3)	2,300	1,610,000
1939	394	(3)	2,920	2,044,000
1940	554	(3)	(4)	(4)

[1] Nickel content of nickel salts and metallic nickel produced as a byproduct in the electrolytic refining of copper.
[2] Nickel recovered as metal and in nonferrous alloys and salts.
[3] Bureau of Mines not at liberty to publish value.
[4] Figures not yet available.

[3] Trauffer, W. E., Froth Flotation Economically Recovers Valuable Material from Talc Waste: Pit and Quarry, vol. 32, No. 4, October 1939, pp. 28–30.

FOREIGN TRADE

The principal nickel imports of the United States are metallic nickel and nickel alloys, matte (containing approximately 55 percent nickel and 25 percent copper), and nickel oxide. All the oxide, 34,884,970 pounds of ore and matte, and 140,497,158 pounds of metallic nickel and alloys were obtained from Canada in 1940; the remainder (5,000 pounds) of the ore and matte came from the Philippine Islands; and the balance of the metallic nickel and alloys (562,639 pounds) was from Europe, chiefly the United Kingdom (454,551 pounds) and Norway (107,666 pounds). The matte is refined to Monel metal and other products at the plant of the International Nickel Co., Inc., Huntington, W. Va. Imports of nickel in 1940 were the largest on record.

Exports of nickel comprise largely products manufactured from imported raw materials. Exports of all classes increased substantially. The United Kingdom (12,812,624 pounds), Japan (3,655,890 pounds), Canada (1,439,665 pounds), France (1,321,647 pounds), and Italy (1,160,046 pounds) were the chief markets for nickel, Monel metal, and other alloys exported in 1940.

Nickel imported for consumption in the United States, 1938–40, by classes

Class	1938		1939		1940	
	Pounds	Value	Pounds	Value	Pounds	Value
Unmanufactured:						
Nickel ore and matte	14, 579, 441	$1, 939, 888	28, 433, 530	$3, 749, 992	34, 889, 970	$4, 705, 454
Nickel pigs, ingots, shot, etc	43, 926, 858	11, 013, 604	99, 309, 184	24, 914, 172	140, 625, 658	35, 152, 218
Nickel bars, rods, tubes, etc	29, 505	21, 577	216, 874	98, 848	434, 139	193, 284
Nickel oxide	555, 181	94, 899	1, 631, 558	311, 128	8, 986, 834	1, 692, 961
Manufactured:						
Nickel silver or German silver in sheets, strips, rods, and wire	296	219			153	84
All other manufactures of nickel	(1)	19, 316	(1)	4, 060	(1)	1, 787
		13, 089, 503		29, 078, 200		41, 745, 788

1 Quantity not recorded.

Nickel exported from the United States, 1938–40, by classes

Class	1938		1939		1940	
	Pounds	Value	Pounds	Value	Pounds	Value
Nickel, Monel metal, and other alloys	11, 877, 498	$2, 896, 806	18, 978, 606	$5, 076, 383	21, 845, 989	$7, 416, 252
Manufactures	(1)	606, 892	(1)	495, 639	(1)	1, 393, 636
Nickel-chrome electric resistance wire	490, 640	552, 470	554, 027	609, 611	640, 816	777, 539
Nickel silver or German silver in bars, rods, or sheets	794, 811	91, 290	800, 456	136, 397	1, 502, 071	269, 907
		4, 147, 458		6, 318, 030		9, 857, 334

1 Quantity not recorded.

Nickel, Monel metal, and other alloys exported from the United States, 1939–40, by countries

Country	1939 Pounds	1939 Value	1940 Pounds	1940 Value
Argentina	1,452	$616	135,293	$52,917
Belgium	870,539	153,233	207,388	43,964
Canada	1,240,921	483,881	1,439,665	506,331
France	437,271	141,399	1,321,647	346,179
Greece	----------	----------	62,724	25,973
Hungary	102,974	40,354	123,587	61,576
Italy	397,570	133,356	1,160,046	429,152
Japan	322,637	129,114	3,655,890	1,601,590
Kwantung	----------	----------	164,707	85,779
Netherlands	2,696,733	567,719	247,311	112,080
Norway	15,259	4,893	56,318	13,750
Rumania	9,169	5,000	125,889	45,025
Switzerland	147,511	46,265	69,652	12,903
United Kingdom	11,306,637	3,165,578	12,812,624	3,947,544
Other countries	1,429,933	204,975	263,248	131,489
	18,978,606	5,076,383	21,845,989	7,416,252

WORLD ASPECTS

World production.—Because of Government restrictions on the publication of statistics for many countries, few figures for 1940 are available; however, production during 1940 was undoubtedly the largest on record.

World production of nickel (content of ore), 1936–40, by countries, in metric tons

[Compiled by L. P. Lounsbery]

Country	1936	1937	1938	1939	1940
Australia	----------	----------	20	----------	(1)
Brazil	478	104	375	25	(1)
Burma	1,312	1,233	959	921	(1)
Canada	76,992	[2] 102,015	95,514	102,559	(1)
Egypt	----------	14	33	(1)	(1)
Germany	660	890	550	(1)	(1)
Greece	1,255	957	1,207	1,336	(1)
Italy	(3)	68	[4] 150	(1)	(1)
Japan	24	(1)	(1)	(1)	(1)
Morocco, French	85	132	163	(1)	(1)
Netherlands Indies	----------	----------	[4] 500	[4] 753	(1)
New Caledonia	9,200	11,600	11,700	[4] 9,300	17,500
Norway	1,270	877	1,245	(1)	(1)
Southern Rhodesia	14	4	76	[4] 490	(1)
Union of South Africa	----------	----------	44	398	(1)
U. S. S. R.	2,000	2,000	2,500	(1)	(1)
United States [5]	97	199	377	357	503
	93,400	120,100	115,500	(1)	(1)

[1] Data not yet available.
[2] Excludes small quantity produced in British Columbia.
[3] Less than 1 ton.
[4] Estimated.
[5] Byproduct in electrolytic refining of copper.

World consumption.—Although figures are not available, world consumption of new nickel established a peak in 1940;[4] there were marked increases in the British Empire and the United States.

[4] International Nickel Co. of Canada, Ltd., Annual Report, 1940: 1941, p. 10.

REVIEW BY COUNTRIES

Brazil.—The only deposits of nickel-bearing ore in Brazil to attract attention in recent years are those at Livramento, in the State of Minas Gerais, and those near São José de Tocantins, in the State of Goiás. The deposits at Livramento are the only ones that have been worked recently. The ore, which consists largely of garnierite, is treated in an electric furnace to produce ferronickel containing about 20 percent nickel. Ore reserves have been estimated at 4 to 10 million metric tons of 1 to 4 percent nickel. The Livramento mine has a direct railroad connection with Rio de Janeiro, a distance of 176 miles. The São José de Tocantins deposits are situated more unfavorably with respect to transportation and fuel than those at Livramento; the nearest railroad is over 200 miles away, and fuel is lacking within a reasonable distance for treating the ore. Despite these handicaps, the deposits were developed to some extent at Jacumbá by the Empreza Commercial de Goiás, S. A., which made shipments to Germany for trial purposes in 1933, 1934, and 1935. Analyses of 15 samples of ore from the deposits were reported to average 7.86 percent nickel. In 1939 the nickel mines and rights of the Empreza Commercial de Goiás, S. A., were reported to have been purchased by a Japanese organization, which had bought 10 trucks for transporting the ore to the railroad; however, no shipments are known to have been made.

Burma.—The nickel produced in Burma is derived from a nickel-bearing speiss made by the Burma Corporation, Ltd., at Namtu in the Northern Shan States. The speiss contains approximately 30 percent nickel, 8 percent copper, and 7 percent cobalt, as well as 17 ounces of silver to the ton. A new market for nickel speiss, which went to Germany before the war, has not yet been developed.[5]

Canada.—Virtually all of the Canadian output is derived from the copper-nickel ores of the Sudbury district, Ontario; and two companies—International Nickel Co. of Canada, Ltd., and Falconbridge Nickel Mines, Ltd.—are the principal producers. Although figures are not available, the output was larger in 1940 than in 1939 when 113,053 short tons were produced.

The International Nickel Co. of Canada, Ltd.,[6] operated its mines continuously, and the tonnage of ore extracted again increased substantially over 1939 when 7,273,835 short tons were produced at the Frood (4,722,563 tons), Creighton (1,298,752 tons), Levack (926,908 tons), and Garson (325,612 tons) mines. Shaft sinking was completed at the Garson mine in August 1940. The surface plant is nearly completed, and underground development is progressing rapidly. Schedules call for this new shaft and surface plant to commence producing ore late in 1941. Development work in connection with the sinking of a new underground shaft at the Creighton mine was continued, and actual shaft sinking will be started during the summer of 1941. The new crushing plant at the Frood open pit was put into service during August 1940. This plant will also crush ore from the Stobie open pit, from which production of ore is scheduled to begin by midyear 1941. A shaft will be started at the Stobie mine in 1941 to bring this large, low-grade ore body into a productive status.

[5] Brady, A. C., American Consul, Rangoon, Burma, January 20, 1941.
[6] International Nickel Co. of Canada, Ltd., Annual Report, 1940: 1941, p. 6.

Development work was carried on at a rate to conform with ore requirements. The total development advances of shafts, drifts and crosscuts, raises, winzes, and box holes was 56,609 feet, making total underground workings in all mines 835,022 feet or approximately 158 miles.

During 1940 the capacity of the concentrator was enlarged, and additional equipment was installed in the smelter. Metallurgical results were very satisfactory. Losses of metal in tailings were reduced for the tenth consecutive year. Further expansion of mill capacity is in progress. The concentrator treated 5,876,501 tons in 1939. The capacity of the nickel refineries was augmented, and the output of refined nickel in 1940 increased markedly over 1939, when 89,695 tons were produced. Sales of nickel in all forms were also greater than in 1939, when 105,097 pounds were sold.

Falconbridge Nickel Mines, Ltd.,[7] operated at a reduced rate in 1940 because of the serious disarrangement resulting from the loss of its refinery in consequence of German occupation of Norway in April. For 8 months of 1940 the ore dressing and reduction plants were operated at about two-thirds capacity. Matte formerly shipped to Norway for refining was stock-piled for a period, pending completion of new refining arrangements. Consequently, much less ore was treated in 1940 than in 1939—576,801 short tons. In January 1941 the mine and smelter output was restored to full capacity. The current production of matte as well as the accumulated stock will be refined by the International Nickel Co. of Canada, Ltd.

Cuba.—Decree 2533 of September 6, 1940, grants exemption from municipal taxes for 5 years to the Nicaro Nickel Co. for establishment of a nickel-refining industry in Mayari, Oriente Province.[8] A process particularly applicable to certain nickel-containing iron ores found in large quantities in Cuba is the subject of United States Patent 2,212,459.

Finland.—The Undersecretary to the Ministry of Economic Warfare stated on November 19, 1940, that the nickel mine at Petsamo was being kept under careful observation, that the mine was not producing, and that there was no reason to believe that any Finnish nickel has been reaching Germany.[9] Before the invasion of Finland in November 1939 the indications were that the mine would begin to produce not later than the early months of 1941.

Italy.—In recent years Italy has purchased nickel chiefly from Norway, which has been unable to make adequate deliveries because of the invasion. Consequently, Italy has had difficulty in obtaining adequate supplies of nickel. To help supply the country's needs of metal for war purposes the Italian Government withdrew from circulation nickel coins of lire 1.00 and lire 2.00, which resulted in the recovery of about 1,600 metric tons of nickel. The withdrawal from circulation of 20- and 50-centesimi coins is expected to yield about 2,900 tons of nickel.

Japan.—Like Italy, Japan experienced difficulty in procuring adequate supplies of nickel, and efforts were made to use substitutes wherever possible; meanwhile, Japanese producers attempted to increase their output, and the Government endeavored to stop

[7] Falconbridge Nickel Mines, Ltd., 12th Annual Report, 1940: 1941, pp. 1-9.
[8] Ducote, C. H., assistant commercial attaché, Habana, October 2, 1940.
[9] Somerville, James, assistant commercial attaché, London, December 3, 1940.

irresponsible attempts to develop home production and planned to restrict the exploitation of the low-grade deposits to technically skilled and experienced concerns.[10] To overcome the problems resulting from the stoppage of imports from Canada it was proposed to establish a nickel-controlling guild, whose object was to lower costs of domestic production and to distribute the output of ore, ferronickel, and pure nickel.[11] The rationalization of the nickel industry has provided problems for some producers, who find they cannot produce refined metal at the maximum price fixed by the authorities.[12] Consequently, there is a tendency to concentrate on the production of nickeliferous pig iron and ferronickel. The Kamogawa Nickel Kaisha is reported to have stopped producing pure nickel at its Funabashi works but is continuing to produce ferronickel. The Nippon Soda Kaisha, which has been making nickel from imported ore, is also to make ferronickel. The Oyeyama Nickel Kogyo K. K. has increased its capital greatly to permit more extensive development of its Oyeyama nickel mine and to erect a nickel works in Kyoto Prefecture.[13] The company has been developing its ore reserves for some years; the ore contains about 29 percent iron, 0.16 percent nickel, 0.1 percent cobalt, and 1.3 percent chromium. Apparently a concentrating plant is to be erected in Kyoto, as the company intends to produce ferronickel at its Hashidate works.

Netherlands Indies.—The Oost-Borneo Maatschappij, N. V., continued to operate the deposits on the island of Celebes, and the ore, of low nickel content, is shipped to Japan. Before the outbreak of the war production of nickel-iron concentrates was contemplated through the use of the Krupp-Renn process; the Nickel and Cobalt chapter of Minerals Yearbook 1940 stated erroneously that Fried. Krupp A. G. was a partner in the enterprise.

New Caledonia.—Ore production in New Caledonia—which produces the second largest quantity—was 459,000 metric tons averaging 3.8 percent nickel in 1940. The output of matte (about 77 percent nickel) was 8,570 metric tons in 1940. It is not known how the product was distributed in 1940, but before the war ore was exported chiefly to France, Germany, and Japan and matte to Belgium and France.

Norway.—The Falconbridge refinery at Kristiansand was operated steadily by Falconbridge Nickel Mines, Ltd., until the German occupation of Norway on April 9, 1940. In consequence, production and sales of nickel in 1940 slumped disastrously in comparison with 1939, when the figures were 9,233 and 9,337 short tons, respectively.

Union of South Africa.—Nickel appeared in the mineral statistics of the Union of South Africa in 1938, when 49 short tons were produced; the output advanced to 439 short tons in 1939. Many years ago, however, two trial shipments of 5 tons each, reported to contain 5.3 percent nickel and cobalt, from deposits at Insizwa were sent to Great Britain. The nickel produced since 1938 was derived from matte containing about 40 percent nickel, which is produced from sulfide ore by the Rustenburg Platinum Mines, Ltd.

The nickel deposits of the Union of South Africa have been described recently.[14]

[10] Metal Bulletin (London), No. 2507, July 16, 1940, p. 12.
[11] Metal Bulletin (London), No. 2523, September 10, 1940, p. 12.
[12] Metal Bulletin (London), No. 2519, August 27, 1940, p. 12.
[13] Metal Bulletin (London), No. 2548, December 6, 1940, p. 11.
[14] South African Mining and Engineering Journal, Nickel in South Africa: Vol. 51, pt. 1, June 29, 1940, pp. 545, 547; vol. 51, pt. 1, July 6, 1940, pp. 573, 575.

U. S. S. R.—"A large electrolytic nickel-refining plant has been opened at Montschegorsk, center of the Russian nickel-mining industry, near Korowsk on the Kola Peninsula." [15] Nickel has been found in the Neulinsk district of the Kola Peninsula,[16] and deposits of nickel and cobalt have been discovered near the village of Chenger-Sai, Aktyubinsk Province.[17] It is proposed to recover the nickel contained in the copper ores treated at the smelter of Pyshma.[18]

COBALT

The consumption of cobalt in the United States increased substantially during 1940; except for a small domestic production, the demand was supplied by imports, chiefly from the Belgian Congo. Total imports (exclusive of re-exports to Japan) measured by cobalt content increased about 53 percent over the all-time high established in 1939. A noteworthy shift in the flow of cobalt resulted from the war. Because of the invasion of Belgium cobalt-bearing residues from Belgian Congo and Northern Rhodesia, which formerly were shipped to Belgium for refining, are now being shipped to the United States and Canada, where equipment has been installed to convert the residues into the required finished cobalt products. Domestic quotations for 97- to 99-percent metal in 100-pound lots and black oxide (70- to 71-percent grade) in 350-pound lots remained unchanged throughout 1940 at $1.50 and $1.84 a pound, respectively.

PRODUCTION

In 1940, for the first time since 1931, there was a marketed production of cobalt ore from domestic sources. The Pyrites Co., Inc., Wilmington, Del., treated cobalt ores and produced cobalt oxide. The cobalt ore was recovered from iron pyrites concentrates produced at Lebanon, Pa., from iron ore mined at Cornwall, Pa. Cobalt has long been known to occur as a minor constituent of these iron ores, and increased amounts have been found in the ore bodies now being mined. The Eastern Magnesia Talc Co., Inc., Burlington, Vt., recovered a small quantity of concentrate containing 2 percent cobalt and 20 percent nickel in 1940; none was sold, however. The concentrate is recovered as a byproduct of froth flotation of talc. The Sullivan Mining Co., Kellogg, Idaho, recovered 93 short tons of residue containing 3.29 percent cobalt at its electrolytic zinc plant in 1940, but none was shipped. Jonathan Gordon, Tombstone, Ariz., reported a production of about 7 short tons of 16-percent cobalt concentrate from the Blue Bird mine in Graham County, Ariz. The Cobalt Gold Mining Co., Boulder, Colo., continued development at its property near Gold Hill, Colo., during 1940 and since July has been constructing a smelter to produce a matte containing 3 to 10 percent each cobalt and copper and 45 to 55 percent nickel. The Uncle Sam Mining & Milling Co., Inc., Salmon, Idaho, continued development work and reported producing a concentrate containing 12 to 14 percent cobalt. John Carroll, Las Vegas, Nev., did development work at a property in the Goodsprings district, Clark County,

[15] Daily Metal Reporter, vol. 40, November 14, 1940, p. 4.
[16] Mining Journal (London), vol. 207, December 23, 1939, p. 1066.
[17] Metal Bulletin (London), No. 2470, March 5, 1940, p. 14.
[18] Metal Bulletin (London), No. 2478, April 9, 1940, p. 12.

Nev., in 1940. Ore blocked out was estimated by Carroll at 40,000 tons containing an average of 1.16 percent cobalt and 1.10 percent copper. Ore-dressing tests of ores in the Goodsprings (Nev.) district have been made by the ore-dressing section of the Bureau of Mines Metallurgical Division [19] and resulted in development of a flotation procedure to produce a bulk concentrate containing cobalt and copper. The electrometallurgical section of the Metallurgical Division has undertaken some work on the separation of copper and cobalt from the Goodsprings ores.[20] According to Dean:

> The minerals are stainierite, malachite, dolomite, some quartz, and iron oxides. Further ore-dressing tests along the lines of differential flotation were made, with indications of ultimate success. However, a good ore-dressing result as such would not produce a product free enough from copper to meet all specifications for cobalt oxides. Consequently, other methods are being tested. Good evidence has been obtained that cobalt can be leached from the bulk flotation concentrates and economically recovered by electrolysis. This investigation was begun only recently, and results will be published when conclusive data are obtained.

The separation of cobalt is the subject of United States Patent 2,232,527. According to this patent:

> * * * The invention may advantageously be applied to the recovery of cobalt from iron pyrites in which it is found to occur. Such iron pyrites may contain up to 2 percent of cobalt, together with copper, zinc, lead, and other nonferrous metals in smaller proportions. In one iron pyrites from which cobalt has been recovered in accordance with the present invention, there is found 1.4 percent cobalt, 1.0 percent copper, 0.3 percent zinc, and small quantities of nickel, manganese, and lead.

FOREIGN TRADE

Imports of cobalt into the United States established an all-time record in 1940. Whereas in 1939 the imports comprised chiefly metal refined in Belgium from Belgian Congo and Northern Rhodesia cobalt alloy, in 1940, because of the invasion of Belgium, they consisted largely of cobalt alloy from Belgian Congo. Consequently, imports of cobalt alloy and ore increased to 10,497,719 pounds in 1940 (611,083 in 1939), and receipts of metal declined to 130,321 pounds (2,130,296 in 1939). Imports of cobalt oxide increased 11 percent over 1939. Although there was a substantial importation of cobalt ore from Canada, the greater part of it is reported to have been re-exported to Japan. On and after January 6, 1941, cobalt could be exported from the United States only when authorized by a license.

[19] Dean, R. S., Progress Reports—Metallurgical Division. 12. Annual Report of the Metallurgical Division, Fiscal Year 1935: Bureau of Mines Rept. of Investigations 3306, 1936, pp. 20–21.
Staff, Ore-dressing Section, Progress Reports—Metallurgical Division. 22. Ore-testing Studies, 1936–37: Bureau of Mines Rept. of Investigations 3370, 1938, p. 101.

[20] Dean, R. S., Progress Reports—Metallurgical Division. 42. Annual Report of the Metallurgical Division, Fiscal Year 1940: Bureau of Mines Rept. of Investigations 3547, 1941, p. 36.

Cobalt ore, metal, and oxide imported for consumption in the United States, 1939–40, by countries, in pounds

Country	Ore		Metal		Oxide	
	1939	1940	1939	1940	1939	1940
Australia						16,800
Belgian Congo		7,843,828				
Belgium			1,910,580	100,321	242,900	488,619
Canada	573,226	2,653,891		30,000		177,450
Chile	37,857					
Finland			219,716		118,300	21,200
France					128,100	52,690
Germany					191,344	
	611,083	10,497,719	2,130,296	130,321	680,644	756,759

Cobalt ore, metal, oxide, and other compounds of cobalt imported for consumption in the United States, 1937–40

Class	1937		1938		1939		1940	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Ore	587,499	$44,352	449,984	$32,354	611,083	$54,446	10,497,719	$3,660,869
Metal	1,073,129	1,341,928	938,476	1,146,559	2,130,296	2,711,677	130,321	207,345
Oxide	842,847	1,059,432	373,215	519,201	680,644	944,836	756,759	1,124,554
Sulfate	56,540	21,858	41,811	18,277	75,290	34,343	11,468	7,818
Other salts and compounds	45	187	56	98	1,374	3,405		

USES

As a result of extensive research, the use of cobalt continues to expand; consequently, world production has increased greatly. Cobalt oxide is used in the ceramic industry; cobalt salts are employed in the preparation of driers for use in paints, varnishes, and linoleums and as a catalyst; and cobalt metal is utilized in cutting tools and drills, welding rod, stock for tipping tools, dies, valve steel, magnets, electroplating, and dental restorations and as a catalyst. Much success has been achieved by applying cobalt to supplement pasture deficiencies that cause various types of sickness among animals.

WORLD PRODUCTION

Government restrictions on the publication of statistics giving the output of cobalt in the chief producing countries in 1940 and lack of data for Belgian Congo (one of the outstanding producers) and for several smaller producing countries in 1938 and 1939 preclude giving an accurate statement of total world output in those years. Nevertheless, such figures as are available for 1938 and 1939 indicate a production of 4,500 to 5,000 metric tons in each year. Despite the fact that cobalt is reported to be produced in 14 countries, three countries (the Belgian Congo, French Morocco, and Northern Rhodesia) contribute about 75 to 80 percent of the total.

World production of cobalt, 1938–40, by countries, in metric tons [1]

[Compiled by L. P. Lounsbery]

Country [1]	Cobalt-bearing material	1938		1939		1940	
		Gross weight	Cobalt content	Gross weight	Cobalt content	Gross weight	Cobalt content
Bolivia	Cobalt ore	(2)	(2)	(2)	(2)	29	2
Burma [3]	Cobaltiferous nickel speiss	3,399	238	3,322	229	(2)	(2)
Canada: Ontario	Cobalt ores, oxide, and metal	(2)	208	(2)	332	(2)	(2)
Morocco, French	Cobalt ore [4]	6,541	720	(2)	(2)	(2)	(2)
Northern Rhodesia	Cobalt alloy [5]	3,756	1,502	3,891	1,556	(2)	(2)

[1] In addition to the countries listed, Belgian Congo, Chile, China, Finland, Germany, Italy, Japan, and Mexico produce cobalt, but production data are not available; the United States produced cobalt ore in 1940, but the Bureau of Mines is not at liberty to publish the figures.
[2] Data not available.
[3] Year ended June 30 of year stated.
[4] Average cobalt content estimated at 11 percent.
[5] Average cobalt content estimated at 40 percent.

Belgian Congo.—Belgian Congo is one of the largest producers of cobalt, but figures for output have not been reported for several years. Imports of cobalt alloy into the United States from Belgian Congo were 3,922 short tons in 1940. Before Belgium was invaded, the cobalt alloy was exported to that country for refining.

Burma.—Cobalt is produced in Burma largely as a byproduct of lead-zinc mining at the Bawdwin mines of the Burma Corporation, Ltd. A nickel speiss obtained at the lead smelter contains about 7 percent cobalt. It was formerly shipped to Germany for treatment.

Canada.—Data on the output of cobalt in Canada are not available because of Government restriction on publication. The decreased production of Ontario mines during the past few years, owing to depletion of the ores, curtailed smelting by the Deloro Smelting & Refining Co., Ltd., to such an extent that enough cobalt-arsenical ore was not available to keep the smelter in operation continuously.[21] As an alternative, the company remodeled its plant to refine copper-cobalt alloy from Africa.

Northern Rhodesia.—Although figures for 1940 are not available, the Rhokana Corporation, Ltd., has stated that the production of cobalt proceeded satisfactorily. During the year ended June 30, 1939, the company sold 1,124 short tons of cobalt in alloy and refined products, and the cobalt plant produced 4,511 short tons of alloy containing 1,761 tons of cobalt.

[21] Drury, C. W., The Mineral Industry during 1940: Vol. 49, 1941, p. 117.

MOLYBDENUM, TUNGSTEN, AND VANADIUM

By Robert H. Ridgway and H. W. Davis [1]

SUMMARY OUTLINE

MOLYBDENUM

Domestic production of molybdenum rose to an all-time high of 34,313,000 pounds (contained molybdenum), which exceeded shipments by about 9,000,000 pounds. Information concerning molybdenum production in other countries is meager, but the general trend appeared to be downward, and the United States probably supplied more than 93 percent of the world output. No data on molybdenum production in Norway have been available since that country came under German control; in Mexico and Peru production dropped, but recovery of molybdenum at the Braden operations in Chile, begun in 1939, continued at an accelerated pace.

As the United States has ample supplies of molybdenum, attention was devoted to substituting molybdenum for nickel and tungsten in alloy steels, thereby relieving the pressure of demand for these less-available metals. For several years, molybdenum high-speed steels employing only small percentages of tungsten have been in commercial use; they are manufactured in the United States by a number of the larger manufacturers of high-speed steels, who market them under various trade names. In previous years, a large proportion of domestic production went to foreign markets (67 percent in 1939) but in 1940 exports of molybdenum concentrates declined sharply and totaled only 6,339 short tons (19 percent of domestic output) valued at $4,904,000 compared with 21,777 tons valued at $14,066,501 in 1939.

The Climax Molybdenum Co. continued to lead the world as a producer of molybdenum and supplied 66 percent of the domestic output. The recovery of molybdenite concentrates as a byproduct of copper operations at Bingham, Utah, Chino, N. Mex., and Miami, Ariz., has become increasingly important in the United States and in 1940 represented about 30 percent of the domestic output.

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

Salient statistics of the molybdenum industry in the United States, 1938–40

	1938	1939	1940
Concentrates:			
Production ... short tons	36,157	32,347	33,128
Molybdenum contained ... pounds	33,297,000	30,324,000	34,313,000
Shipments ... short tons	25,852	31,479	24,300
Molybdenum contained:			
Average ... percent	49.76	51.49	52.12
Total ... pounds	25,727,000	32,415,000	25,329,000
Value [1]	$17,977,000	$22,157,000	$17,189,000
Exports ... short tons	(2)	21,777	6,339
Molbdenum contained ... pounds	(3)	(3)	6,584,714
Value	(2)	$14,066,501	$4,904,000
Imports for consumption (molybdenum contained):			
Pounds	25	26,347	
Value	$81	$32,327	

[1] Estimated by Bureau of Mines.
[2] Not separately recorded.
[3] Not recorded.

Moral embargo.—Following the President's statement of December 2, 1939, regarding exports of airplanes and materials essential in airplane manufacture to nations guilty of unprovoked bombing of civilian populations from the air, the State Department on December 15 addressed a letter to all producers of molybdenum, which added this metal to the embargo list. Molybdenum steels have been widely employed in aircraft construction during the last decade.

Consuming nations to which domestic supplies of molybdenum were available were restricted, therefore, chiefly to the United States, Canada, and the United Kingdom—France was eliminated after its capitulation to Germany. The moral embargo was lifted for Russia on January 22, 1941.

Export control.—On July 2, 1940, the President issued a proclamation providing for the licensing of exports of "molybdenum ores, concentrates, metal, alloys containing in excess of 10 percent molybdenum and molybdenum compounds" and other specified materials vital to defense and appointing an Administrator of Export Control. Ferromolybdenum is one of a number of ferro-alloys coming within the definition of "iron" and "steel," which were included in the licensing requirement under a Presidential proclamation issued October 10, to become effective December 30, 1940. Under authority of an Executive order of January 15, 1941, the Secretary of State issued general licenses for the export of molybdenum and ferromolybdenum to Canada.

PRICES

Prices for molybdenite concentrates carrying 90 percent MoS_2 were quoted nominally by the Engineering and Mining Journal at 45 cents per pound of contained MoS_2 throughout 1940; this is equivalent to 75 cents per pound of contained Mo. London quotations for 85- to 90-percent concentrates were 52 shillings per long-ton unit during the greater part of the year; however, the equivalent in United States currency ranged from 38 cents per pound of contained MoS_2 in May to 46.85 cents in November, according to the rate of exchange in effect at a given time.

DOMESTIC PRODUCTION

Arizona.—Molybdenum was recovered by the Miami Copper Co. as a byproduct of copper-mining operations at Miami, Gila County, and by the Mammoth-St. Anthony, Ltd., which recovers gold, silver, lead, molybdenum, and vanadium by selective flotation of ores from Mammoth. At Miami most of the molybdenum, which is present in minute quantities (0.009 percent MoS_2), is floated along with the sulfide copper. The molybdenum sulfide is separated from the copper sulfide by steaming off the reagents by which both sulfides are floated and refloating with a reagent that will float the molybdenum sulfide but not the copper. About 30 tons of molybdenum concentrates per month are produced at Miami.[2]

California.—There was a small production of molybdenite concentrates from a tungsten operation in Inyo County in 1940.

Colorado.—The Climax Molybdenum Co., Climax, Colo., continued to be the world's largest producer of molybdenum, operating continuously, but not at capacity, its mine and 12,000-ton flotation mill; the production of 22,782,608 pounds of elemental molybdenum was nearly a million pounds greater than in 1939. Health and safety conditions at Climax were described in articles in the technical press by Feiss [3] and Richardson.[4]

Molybdenum (element) contained in concentrates produced from the Climax deposit, Colorado, 1935–40

	Pounds		Pounds
1935	10, 168, 635	1938	28, 242, 085
1936	15, 216, 806	1939	21, 796, 116
1937	22, 750, 368	1940	22, 782, 608

The Molybdenum Corporation of America undertook preliminary work on a molybdenum property in the Red Mountain district of Clear Creek County near Empire, Colo., acquired several months earlier from the Vanadium Corporation of America.

New Mexico.—Molybdenum concentrates were produced by the Molybdenum Corporation of America from its property near Questa and by the Nevada Consolidated Copper Corporation at the Chino property, incident to the treatment of copper ores.

Utah.—All production in 1940 came from the Utah Copper Co., where molybdenite is recovered as a byproduct in the concentration of copper ores and re-treatment of molybdenum-bearing concentrates. The molybdenum concentrate is freed of its small amount of copper and "insoluble" by roasting in a hearth furnace at a temperature that oxidizes the copper but not the molybdenum sulfide. The "insoluble" is then floated off and finally the molybdenum sulfide.[5]

IMPORTS AND EXPORTS

As data covering exports of molybdenum concentrates by countries of destination were not available prior to 1939, figures for that year provide the only basis for comparison. Exports declined about 71 percent, as shipments to Belgium, Czechoslovakia, Germany, Hungary, and Norway ceased abruptly and those to Japan, Netherlands, Sweden, and U. S. S. R. dwindled to small percentages of the 1939 exports. Shipments to the United Kingdom were little more than half of the 1939 total, but exports to Canada, France, and Italy rose appreciably.

[2] Carlson, Raymond, Miami Copper Co.: Arizona Highways, vol. 16, No. 5, May 1940, p. 36.
[3] Feiss, Julian W., Ventilation and Dust Control at Climax Molybdenum: Mining Cong. Jour., vol. 26, No. 7, July 1940, pp. 12–19.
[4] Richardson, James K., Safety at Climax: Eng. and Min. Jour., vol. 141, July 1940, pp. 44–47.
[5] Benedict, C. H., Ore Concentration and Milling: Min. and Met., vol. 22, No. 410, February 1941, p. 71.

Molybdenum ore and concentrates exported from the United States, 1939–40, by countries

County	1939 [1]		1940		
	Gross weight (pounds)	Value	Gross weight (pounds)	Molybdenum content (pounds)	Value
Belgium	621,116	$55,560			
Brazil			332,676	201,362	$149,856
Canada	188,828	84,433	554,951	284,458	255,256
France	2,960,543	792,000	5,299,380	2,740,065	2,021,685
Italy	1,004,440	409,701	1,650,650	849,578	631,696
Japan	9,361,160	3,741,888	133,215	117,100	53,929
Mexico	2,000	60	250	125	128
Netherlands	2,734,211	707,368	11,200	6,474	5,588
Sweden	766,294	310,186	54,722	29,462	29,897
U. S. S. R.	18,142,378	6,832,104	654,789	336,289	241,113
United Kingdom	7,556,560	1,049,488	3,985,961	2,019,801	1,514,852
Other countries	216,780	83,713			
	43,554,310	14,066,501	12,677,794	6,584,714	4,904,000

[1] Molybdenum content not shown in 1939.

Imports of molybdenum or molybdenum compounds are usually small; in 1940 there were none.

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, 1939–40

Year	Molybdenum content (pounds)	Value	Year	Molybdenum content (pounds)	Value
1936	49	$213	1939	26,347	$32,327
1937	7,707	13,491	1940		
1938	25	81			

There were no imports of molybdenum ore and concentrates for smelting, refining, and export in 1940 although 87,232 pounds of ore and concentrates, containing 49,613 pounds of molybdenum, were entered under this classification in 1939.

USES

Molybdenum is used principally in the iron and steel industry for making special alloy steels. Continued research is broadening the field of applications, both in new outlets and as a substitute for and in addition to other alloying elements. This is true particularly with respect to the substitution of molybdenum for strategic metals; as ample supplies of molybdenum are available in the United States it is not classed as a strategic material, but it is, nevertheless, important, for molybdenum is being substituted for other alloying metals, such as nickel, tungsten, and manganese, which are strategic. Molybdenum may be used alone to impart certain desired properties to iron and steel, but more frequently it is employed with one or more of the other ferro-alloying elements. Alloy steels containing molybdenum are finding increased favor in the aircraft industry. The newer developments include a 3-percent chromium steel with molybdenum, introduced from England and used successfully for crankshafts; a nitriding steel containing chromium, molybdenum, and nickel (but no aluminum) that is being specified by aircraft producers; and a steel containing 2 percent chromium with 0.50 percent molybdenum, which has been successful for cylinder liners in aircraft engines.[6] Modernized railway-locomotive construction utilizes nickel-chromium-molybdenum rods, pistons, axles, shafts, and pins to reduce fatigue failures and save weight; molybdenum steels and cast irons are also being used increasingly by railroads in tires, car wheels, flues, and cylinders. Oil-well drilling and oil refining absorb additional quantities of molybdenum steels, and molybdenum high-speed steels are receiving increased attention. Several of these uses, applicable to die steels, have been described by Herzig.[7]

For most purposes molybdenite (MoS_2), the principal raw material, is converted, before use, to ferromolybdenum (a product carrying 60 to 65 percent molybdenum) or to calcium molybdate (a compound containing 35 to 45 percent molybdenum and resulting from the roasting of molybdenite with lime). The latter is the cheaper method of preparing molybdenum for industrial uses. Molybdenum oxide briquets also are used in making additions of molybdenum to iron and steel.

Molybdenum compounds are used to a limited extent in the chemical and ceramic industries, but consumption is not large. Translations of expired German patents recently issued by the Climax Molybdenum Co. describe the use of molybdenum compounds in dyeing furs, feathers, hair, skins, and similar products.[8] Certain molybdenum compounds are reported to promote adherence in ground coats for enamels.[9]

WORLD PRODUCTION

Aside from the very large output of molybdenum in the United States, world production of molybdenum comes from a small number of mines that furnish up to a few hundred tons annually. Of these, operations in Mexico, Norway, and Peru are of leading interest.

Canada.—Production of molybdenite in Canada dwindled to insignificant proportions following the World War of 1914–18, but in 1939 interest in developing new sources of supply revived as a result of war needs for alloy-steel metals and continued during 1940 in British Columbia, Manitoba, Ontario, and Quebec. A recent bulletin issued by the British Columbia Department of Mines describes molybdenum deposits in that Province.[10]

Chile.—The recovery of molybdenite concentrates from copper operations of the Braden Copper Co. at Sewell was inaugurated in 1939, when 111,561 pounds of molybdenite were produced in an experimental plant. During 1940 operations were reported to be proceeding at the rate of 800 to 900 tons a year; exports totaled 680 metric tons of ore and concentrate.

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[6] Herzig, Alvin J., Molybdenum Steels and Irons: Metal Progress, vol. 38, No. 4, October 1940, pp. 391–392.
[7] Herzig, Alvin J., Molybdenum Important Element in New Aircraft Alloy Steels: Steel, vol. 107, No. 16, Oct. 14, 1940, p. 163.
[8] Oil, Paint, and Drug Reporter, Fur Dyeing with Molybdates Described in Patent Reprints: Vol. 139, No. 7, Feburary 17, 1941, p. 31.
[9] Kautz, Karl, Molybdenum in Enamels; Adherence Produced with Molybdenum Compounds: Jour. Am. Ceram. Soc., vol. 23, No. 10, October 1940, pp. 283–287.
[10] Stevenson, John S., Molybdenum Deposits of British Columbia: British Columbia Dept. of Mines Bull. 9, 1940, pp. 1–96.

World production of molybdenum ores and concentrates, 1936–40, in metric tons

[Compiled by L. P. Lounsbery]

Country [1]	1936	1937	1938	1939	1940
Australia:					
New South Wales (concentrates)	(2)	16	9	(3)	(3)
Queensland (concentrates)	20	23	14	20	(3)
Victoria (concentrates)		31	36	26	(3)
Burma		(2)		(3)	(3)
Canada (concentrates)		7	6	1	(3)
Chile (Mo content)				30	(3)
Chosen (ore)	80	(3)	(3)	(3)	(3)
Greece (ore)			1,560	(3)	(3)
Italy (ore)	861	46	12	(3)	(3)
Japan (dressed ore)	7	(3)	(3)	(3)	(3)
Mexico (Mo content)	534	629	483	523	310
Morocco, French (concentrates) (exports)	187	149	258	(3)	(3)
Norway (Mo content)	422	344	462	423	(3)
Peru (concentrates)	19	83	185	342	293
Rumania (Bi-Mo ore)	46	27	160	(3)	(3)
Turkey (ore)		43	80	(3)	(3)
United States (Mo content)	7,795	13,344	15,103	13,755	15,564
Yugoslavia		84	19	60	(3)

[1] In addition to countries listed, molybdenum ore is also produced in China, but data on production are not available.
[2] Less than 1 ton.
[3] Data not available.

Greece.—The Krupp interests were reported to have installed a plant with a capacity of 10,000 tons of crude ore a year at the Axiopolis molybdenum property in Greece, for the production of 85-percent concentrates.

Mexico.—Output in Mexico declined from 523 metric tons (molybdenum content) in 1939 to 310 in 1940. Early in the year, the 3,500-ton selective flotation plant of the Cananea Consolidated Copper Co., S. A., Cananea, Sonora, Mexico, was reported to be treating about 2,000 tons of copper, gold, silver, and molybdenum ore daily and employing 1,350 men.

Norway.—Before 1933, Norway was the only important source of molybdenum outside of the United States; since then world sources of molybdenum have expanded, but Norway furnishes concentrates containing a few hundred tons of molybdenum annually. Since the country came under German control little or no information as to its molybdenum industry has been made public, although production probably is continuing at an increased rate.

Peru.—In recent years, Peru has become one of the more important foreign sources of molybdenum. During the first half of 1940 it was reported that molybdenum production had been stepped up to about 38 tons a month, or over 400 tons annually, nevertheless the total output for the year declined to 293 metric tons of concentrates compared with 342 tons in 1939. Molybdenum prospects are reported to occur in the Provinces of Huarochiri and Cajatambo in the Department of Lima, in the districts of Bolognesi, Recuay, Ticapampa, and Conchucos in the Department of Ancash, and near Solceantay in the Urubamba district of Cuzco. The principal producing mine, however, is that of the "Peru Molibdeno" near Ricran in the Department of Junin.

Sweden.—Discovery of molybdenum at the Algruvan mine in Lillhärad Parish, Sweden, was the reward of the Toftgruvans Silverintrissenters Aktiebolag, Västerås (a company formed in 1937 to exploit silver deposits at Toftgruvan), when it proceeded with prospecting after failing to find silver of marketable grade. The Algruvan deposit is said to be fairly extensive and easily accessible; tests by the Swedish Government Testing Institute placed the MoS_2 content of the ore at 4.8 percent.

U. S. S. R.—Considerable publicity was given to the announcement that the first molybdenum smelter in the U. S. S. R. would begin operation on Lake Balkhash in Kazakstan as a unit of the Balkhash copper smelter for recovery of molybdenum in concentrates of copper ore mined at Kounrad north of Lake Balkhash. A crushing mill and concentrating plant near Nalchik, 10,000 feet up among the northeast foothills of Mount Elbrus, was reported being equipped for handling molybdenum ore in the Caucasus.

TUNGSTEN

Universal armament activities in 1940 put further emphasis on the strategic nature of tungsten. Increased demands and disturbed flow from producing areas upset usual commercial relations, and supplies became a matter of national concern to the larger consuming countries. Despite increasing difficulties in moving Chinese tungsten—the principal world supply—exports from China continued, although at a greatly reduced rate. With Japanese occupation of most of the Chinese ports, movement of tungsten shifted to flow out of Indochina; this was stopped in July but was offset somewhat by reopening of the Burma Road in October. With the diminution of Chinese concentrates, output in other countries was stimulated in 1940, notably in Portugal, the United States, and Latin America.

Shipments of tungsten concentrates from domestic mines increased 24 percent from 1939 to a near-all-time high of 5,319 short tons (60 percent WO_3) in 1940, and imports for consumption rose to nearly four times their volume in 1939, greatly augmenting the supplies of tungsten available in the United States during 1940. General imports from China were more than three times as great as in 1939, and Latin American countries assumed real importance as foreign sources of supply when Argentina, Bolivia, Brazil, Chile, Cuba, Mexico, and Peru furnished 3,362,778 pounds (tungsten content), which was more than total general imports from all sources in 1939. The search for domestic deposits of tungsten ores was greatly stimulated, and many small lots ranging from a few hundred pounds to several tons were produced from new or previously abandoned deposits.

Although the supply may suffice for current demand, efforts directed to the substitution of other materials for tungsten, especially for war purposes, were increased. As the defense program progresses it is expected that molybdenum will be substituted for certain tungsten high-speed steels. Consumption of cemented carbide is increasing rapidly, but a pound of tungsten goes much farther in machining operations as cemented carbide than as high-speed steel. Small quantities of tantalum carbide and titanium carbide are also used, but tungsten carbide dominates the cemented-carbide industry.

Tables of domestic shipments, imports, exports, and apparent consumption of tungsten in the United States from 1910 to 1938, which present the historical background for considering the strategic nature of tungsten, are given in Minerals Yearbook, 1939 (p. 621).

Salient statistics of the tungsten industry in the United States, 1939–40

	1939		1940	
	Short tons	Value	Short tons	Value
Production (60 percent WO_3)	3,603	(1)	5,120	(1)
Concentrates shipped (60 percent WO_3)	4,287	$4,402,182	5,319	$6,576,318
Imported for consumption (W content)	743	997,971	2,805	4,690,723
Stocks in bonded warehouses, Dec. 31:				
Ore (W content)	843	1,357,219	2,196	3,956,825
Metal (W content)	6	14,975	7	23,587

[1] Figures not available.

The basic patents on tungsten carbide (including the Schroeder and hot-press process patents) were held invalid in a decree handed down by Judge Arthur J. Tuttle on August 14, 1940, in the case of General Electric Co. and Carboloy Co. versus Willey's Carbide Tool Co., et al. There was no appeal from the decision by the plaintiff. As a result of the decision, American manufacturers were relieved of royalty payments to foreign holders of the patents.

Following price reductions early in 1939, tungsten carbide prices were reduced further in 1940.

Toward the end of 1940, concerted efforts were being made by tool-steel manufacturers to accumulate their high-speed mill scale and grindings and have them converted into a "super-high-speed scrap," the tungsten content being "not less than twice the tungsten analysis of scale or grindings." This action was taken in an effort to maintain adequate supplies of scrap, which is an essential part of the charge in making steel, and thereby ease prices for scrap, which were tending to soar.[11]

Emergency stock pile.—Purchases of tungsten, authorized by the Strategic Materials Act of 1939, were continued during 1940. In June the Advisory Commission to the Council of National Defense was informed that there was a large tonnage of Chinese tungsten ore at the ports of Haiphong and Saigon, Indochina, which the Chinese Government wished to move to the United States before shipment could be stopped by Japanese or French authorities. Events moved rapidly; the Reconstruction Finance Corporation agreed to purchase all ore available from Indochina, space was obtained on two American vessels, authority for clearance was obtained from officials at Bordeaux and Haiphong, and shipment was made within about 2 weeks. Later in the year, the Metals Reserve Co.—subsidiary of the Reconstruction Finance Corporation—arranged to accept $30,000,000 worth of tungsten from China in repayment of a loan by the Export-Import Bank. Delivery will be made over a period of years at prices agreed upon from time to time. Subsequently another loan of $60,000,000 was arranged, to be repaid by sales of tungsten, antimony, and pig tin to the United States.

Government purchases of tungsten ores during 1940 included 2,000 short tons of California scheelite, in addition to the Chinese wolframite, contracted for by the Metals Reserve Co.; and 7,300 short tons of tungsten ores from China, South Africa, and South American coun-

[11] Steel, Reclaiming Tungsten Scrap Is Economy Move: Vol. 107, No. 19, November 4, 1940, pp. 121–122.

tries, contracted for by the Procurement Division of the Treasury Department with five firms in the United States.

A plant to clean tungsten ores imported for stock-pile purposes was put into operation by the National Reconditioning Co. at the Foreign Trade Zone, Stapleton, Staten Island.

To relieve a temporary stringency in spot supply of tungsten and assure adequate future deliveries to industry, part of the Government-held stock pile of tungsten was released for sale to industry early in February 1941, under authority granted to the Procurement Division of the Treasury Department. The order authorized the Procurement Division to sell or otherwise dispose of its tungsten stocks for defense production "to such buyers or users and in such amounts as may be requested from time to time by the Office of Production Management." Applications from industrial users for the purchase of Government stocks were to be made to the Procurement Division and granted upon approval of the Office of Production Management, the sale price to be the same as the cost of acquisition to the Government.

Export control.—On July 2, 1940, tungsten (defined as "tungsten ores and concentrates, metal, alloys containing in excess of five percent tungsten and tungsten compounds") was proclaimed by the President as one of a number of materials vital to defense for which export licenses would be required. Ferrotungsten was included in a later Presidential proclamation and Executive order which provided for the licensing, as of December 30, 1940, of iron ore, pig iron, ferro-alloys, and certain iron and steel manufactures and semimanufactures. On January 15, 1941, the Secretary of State issued general licenses for the export of tungsten and ferrotungsten to Canada.

Government exploration.—Continuing the search for ore deposits of stragetic metals, as authorized under section 7 of the Strategic Materials Act, the Bureau of Mines explored tungsten deposits in six areas in California and Nevada. In two areas, the deposits were definitely proved to be shallow as well as low-grade. In another instance, some additional low-grade ore was found, but the deposits were so erratic that it was impossible to calculate appreciable reserves. The remaining three projects are still active. Surface trenching and diamond drilling revealed additional reserves near Mill City and Shoshone, Nev., and in the Huachuca Mountains, Ariz. In connection with another project undertaken to determine reserves of antimony ore in the Yellow Pine District, Valley County, Idaho, a strike of high-grade tungsten ore was made. By May 15, 1941, seven drill holes had penetrated tungsten-bearing material of commercial grade within a length of over 400 feet along the strike; the limits of the deposit have not yet been determined. Some of the richer zones appear to be up to 25 feet thick. The discovery is believed to be important, as it can be developed rapidly; it is near the surface and in an established camp with an experienced operating staff in charge. The deposit is being developed as rapidly as possible by the owners of the property.

As part of its program of investigation of strategic mineral deposits the Geological Survey published reports describing tungsten deposits of the Atolia district, San Bernardino and Kern Counties, Calif.; Tungsten Hills, Inyo County, Calif.; Benton Range, Mono County, Calif.; and Boulder County, Colo., which are abstracted elsewhere in this chapter. Mapping of the Mill City district in the Eugene Mountains, Nev., was completed, and detailed examinations were made of the tungsten deposits in the Osgood Range, Humboldt County, and in the Minerva district, White Pine County. The Blue Wing district, Lemhi County, Idaho; Germania district, Stevens County, Wash.; and Silver Hill district, Spokane County, Wash., were also mapped in detail.

PRICES

Quotations on tungsten ore or concentrates were relatively steady throughout 1940. Chinese ore was quoted in the Engineering and Mining Journal at $23.00 to $24.50 per short-ton unit of WO_3, duty-paid, until December, when the quotation rose to $26.00; Bolivian and Portuguese ores were quoted at $21.50, duty-paid, early in 1940, rising gradually to $23.50 in October and $25.00 to $26.00 in December. Quotations for domestic scheelite, in carlots, delivered, were within the range of $21.00 to $25.00 during the year; western buyers were offering $17.00 and $18.00 a unit, delivered at Boulder, Colo. The average price for the 1940 shipments, as reported to the Bureau of Mines, was $20.61 per short-ton unit of WO_3. London prices for wolframite containing 65 percent WO_3 were nominal at 50 shillings per long-ton unit.

DOMESTIC PRODUCTION

Stimulated by defense activities, production of tungsten ore and concentrates in the United States rose to 5,120 short tons of concentrates (reduced to an equivalent of 60 percent WO_3) in 1940—a 42-percent increase over 1939. Development work was begun at many new properties, and output was reported from a number of widely scattered operations in Arizona, California, Colorado, Idaho, Missouri, Montana, Nevada, New Mexico, Utah, and Washington. California produced the most tungsten of any state in 1940, replacing Nevada. Total shipments from domestic mines, which were 24 percent larger than in 1939, were not only the largest since 1917 but have been exceeded in only one other year—1916.

Tungsten ore and concentrates shipped from mines in the United States, 1936–40

Year	Quantity		Reported value f. o. b. mines		
	Ore and concentrates, 60 percent WO_3 (short tons)	Tungsten content (pounds)	Total	Average per unit of WO_3	Average per pound of tungsten
1936	2,612	2,485,893	$2,323,818	$14.83	$0.93
1937	3,500	3,331,020	4,094,000	19.50	1.23
1938	3,044	2,897,036	3,161,498	17.31	1.09
1939	4,287	4,080,024	4,402,182	17.11	1.08
1940	5,319	5,062,199	6,576,318	20.61	1.30

Arizona.—Shipments of tungsten concentrates from Arizona operations totaled 302 short tons containing 69.33 percent WO_3 in 1940 compared with 88 tons containing 68.38 percent WO_3 in 1939. The output comprised scheelite, wolframite, huebnerite, and ferberite. The Boriana mine of the Molybdenum Corporation of America in Mohave County, which provided the major part of production in the State, operated its mine on two shifts and its mill on one shift during most of the year. The remaining output was reported by a number of small producers. The Williams mine, in Mohave County 72 miles southeast of Kingman, was being prospected and developed during 1940 by the Continental Mining Corporation. The 100-ton mill, which was erected and put into operation in July, was closed temporarily later in the year.

California.—Shipments of tungsten concentrates from California amounted to 2,076 short tons containing 59.83 percent WO_3 in 1940 compared with 1,250 short tons containing 60.63 percent in 1939. Four producers—the Atolia Mining Co., in San Bernardino County; the Tungstore Mines, in Tulare County; and the Tungstar Corporation and the United States Vanadium Corporation, both in Inyo County—shipped 1,848 short tons of concentrates or 89 percent of the shipments reported from the State. The remainder came from 28 smaller operations.

Tungsten deposits of California are described in three papers in Strategic Minerals Investigations, 1940, of the Geological Survey. In one describing tungsten deposits of the Atolia District, Lemmon and Dorr [12] express the belief that with favorable prices an annual production of 300 to 400 tons of 60 percent WO_3 concentrates may be maintained over a short period of years.

With reference to tungsten deposits in the Tungsten Hills of Inyo County, Calif., Lemmon [13] states that although the larger known ore bodies apparently are nearly exhausted, numerous small, low-grade deposits, ranging in size from a few hundred to a few thousand tons, remain undeveloped. It is estimated that there are 100,000 tons of probable ore containing 0.25 to 0.5 percent WO_3 in reserve. Additional ore bodies may be found at depth in the Round Valley deposit.

According to another report in the Strategic Minerals Investigations series,[14] of the four scheelite deposits found in the Benton Range, Mono County, prior to 1940, only one—that at the Black Rock mine—has been productive, although another (on the Coos claims) is being developed.

At the Black Rock mine the proved ore does not exceed 10,000 tons and averages less than 1 percent WO_3. The possible ore reserves may total several hundred thousand tons if the isolated outcrops prove to be connected underground or if new discoveries are made.

At Pine Creek in the Bishop (Calif.) area, the United States Vanadium Corporation operated its 350-ton-per-day mill at the mine and had under construction a 1,200-ton mill at the junction of Pine and Morgan Creeks at an elevation of about 7,600 feet. The mine is at an elevation of about 11,000 feet and will be connected to the new mill by an aerial tramway. Large tonnages of complex tungsten-molybdenum ore have been blocked out, and a suitable method of separation has been developed involving selective flotation, with chemical treatment of the flotation concentrates to raise the tungsten in the final product to the 60-percent range. There is a chemical plant on Pine Creek. The company also purchases low-grade flotation concentrates from other producers.[15]

A comprehensive survey of tungsten resources of California was

[12] Lemmon, Dwight M., and Dorr, John V. N., 2d, Tungsten Deposits of the Atolia District, San Bernardino and Kern Counties, Calif.: Geol. Survey Bull. 922–H, 1940, pp. 205–245.

[13] Lemmon, D. M., Tungsten Deposits in the Tungsten Hills, Inyo County, Calif.: Geol. Survey Bull. 922–Q, 1941, pp. 497–514.

[14] Lemmon, D. M., Tungsten Deposits of the Benton Range, Mono County, Calif.: Geol. Survey Bull. 922–S, 1941, pp. 581–593

[15] Lenhart, Walter B., Milling Scheelite at Tungstar Mine: Mining Cong. Jour., vol. 27, No. 4, April 1941, p .67.

published by the California State Department of Mineral Resources.[16]

Colorado.—Total shipments rose to 849 short tons of ferberite concentrates averaging 48.95 percent WO_3 in 1940 from 617 short tons averaging 46.59 percent WO_3 in 1939. The greater part of the output came from properties of the Wolf Tongue Mining Co. and the Vanadium Corporation of America near Nederland.

The total production of ferberite concentrates in Boulder County[17] from 1900, when mining began, through 1938 has been equivalent to 20,650 tons containing 60 percent WO_3. Much of the ore mined averaged about 7 percent WO_3, and the lower limit of commercial grade is regarded as about 1½ percent WO_3.

It is probable that very few outcrops of ore shoots have remained undiscovered in the district, and although many blind shoots may exist the cost of finding them would be high. A small annual production may be expected to continue for many years but is unlikely ever again to reach 1,000 tons a year.

Idaho.—The Ima mine on Patterson Creek about 11 miles east of May was the only producer in Idaho in 1940 and shipped 240 short tons of huebnerite concentrates averaging 65 percent WO_3.

A deposit of high-grade tungsten ore was discovered in the Yellow Pine District, Valley County, Idaho, by engineers of the Bureau of Mines and geologists of the Geological Survey in connection with their search for ore deposits of strategic metals.

Montana.—The Jardine Mining Co.—the only producer in Montana in 1940—shipped 42 tons of scheelite concentrates averaging 70.62 percent WO_3 from operations at the Jardine mine in Park County. The principal output is gold, and tungsten is produced entirely as a byproduct.

Nevada.—Shipments of concentrates (virtually all scheelite) totaled 1,748 short tons averaging 61.67 percent WO_3. The Nevada-Massachusetts Co. near Mill City (the leading producer in the State) is also the largest individual source of tungsten ores in the United States. At the end of 1940, a new tailings plant at Mill City and chemical plant at Golconda were nearly completed and were expected to go into production in February 1941.

Washington.—Virtually all shipments of tungsten concentrates from Washington in 1940 came from the Germania mine near Fruitland, Stevens County, where the General Electric Co. worked over surface float and tailings to recover 53 short tons of wolframite concentrates averaging 67.78 percent WO_3 and 33 tons of wolframite jig concentrates averaging 14 percent WO_3. No new development was undertaken at the property during 1940.

FOREIGN TRADE

Domestic supplies of tungsten are supplemented by imports, principally of concentrates but also in other forms. Imports of ore and concentrates for consumption (tungsten content) rose sharply from 1,485,157 pounds in 1939 to 5,610,882 in 1940, Bolivia and China supplying 22 and 34 percent of the 1940 total, respectively. The distribution of imports for consumption is shown in the following table for 1939 and 1940.

[16] Bradley, Walter W., Tungsten: California Dept. Mineral Resources, Div. of Mines, Mineral Abstracts, 1940, pp. 1–32.

[17] Lovering, T. S., Tungsten Deposits of Boulder County, Colo.: Geol. Survey Bull. 922-F, 1940, pp. 135–156.

Tungsten ore and concentrates imported for consumption in the United States, 1939–40 by countries

Country	1939			1940		
	Gross weight (pounds)	Tungsten content (pounds)	Value	Gross weight (pounds)	Tungsten content (pounds)	Value
Africa:						
Union of South Africa				102,577	53,511	$47,325
Other British South Africa				142	73	65
Argentina	141,872	76,524	$50,324	1,450,424	762,012	632,484
Australia	102,216	56,639	42,196	1,017,236	573,038	479,944
Bolivia	180,019	96,164	77,342	2,523,354	1,208,595	970,251
British Malaya	200,843	123,682	113,063	274,847	162,783	167,671
Burma	24,576	12,878	8,683	175,225	93,549	71,759
Chile				4,409	2,469	1,697
China	1,656,307	899,806	587,489	3,634,563	1,899,526	1,670,085
Cuba				5,092	2,781	3,810
Ecuador	37,440	21,326	7,500			
French Indochina	5,630	2,876	2,832	47,710	14,417	14,459
India, British				53,943	30,000	25,486
Mexico	306,907	146,637	89,352	217,430	113,867	71,823
Peru	87,662	48,625	19,190	369,885	174,893	129,579
Portugal				598,172	322,681	273,244
Thailand				354,084	196,687	131,041
	2,743,472	1,485,157	997,971	10,829,093	5,610,882	4,690,723

General imports of tungsten ore or concentrates, which represent the movement of ore to this country, amounted to 18,481,342 pounds containing 9,666,228 pounds of tungsten in 1940. Of the total general imports of tungsten, China supplied 46 percent, Bolivia 20 percent, Argentina 10 percent, Portugal and Australia 6 percent each, Peru 4 percent, Thailand and Burma 2 percent each, and Mexico 1 percent.

In addition, 1,348,495 pounds of tungsten in concentrates were imported for smelting, refining, and export in 1940 compared with 589,828 pounds in 1939. Material brought in under this classification is free of duty. There is no record of any exports of tungsten ore or concentrates from this country.

Imports of tungsten metal and tungsten carbide declined from 39,498 pounds in 1939 to 36,652 (metallic content) in 1940. No tungstic acid nor other compounds of tungsten were imported in 1940.

Exports of tungsten metal, wire, shapes, and alloys other than ferrotungsten (for which export data are not available) increased to 237,940 pounds in 1940 from 195,002 pounds in 1939.

Tungsten in metal and compounds imported for consumption in the United States, 1939–40, by countries

Country	Tungsten (metal) and tungsten carbide [1]				Tungstic acid and other compounds of tungsten			
	1939		1940		1939		1940	
	Tungsten content (pounds)	Value	Tungsten content (pounds)	Value	Tungsten content (pounds)	Value	Tungsten content (pounds)	Value
Germany	251	$1,430			438	$2,002		
Hungary					262	2,422		
United Kingdom	39,247	41,440	36,652	$41,041				
	39,498	42,870	36,652	41,041	700	4,424		

[1] Includes combinations containing either metal or carbide.

USES

The principal use of tungsten, according to quantity, is in the manufacture of tools for metal cutting. For this purpose it is employed either in high-speed tool steels or in cemented carbides, used in making the tips of cutting tools and in the production of hard dies. New types of steel employing only 1 or 1.50 percent tungsten in place of the usual 18 percent tungsten - 4 percent chromium - 1 percent vanadium steel (the tungsten deficiency being compensated for by as much as 9.50 percent molybdenum) are being used successfully and should aid materially in meeting the increased demand for tungsten in high-speed tool steels. The need for stretching tungsten supplies also favors greater use of tungsten carbide. The use of tungsten in electric-light and radio-tube filaments is also important, but the quantities consumed are not large. For military purposes, tungsten is used as a core in armor-piercing bullets, as an erosion-resistant liner in heavy ordnance, in armor plate, and in gun breeches. Tungsten salts are used in the chemical, pigment, and tanning industries.

WORLD PRODUCTION

The sharp decline of tungsten production in China of more than 8,000 metric tons (as shown by exports) was compensated for only in part by substantally increased output in the United States, Bolivia, and Portugal. Complete figures are not available, but preliminary data indicate that world production in 1940 was lower than in any year since 1936.

Argentina.—Argentina has become increasingly important as a source of tungsten and now ranks fifth or sixth among producing countries. High prices offered by local buyers were largely responsible for increased output and tended not only to stimulate production by established operators but attracted many new ones. At the year's end at least 50 small operations were reported to be active, and their yield ranged from a few hundred pounds to several tons monthly. All tungsten mines in the Department of Iglesias, 700 miles northwest of Buenos Aires in the Andean Province of San Juan, have been leased for 10 years to Granfor, Keen & Co., an American concern. Exports to Europe have virtually ceased since September 1939. Aside from one small shipment to Sweden, all exports of tungsten ores from Argentina during 1940, amounting to about 1,400 short tons, were consigned to the United States or to Japan; the latter country took about 19 percent of the tonnage exported.

Bolivia.—Bolivia is the largest tungsten producer in South America, and output in 1940 (as indicated by exports) was exceeded only by that from the United States and Portugal, and possibly Burma. Tungsten production was begun in a small way in Bolivia in 1908 and was stimulated by war demand in 1917. Many mines were unable to survive the subsequent drop in the price of tungsten, but as a result of active operation of the rich Conde Auque scheelite property near Oruro in 1929, Bolivian tungsten production again took an upturn. By 1934 a number of scattered properties were producing, and the industry was well-established. Wolframite is the principal tungsten mineral mined, scheelite comprising only a small percentage of exports. According to Reagan,[18] the following four companies

[18] Reagan, P. H., Bolivia for Strategic Minerals: Eng. and Min. Jour., vol. 141, No. 10, October 1940, pp. 54–58.

World production of tungsten ores, 1936–40, by countries, in metric tons of concentrates containing 60 percent WO_3

[Compiled by L. P. Lounsbery]

Country [1]	1936	1937	1938	1939	1940
North America:					
Mexico	57	33	76	118	112
United States (shipments)	2,370	3,175	2,761	3,889	4,825
	2,427	3,208	2,837	4,007	4,937
South America:					
Argentina	702	866	1,195	1,309	(2)
Bolivia (exports)	1,741	1,802	2,530	3,337	4,183
Brazil (exports)	-	6	2	7	9
Chile	3	5	5	(2)	(2)
Peru	92	30	170	170	290
	2,538	2,709	3,902	(2)	(2)
Europe:					
France	-	-	22	(2)	(2)
Great Britain (Cornwall)	221	148	258	(2)	(2)
Italy	-	3	4	(2)	(2)
Norway	-	3	19	(2)	(2)
Portugal	1,414	2,069	2,810	3,851	4,858
Sweden	62	127	180	200	(2)
	1,697	2,350	3,293	(2)	(2)
Asia:					
Burma	5,382	5,924	6,334	(2)	(2)
China (exports)	7,638	17,895	13,387	11,580	3,118
Chosen	1,849	2,058	(2)	(2)	(2)
India, British	-	15	12	(2)	(2)
Indochina (Tonkin)	503	648	545	510	392
Japan	61	(2)	(2)	(2)	(2)
Malay States:					
Federated Malay States	1,712	1,077	749	246	108
Unfederated Malay States	325	279	333	362	427
Netherlands Indies	1	(3)	(3)	2	(2)
Thailand	82	221	251	378	(2)
	17,553	[4] 28,117	(2)	(2)	(2)
Africa:					
Egypt	-	193	(2)	(2)	(2)
Morocco, French	-	-	7	(2)	(2)
Nigeria	11	9	49	237	(2)
Southern Rhodesia	88	275	329	270	(2)
South-West Africa	46	41	48	50	24
Tanganyika Territory	2	2	5	(3)	(2)
Uganda	-	2	2	2	(2)
Union of South Africa	30	40	127	100	105
	177	562	(2)	(2)	(2)
Oceania:					
Australia:					
New South Wales	18	66	113	(2)	(2)
Northern Territory	141	345	515	354	320
Queensland	22	110	167	107	(2)
Tasmania	245	345	390	472	(2)
New Zealand	49	28	54	49	(2)
	475	894	1,239	(2)	(2)
	24,867	[4] 37,840	(2)	(2)	(2)

[1] In addition to countries listed, tungsten ore is produced in Spain and the U. S. S. R., but no data of production are available for the period under discussion.
[2] Data not available.
[3] Less than 1 ton.
[4] Exclusive of Japan.

furnish about 50 percent of the Bolivian exports of tungsten: International Mining Co. (W. R. Grace & Co.), Cia. Aramayo Mines de Bolivie, Bolivian Tin & Tungsten Mines Corporation, and Sociedad Empresa de Estano Araca. The production from these companies probably could be expanded; comprehensive mine-development work has been undertaken, and modern mills are in use. The small companies that supply the remainder of Bolivian production have mined the easily available ore by hand and treated it in small, crude, hand mills. The output from most of these operations is purchased by the Banco Minero de Bolivia, the Government ore-buying agency. The principal tungsten-producing districts are, from north to south, Sorata, La Paz, Araca-Quime, Chicote-Kami, Conde Auque, Tazna, and Esmoraca.

Burma.—Exports of tin-tungsten concentrates during 1940 were 8,973 metric tons, compared with 12,212 in 1939. Exports from Burma are controlled by the Ministry of Supply in London, which fixed a price of 50 shillings per long-ton unit (22.4 pounds), f. o. b. Rangoon; shipments are permitted to Great Britain only.

Canada.—A considerable amount of exploration and development work was done in Canada. Deposits of tungsten-bearing minerals, usually scheelite, are known in Nova Scotia, New Brunswick, Manitoba, British Columbia, and the Yukon Territory, and small commercial shipments were made by Columbia Tungstens Co., Ltd., at Wells, British Columbia, in 1939 and by the Kirkpatrick Tungsten Syndicate from a deposit at Goff, Halifax County, Nova Scotia, in 1940.

China.—Difficulties of production, transport, and shipment caused by temporary closing of the Burma Road, the Indochina crisis, and other effects of the Sino-Japanese hostilities affected the tungsten industry of China adversely. Exports of tungsten concentrates dropped sharply in 1940 to 3,118 metric tons from 11,580 tons in 1939. During recent years, export centers have shifted from place to place as a result of war difficulties. In 1936 and 1937, 60 to 70 percent of all exports of tungsten from China were shipped from Shanghai; in 1938, virtually all exports left from the southern ports of Canton, Kowloon, Wuchow, and Mengtsz; following the capture of Canton in the fall of 1938, export clearance shifted to Lungchow on the southern Kwangsi border. Hong Kong was an active trading center for tungsten ores during the first 6 months of 1940, but as the months passed it became increasingly difficult for ores from the interior to reach that port. Shipments from Hong Kong to the United States dropped sharply during the third quarter of 1940 and apparently were nonexistent during the remainder of the year. Receipts from the adjacent Province of Kwangtung were interrupted by hostilities, and apparently increasing shipments were made direct to Japan, as Kwangtung was largely under Japanese control. Such small quantities as reached Hong Kong direct from Kwangtung were said to be below standard market grade, requiring further treatment at Hong Kong. The opinion was expressed in some sources that supplies of tungsten from Kiangsi and Hunan Provinces, ordinarily passing through the Hong Kong market, were being diverted to Japanese interests. Official trade statistics indicated that shipments of tungsten from Hong Kong during the first 6 months of 1940 were about equally divided between the United States and Japan. At the end of 1940 it was reported that, aside from the small production of about 25 tons a month in Hong Kong Province, supplies of tungsten were obtainable in Hong Kong only by means of porters or small boats on inland water routes.

Great Britain.—Effective April 8, 1940, the Ministry of Supply placed the sale and purchase of tungsten ores under a licensing scheme, whereby persons handling these materials were required to keep records and produce them for inspection upon demand.

Peru.—Within recent years, tungsten deposits have been developed in primitive fashion in the Provinces of Ancash and Santiago de Chuco in the Department of La Libertad. The Julcani mine, an old lead-silver property in the central part of Peru, was to be reopened in 1940; reserves of low-grade ore are estimated at 2½ million tons and are said to average 1 to 2 percent WO_3 in the upper levels.[19]

Portugal.—Responding to attractive prices offered by Germany, the United States, and the British Ministry of Economic Warfare (75 to 80 shillings per long-ton unit of WO_3), production of tungsten ores in Portugal rose 26 percent in 1940. The Beralt Tin & Wolfram, Ltd., with properties at Panasqueira in the Province of Beira Baixa, district of Castello Branco, was the largest producer.

U. S. S. R.—The most important source of tungsten in the U. S. S. R. is the Dzidha Tungsten Combine, which has been developing deposits and since May 1939 has been operating a concentrating plant. It is reported that favorable results have not been achieved as rapidly as anticipated, and the Commissariat for Nonferrous Metals was attempting to expedite developments by expanding visible ore reserves.

VANADIUM

Vanadium production continued at about the same rate in 1940 as in 1939. The world supply comes from a limited number of operations, principally in four countries, of which Peru and the United States are the most important. The yield in Peru, all from the Minasragra mine, was 23 percent higher in 1940 than in 1939. Domestic shipments of vanadium from all sources increased only about 5 percent. Further attention was devoted to the recovery of vanadium from sources other than ore. Germany was reported to be obtaining vanadium from blast-furnace slag in large enough quantities to render itself virtually independent of imports; in Italy, vanadium oxide was being recovered from the caustic-soda solution employed in the Bayer process of refining bauxite and from naphtha soot collected from smoke stacks of ships and industrial plants; an American firm reports the accumulation of considerable quantities of flue dust containing 20 to 40 percent V_2O_5 from the boilers of ships burning Venezuelan fuel oil.

In the United States, the Anaconda Copper Mining Co. undertook to recover vanadium in the treatment of phosphates under a patented process [20] whereby the vanadium content of a phosphoric acid solution is converted to the pentoxide form by an oxidizing agent such as potassium persulfate, and the vanadium content is extracted by the action of a selective solvent, such as ethyl ether, ethyl acetate, or butyl acetate. The company contemplates production of 100,000 pounds of vanadium annually.

Vanadium is not classed as a strategic metal, but its principal field of usefulness lies in special alloy steels, and as such it was included among the materials vital to defense that the President placed under the export-licensing system on July 2, 1940. The term "vanadium,"

[19] Wright, Charles Will, South America as a Source of Strategic Minerals: Min. and Met., vol. 21, No. 402, June 1940, pp. 284–285.

[20] Frick, Frederick F., and Woodman, Frank W., Recovery of Vanadium: U. S. Patent 2,193,092, March 12, 1940.

as employed in the act, includes vanadium ores and concentrates, alloys containing more than 10 percent vanadium, and vanadium compounds. Later in the year the President announced that, effective December 30, 1940, iron ore, pig iron, ferro-alloys and certain iron and steel manufactures and semimanufactures would be subjected to the licensing requirement; in the accompanying regulations, ferrovanadium was specifically mentioned as one of the ferro-alloys falling within the definition of "iron" and "steel." On January 15, 1941, the Secretary of State issued general licenses for the export of vanadium and ferrovanadium to Canada.

Salient statistics of the vanadium industry in the United States, 1939–40

	1939		1940	
	Quantity	Value	Quantity	Value
Shipments:				
Carnotite ores short tons	6,256	$174,660	[1] 796	[1] $61,800
Vanadium contained pounds	206,509	(2)	51,377	(2)
Uranium contained do	59,269	(2)	16,909	(2)
Vanadium ores short tons	[3] 273,098	[3] [4] 879,000	95,549	[4] [5] 968,000
Vanadium contained pounds	[6] 1,777,559		2,015,729	
Byproduct salt from complex ores—vanadium contained pounds	(2)	(2)	23,495	(5)
Imports:				
Vanadium ores short tons	15,694	991,511	22,551	1,216,705
Vanadium contained pounds	2,132,548		2,574,951	

[1] Includes only ore sold for uranium and vanadium values; ore sold only for its vanadium value included with vanadium ores.
[2] Figures not available.
[3] Includes complex ores.
[4] Estimated by Bureau of Mines.
[5] Value of vanadium contained in byproduct salt from complex ores included with value of vanadium ores.
[6] Includes vanadium content of complex ores.

DOMESTIC PRODUCTION

United States production (as measured by shipments) of vanadium contained in all types of ore from which it was recovered totaled 2,090,601 pounds in 1940 compared with 1,984,068 pounds in 1939. Shipments in 1940 comprised chiefly vanadium and carnotite ores (containing 2,067,106 pounds of vanadium) but also included salts obtained as a byproduct of complex ores (containing 23,495 pounds of vanadium). Output came from Arizona, Colorado, New Mexico, and Utah.

Arizona.—Vanadium was produced from operations of the Mammoth-St. Anthony, Ltd., near Mammoth, where complex ores containing recoverable gold, silver, lead, molybdenum, and vanadium are treated in the company flotation mill.

Colorado.—The output of vanadium in Colorado in 1940 amounted to 1,953,293 pounds in vanadium and carnotite ores. Purchase of custom ores by the United States Vanadium Corporation and the Vanadium Corporation of America stimulated the output of vanadium ore by small producers. The United States Vanadium Corporation continued to operate its 260-ton roasting, leaching, and vanadium oxide precipitation plant at Uravan. Some ore treated there came from an old operation at Rifle, Colo. The company also completed a uranium-concentration plant to reclaim uranium from accumulated tailings at its vanadium mill. The Vanadium Corporation of America reopened its property at Naturita, Colo., which had been idle since 1920. The North Continent Mines, Inc., built a mill for treating vanadium ores near Cedar, San Miguel County.

Utah.—Vanadium-bearing ores were produced from a number of rather widely scattered places in Utah. Shipments, which were higher than in 1939, totaled 203,238 pounds of contained V_2O_5 (113,813 pounds of V) in 1940 and originated in Grand and San Juan Counties in the southeastern part of the State.

FOREIGN TRADE

Imports of vanadium ores in 1939, all from Peru, totaled 22,551 short tons containing 2,574,951 pounds of V. Data on exports are not given by the Bureau of Foreign and Domestic Commerce. Producers reported no exports in 1940.

USES

The principal use of vanadium is in the manufacture of special alloy steels and irons; the trend toward higher vanadium content in modern high-speed tool steels is apparent, especially in those steels where all or part of the tungsten has been replaced by molybdenum. Chrome-vanadium steels find widespread use in railway, bus, and truck operation and are proving their usefulness in ordnance. A new class of ferro-alloys has been placed on the market under the trade name "Grainal." These are primarily vanadium-titanium-aluminum ferro-alloys, and it is claimed that they not only increase the hardening capacity of ferritic constructional steels of given chemical composition but also reduce the variability of a given composition in successive heats.[21] A minor quantity of vanadium is employed as a catalyst, in the form of ammonia metavanadate, in the manufacture of sulfuric acid, and in the nonferrous, glass, ceramic, and color industries. Vanadium is classified by the Army and Navy Munitions Board as one of the "critical" materials that are as essential as strategic materials and may be difficult to obtain but for a number of reasons probably will not present as serious a problem of supply.

WORLD PRODUCTION

The world output of vanadium in 1940 proceeded at about the same rate as in 1939, with Peru still the principal producing country. By obtaining greatly increased quantities of vanadium from blast-furnace slag, Germany is said to have become virtually independent of foreign sources of supply. A national cartel, Vanadium G. m. b. H., comprising three companies, is responsible for supplying German requirements. In Italy, vanadium is recovered from naphtha soot collected from the smokestacks of ships and industrial plants at a plant at Rivarole, Genoa; 50 metric tons of V_2O_5 were obtained from 974 metric tons of soot from July 1938 to June 1939. Construction of a new plant at Serra Rico near Genoa is contemplated. During the first 9 months of 1940, vanadium ores were produced and exported by the Southwest Africa Co., Ltd., of Grootfontein from its mines at Abenad and Baltika and by the Otavi Minen und Eisenbahn Gesellschaft of Tsumeb from its Nageib mine and prospecting claims.

[21] Strauss, Jerome, Vanadium in Steel: Metal Progress, vol. 38, No. 4, October 1940, pp. 389–390.

All production from the latter mine ceased on September 25, 1940. Ore reserves of 2,400,000 tons of oxide at properties of the Rhodesian Broken Hill Development Co., Ltd., are reported to contain 23.5 percent zinc and 0.83 percent V_2O_5. Additions to the acid and leaching plants and erection of a small flotation plant were expected to make vanadium production possible for many years.

World production of vanadium in ores and concentrates, 1936–40, in metric tons

[Compiled by L. P. Lounsbery]

Country	1936	1937	1938	1939	1940
Mexico		45	180	148	57
Northern Rhodesia	204	235	374	384	(1)
Peru	161	583	826	1,016	1,254
South-West Africa	547	591	557	514	428
United States (shipments)	63	493	732	900	948

1 Data not available.

BAUXITE AND ALUMINUM

By Herbert A. Franke and M. E. Trought[1]

SUMMARY OUTLINE

Spurred onward by the national defense program, production of aluminum in the United States during 1940 exceeded by 26 percent the high point reached in 1939. Consumption rose 35 percent above the 1937 and 1939 records to establish an all-time peak. During 1940 the basic price of aluminum was reduced 3 cents, an expansion in ingot and fabricating capacity was inaugurated for completion within 2 years on a scale that normally would take 2 decades, and the demand for aluminum became so great that priorities had to be imposed on the metal early in 1941 to conserve and wisely allocate it for defense and nondefense purposes. The price reduction from 20 to 17 cents a pound was made possible by economies brought about by increased production. The Aluminum Co. of America began expansions that will cost almost $200,000,000. The Reynolds Metals Co. announced the extension of its fabricating capacity and its entrance into the aluminum-ingot-producing field. Thus in 1941, for the first time in the history of the industry there will be more than one substantial producer.

By April 1941 military requirements were taking most of the aluminum supply, leaving only a fractional quantity for very important civilian needs. Imports of crude and semicrude aluminum increased 26 percent; exports declined 25 percent compared with 1939 but were the second highest on record.

The production of bauxite in the United States was the largest in 18 years, and imports climbed to a new high. Demand for the ore by the aluminum industry attained an unprecedented level in 1940. The abrasive and chemical industries, stimulated by defense activities, also consumed more bauxite than in 1939. Shipments (dried bauxite equivalent) from Arkansas mines continued to advance, enabling domestic output to rise 17 percent over that in 1939. Imports of bauxite advanced 21 percent over the 1939 record; and ex-

[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.

ports, chiefly to Canada, increased 39 percent. Apparent consumption in 1940 rose 22 percent over that in 1939, and domestic output was equivalent to 47 percent and net imports to 53 percent of the total. Quoted prices for bauxite were slightly above those in 1939.

Salient statistics of the bauxite and aluminum industries in the United States, 1938–40

	1938	1939	1940
Bauxite:			
Production (mine shipments) [1] ... long tons	310,916	375,307	438,913
Value [2]	$1,812,545	$2,166,236	$2,578,968
Imports [2] ... long tons	455,693	520,179	629,552
Exports (including concentrates) [2] ... do	57,726	51,635	81,913
World production ... do	3,788,000	4,238,000	[3] 4,554,000
Aluminum:			
Primary production ... short tons	143,441	163,545	206,280
Value	$56,659,000	$64,600,000	$75,292,000
Quoted price per pound [4] ... cents	20.0	20.0	18.7
Secondary production ... short tons	38,800	50,000	(5)
Imports	$3,379,018	$4,766,260	$5,159,924
Exports	$5,484,047	$23,705,250	$22,437,125
World production ... short tons	638,000	[3] 735,000	[3] 885,000

[1] Dried bauxite equivalent.
[2] As shipped.
[3] Estimated.
[4] New York: 99 percent plus, pure virgin ingot, according to Metal Statistics 1941, published by American Metal Market.
[5] Figures not yet available.

World output of bauxite and aluminum in 1940 is believed to have exceeded all previous records. Although official data are lacking it is estimated that world production of bauxite increased 7 percent and production of aluminum 20 percent over that in 1939. Defense and war efforts were focused on aluminum because lightness and high strength are essential in the manufacture of more efficient fighting aircraft and other military equipment.

BAUXITE

PRODUCTION

Production (mine shipments), dried bauxite equivalent, of bauxite in the United States in 1940 increased 17 percent in quantity and 19 percent in value over that in 1939 and was the highest on record since 1923 (see fig. 1). Mines in Saline and Pulaski Counties, Ark., supplied 97 percent of the total output and virtually all of the increased domestic production. For the first time Virginia produced a small tonnage of ore from very limited reserves in Augusta County. Shipments from Alabama (Barbour and Henry Counties) and Georgia (Sumter County) continued to decline.

Stocks of bauxite on hand at all mines and processing plants on December 31, 1940, totaled 167,828 long tons of crude ore and 9,088 of processed ore, compared with 149,377 tons of crude ore and 9,367 of processed ore on December 31, 1939.

Domestic bauxite mining and processing companies active in 1940 were: The Aluminum Ore Co., East St. Louis, Ill. (operated in Arkansas—processor only); American Cyanamid & Chemical Corporation, 30 Rockefeller Plaza, New York, N. Y. (in Arkansas and Georgia); Arkansas Bauxite Corporation, Bauxite, Ark. (in Arkansas—active only first 7 months of 1940); Bauxite Co. of Alabama, 1215 First National Bldg., Birmingham, Ala. (in Alabama); Consolidated Chemical Industries, Inc., 811 Petroleum Bldg., Houston, Tex. (in Arkansas); Crouch Mining Co., Inc., P. O. Drawer D, Bridge Station, Niagara Falls, N. Y. (in Arkansas); Dixie Bauxite Co., Inc., Sweet Home, Ark. (in Arkansas); Benjamin Easterlin, Americus, Ga. (in Georgia); Floridin Co., 220 Liberty St., Warren, Pa. (in Alabama); Norton Co., Worcester, Mass (in Arkansas—processor only); Porocel Corporation, 260 South Broad St., Philadelphia, Pa. (in Arkansas—processor only); and Republic Mining & Manufacturing Co., 230 Park Ave., New York, N. Y. (in Arkansas, Alabama, and Virginia). In addition to the above (except the Arkansas Bauxite Corporation), the following concerns definitely plan to produce bauxite in 1941: Bauxite Mining Corporation, subsidiary of Reynolds Metals Co., Federal Reserve Bank Bldg., Richmond, Va. (in Arkansas); Dulin Bauxite Co., 2222 Vance St., Little Rock, Ark. (in Arkansas); J. C. Hebble, Cartersville, Ga. (in Georgia and Alabama); and Reynolds Ore Co., subsidiary of Reynolds Metals Co., Federal Reserve Bank Bldg., Richmond, Va. (in Alabama, Georgia, Tennessee, and Mississippi).

Bauxite shipped from mines in the United States, 1936–40, by States

State and year	Long tons					Value f. o. b. mine, as shipped
	Crude	Dried	Calcined	Total		
				As shipped	Dried bauxite equivalent	
Alabama and Georgia:						
1936	91	16,971		17,062	17,056	$109,327
1937	3,410	14,627		18,037	17,614	121,825
1938	5,532	[1] 12,542		18,074	17,253	132,882
1939	2,727	11,318		14,045	13,617	91,282
1940	[2] 2,363	9,342		[2] 11,705	[2] 11,381	[2] 77,575
Arkansas:						
1936	49,243	268,900	36,800	354,943	363,255	2,089,196
1937	98,340	257,023	46,832	402,195	407,462	2,322,861
1938	72,097	194,945	[1] 26,238	293,280	293,663	1,679,663
1939	99,215	225,355	[3] 36,686	361,256	361,690	2,074,954
1940	114,921	261,103	[3] 47,259	423,283	427,532	2,501,393
Total United States:						
1936	49,334	285,871	36,800	372,005	380,311	2,198,523
1937	101,750	271,650	46,832	420,232	425,076	2,444,686
1938	77,629	[1] 207,487	[1] 26,238	311,354	310,916	1,812,545
1939	101,942	236,673	[3] 36,686	375,301	375,307	2,166,236
1940	117,284	270,445	[3] 47,259	434,988	438,913	2,578,968

[1] Includes small quantity of activated.
[2] Includes Virginia.
[3] Includes sintered.

In Arkansas in 1940 the American Cyanamid & Chemical Corporation shipped ore from the Rauch, Heckler, Ozark Nos. 24 and 28, and Townsend mines and the newly opened Cleveland mine. On August 1, 1940, the company acquired the recently developed Townsend mine and the West Bauxite drying plant of the Arkansas Bauxite Corporation. At the same time the Porocel Corporation purchased the West Bauxite activating plant. The Arkansas Bauxite Corporation abandoned its operations at the McDonald mine in the spring of 1940. In June 1940 the Crouch Mining Co. began to mine and calcine bauxite at its new Young property in Saline County, after abandoning its operations on the England property in Pulaski County. The new circular vertical shaft at the Young mine (about 300 feet deep) was sunk by the Layne-Arkansas Co., which employed a special 84-inch rotary drilling bit in sinking through difficult quicksand. The Republic Mining & Manufacturing Co., subsidiary of the Aluminum Co. of America, continued its former extensive open-pit and underground mining operations and early in 1941 began to expand its bauxite-drying-kiln capacity. In reply to the antitrust suit charges that the Aluminum Co. of America monopolizes the raw materials

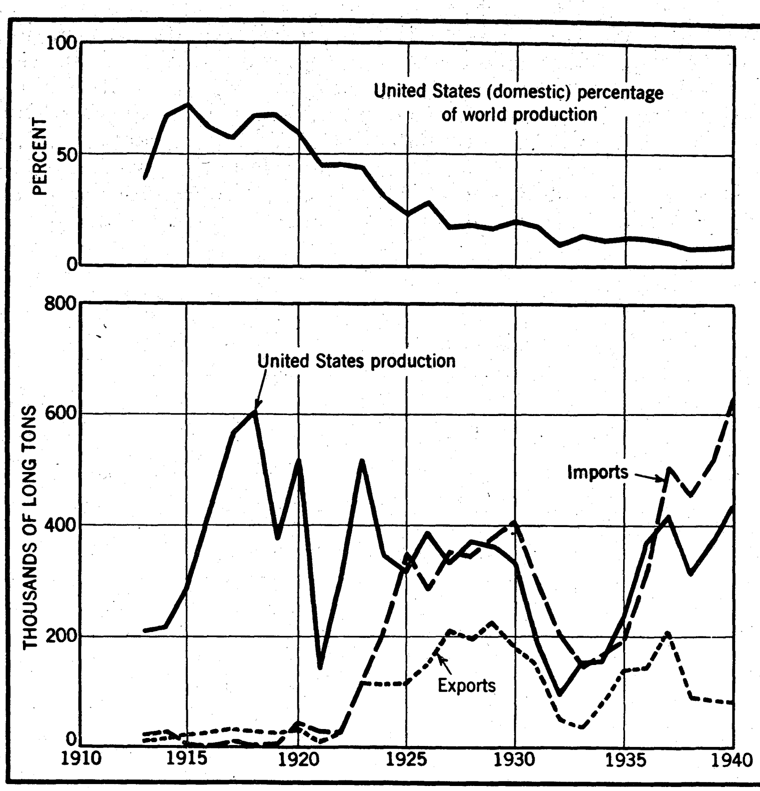

FIGURE 1.—Trends in production, imports, and exports of bauxite, 1913–40.

used in the production of aluminum, a Republic official testified that the company owned approximately 6,000,000 tons out of about 11,500,000 tons of known commercially recoverable bauxite in Arkansas. During most of 1940 Arkansas bauxite operators worked one shift 5 days a week or more instead of the former 4-day-week schedule.

In the other bauxite-producing States of the South, the Republic Co. continued to ship dried ore from southeastern Alabama and commenced a new small mining operation at Spottswood, Augusta County, Va.; the Bauxite Co. of Alabama—a new producer—and the Floridin Co. shipped crude ore from Barbour and Henry Counties, Ala.; and the American Cyanamid & Chemical Corporation and B. Easterlin continued to ship small quantities of dried ore from near Andersonville, Ga.

CONSUMPTION

The apparent domestic consumption of bauxite shown in the following table actually should be increased by a quantity almost equivalent to the exports reported, inasmuch as Canada takes most of the bauxite and alumina exported and uses it to manufacture crude abrasives, which are returned to the United States for final manufacture and consumption. Viewed from this standpoint, in 1940 the United States actually consumed approximately 1,072,000 tons of bauxite (dry basis). Net imports (imports minus exports) comprised 53 percent of the apparent consumption of bauxite in 1940 (shown in the table) compared with 55 percent in 1939 (see fig. 1).

Shipments, imports, exports, and apparent consumption of bauxite in the United States, 1936-40, in long tons

[Dried-bauxite equivalent]

Year	Domestic shipments from mines and processing plants to industry			Imports	Exports	Apparent consumption
	Arkansas	Alabama and Georgia	Total			
1936	352,919	17,056	369,975	322,790	144,445	548,320
1937	415,050	17,614	432,664	507,423	210,657	729,430
1938	275,078	17,253	292,331	455,693	90,341	657,683
1939	335,647	13,689	349,336	520,179	86,540	782,975
1940	437,595	[1] 11,603	[1] 449,198	629,552	120,055	958,695

[1] Includes Virginia.

BY INDUSTRIES

The following table reports shipments of domestic bauxite from mines and intermediate processing plants to ultimate consuming industries. The consumption picture is incomplete insofar as it does not include imported or foreign bauxite. Although most of the bauxite imported from Surinam and British Guiana in 1940 was consumed by the aluminum industry a small part was used by the chemical industry. Netherlands Indies ore was received for manufacture of aluminum.

Litchfield [2] gives a timely description of the properties, uses, and preparation of bauxite and Lee [3] outlines the successive steps used in producing alumina from bauxite.

Aluminum.—Domestic shipments of bauxite from Arkansas and Alabama to the aluminum industry increased 33 percent over those in 1939 and comprised 48 percent of the total 1940 shipments. However, as in the year before, about three-fourths of the industry's ore requirements were imported from Surinam.

Abrasive.—Canadian and American aluminous abrasive manufacturing plants were consigned 29 percent of the domestic bauxite, or a quantity of ore 56 percent greater than that shipped to the industry in 1939.

[2] Litchfield, Jr., Lawrence, Bauxite: Chem. Ind., vol. 48, Nos. 2 and 3, February and March 1941, pp. 154-159 and 290-295.

[3] Lee, J. A., Making Alumina at Mobile: Chem. and Met. Eng., vol. 47, No. 10, pp. 674-677, 708-709.

Bauxite shipped from mines and processing plants in the United States, 1936–40 by consuming industries, in long tons

Industry	1936		1937		1938		1939		1940	
	As shipped [1]	Dried-bauxite equivalent	As shipped [1]	Dried-bauxite equivalent	As shipped [1]	Dried-bauxite equivalent	As shipped [1]	Dried-bauxite equivalent	As shipped [1]	Dried-bauxite equivalent
Aluminum	194,764	194,764	209,476	209,476	144,208	144,208	161,008	161,008	215,131	214,194
Chemical	74,512	74,741	78,261	79,150	63,940	63,350	81,444	79,536	82,799	80,933
Abrasive [2]	63,654	98,069	88,685	135,849	48,999	74,614	55,346	82,326	80,823	128,818
Oil refining, refractory,[2] and other	1,680	2,401	7,107	8,189	10,332	10,159	14,238	26,466	12,727	25,253
Total quantity	334,610	369,975	383,529	432,664	267,479	292,331	312,036	349,336	391,480	449,198
Total value	$2,282,301		$2,722,403		$1,823,307		$2,448,038		$3,075,317	

[1] Includes crude, dried, and calcined, 1936–40; also activated, 1938–40, and sintered, 1939–40.
[2] Small quantity of bauxite shipped to makers of refractories probably included under "Abrasive."

Chemical.—Shipments of domestic bauxite to manufacturers of aluminum salts increased 2 percent in 1940 and comprised 18 percent of the total tonnage. Chemical consumers reported the consumption in 1940 of approximately 182,000 long tons of dried bauxite (58 percent domestic, 42 percent foreign), 8,047 short tons of alumina (dry equivalent), 2,076 tons of aluminum, and a quantity of clay, alunite, beryl, and chromite residue. Aluminum salts produced and shipped from these raw materials increased 4 percent. Shipments of alumina advanced 9 percent; of the total quantity, 31 percent was consumed in the manufacture of aluminum salts. Exports of aluminum salts, which were placed under export control April 15, 1941, advanced 25 percent in 1940 over those in 1939.

Aluminum salts and alumina produced and shipped in the United States, 1939–40

	1939				1940			
	Production	Shipments			Production	Shipments		
	Short tons	Shippers	Short tons	Value	Short tons	Shippers	Short tons	Value
Aluminum salts:								
Alum:								
Ammonia	5,112	7	5,570	$294,866	6,546	7	5,754	$326,736
Potash	2,537	5	2,709	156,358	2,857	4	2,852	179,020
Aluminum chloride:								
Liquid	3,145	6	3,121	136,792	3,176	6	3,184	136,952
Crystal	8,340	4	8,351	830,347	10,790	4	10,755	1,267,827
Anhydrous		5				5		
Aluminum sulfate:								
Commercial:								
General	403,813	17	408,324	8,031,897	432,422	17	428,179	8,532,972
Municipal	11,239	10	11,010	166,590	11,861	10	11,944	185,570
Iron-free	23,640	9	23,695	587,573	24,347	8	23,676	679,356
Sodium-aluminum sulfate	31,545	2	31,252	1,608,876	26,674	2	27,176	1,574,145
Sodium aluminate		8				9		
Total aluminum salts	489,371		494,032	11,813,299	518,673		513,520	12,882,578
Alumina [1]	[2] 24,300	11	[2] 24,133	2,143,522	26,070	9	26,284	2,692,411

[1] Excludes alumina produced for use in making aluminum; includes activated, calcined, crude, light and heavy hydrate, and monohydrate D, converted to a calcined-alumina equivalent.
[2] Computed on a calcined-alumina equivalent basis. Figures not comparable with previous years.

Aluminum salts shipped in, imported into, and exported from the United States, 1936–40

Year	Domestic shipments		Imports		Exports			
					Aluminum sulfate		Other aluminum compounds	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1936	444,660	$10,965,660	2,106	$50,608	28,788	$578,001	1,483	$250,262
1937	466,894	12,092,992	2,864	61,665	31,807	679,214	2,609	423,363
1938	412,905	10,197,354	1,871	40,189	27,715	578,330	1,770	257,545
1939	494,032	11,813,299	828	22,335	34,734	744,755	1,792	208,455
1940	513,520	12,882,578	21	866	43,615	994,861	1,920	271,715

Oil refining, cement, refractory, and other.—Thermally activated bauxite has been used in oil refining as a highly efficient adsorbent; this use has been extended to the sugar [4] and other industries. A small percentage of domestic bauxite was consumed in the manufacture of aluminous refractories and as a flux in the steel and ferroalloy industries.

PRICES

The average selling price, f. o. b. mines and processing plants, in 1940 was $3.44 per long ton for crude (undried) bauxite; $5.51 for crushed dried bauxite; $14.30 for calcined bauxite; and $36.97 for activated bauxite. The average value for all grades of domestic ores as shipped by mine producers was $5.93 per ton ($5.77 in 1939).

Nominal quotations given in the following table are from Engineering and Mining Journal Metal and Mineral Markets:

Range of quotations on bauxite, 1938–40

Type of ore	Chemical specifications (percent)		Prices during year		
	Al_2O_3	SiO_2	1938	1939	1940
Domestic ore (per long ton):					
Chemical, crushed and dried [1]	55–58	[2]	$6.00–$7.50	$6.00–$7.00	$6.00–$8.00
Other grades [3]	56–59	5–8	6.00– 7.50	6.00– 7.00	6.00– 8.00
Pulverized and dried [3]	56–59	8–12	9.00–12.00	9.00–11.00	9.00–16.00
Abrasive grade, crushed and calcined [3]	78–84	[4]	12.00–15.00	12.00–14.00	12.00–14.00
Foreign ore (per metric ton):					
Dalmatian [5]	50–55	1–3	6.00– 7.50	6.00– 8.00	7.00– 8.00
Greek [5]	56–58	3–5	7.00– 8.50	7.00– 8.00	7.00– 8.00
French [5]	56–59	2–4	7.00– 9.00	7.00– 8.00	7.00– 8.00

[1] F. o. b. Alabama and Arkansas mines.
[2] SiO_2 not specified; Fe_2O_3, 1.5–2.5 percent.
[3] F. o. b. Arkansas mines.
[4] Not specified.
[5] C. i. f. Atlantic ports.

FOREIGN TRADE

Imports of bauxite in 1940 exceeded the previous peak reached in 1939 by 21 percent. Exports (dry equivalent) increased 39 percent. Of the 1940 imports Surinam supplied 585,993 long tons, British

[4] LaLande, Jr., W. A., Bauxite as a Sugar-refining Adsorbent: Ind. Eng. Chem., vol. 33, No. 1, January 1941, pp. 108–111: U. S. Patent 2,211,727.

Guiana 29,929, and Netherlands Indies 13,630. Imports by customs districts were as follows: 387,283 tons to Mobile, 190,282 to New Orleans, 45,450 to Philadelphia, 3,426 to Massachusetts, 2,611 to Sabine and 500 to New York. Of the exports in 1940, 75,035 tons were classified as bauxite and other aluminum ores, 6,860 tons as other bauxite concentrates, and 18 tons as alumina; of these, Canada was consigned 74,908, 5,318, and 14 tons, respectively. Of the remaining "other bauxite concentrates" 1,002 tons went to Sweden, 505 to Japan, 30 to Mexico, 4 to Switzerland, and 1 to France. Effective April 15, 1941, bauxite was subjected to export license.

Bauxite imported into and exported from the United States, 1936–40

Year	Imports for consumption [1] [2]		Exports (including bauxite concentrates) [3]	
	Long tons	Value	Long tons	Value
1936	322,790	$2,370,778	84,471	$2,322,915
1937	507,423	3,609,063	123,191	3,456,916
1938	455,693	3,521,325	57,726	1,459,491
1939	520,179	$3,765,140	51,635	$1,117,564
1940	629,552	4,298,969	81,913	1,542,703

[1] Also "alumina" as follows: 1936, 117 long tons valued at $11,618; 1937, 182 tons, $16,461; 1938, 64 tons, $5,464; 1939, 1 ton, $432; 1940, 11 tons, $1,743.
[2] Chiefly dried ore.
[3] As shipped.

ALUMINUM

PRODUCTION

Primary.—Impelled by the aircraft and rearmament programs, domestic production of primary aluminum in 1940 surpassed the peak reached in 1939 by 26 percent in quantity and 17 percent in value. The Aluminum Co. of America attained this large output by expanding aluminum-reduction facilities at existing plants and beginning operations in September 1940 at a fifth plant at Vancouver, Wash. Of the 412,560,000 pounds of new aluminum produced, 164,512,530 pounds were made at Alcoa, Tenn.; 142,003,223, at Massena N. Y.; 58,882,397 at Badin, N. C.; 37,173,893 at Niagara Falls, N. Y.; and 9,987,957 at Vancouver, Wash. At the end of 1940 aluminum was being produced at a rate exceeding 500,000,000 pounds a year, and the Aluminum Co. planned to produce about 585,000,000 pounds during 1941. By the end of 1941 the Aluminum Co. and its new competitor—the Reynolds Metals Co.—are expected to be producing at a rate exceeding 800,000,000 pounds a year. Further expansion in production and fabrication appears likely and it is reported that the government may finance some of the additional facilities. The value of aluminum produced in 1940 averaged 18.25 cents a pound compared with 19.75 cents in 1939.

It is understood that the Aluminum Co. of America will spend approximately $200,000,000 on increased facilities for defense purposes before the end of 1942, constructing permanent buildings and installing up-to-date equipment that can be used to whatever extent the market may require after the emergency is past. Any additional increases in production of aluminum will depend on the amount of power the company can obtain. Projects completed during 1940 and the first quarter of 1941 include: A large expansion in aluminum-reduction facilities at Alcoa, Tenn., and Vancouver, Wash.; a 375-ton addition to the 500-ton alumina plant at Mobile, Ala. (875 short tons capacity a day); a new carbon electrode plant at Vancouver, Wash. (60,000 tons capacity a year); a bauxite crushing and drying plant at Paranam, Surinam (150 metric tons capacity an hour); mining operations at Topibo Hill in Para Creek district, Surinam; acquisition of 10 old vessels from the Maritime Commission and 2 new ships by the Alcoa Steamship Co., for carrying bauxite from Surinam; extension of casting and forging plants and construction of a new extrusion plant at Los Angeles, Calif.; extension of the extrusion plant and construction of a new tube mill at La Fayette, Ind.; extension of the rolling mill at Alcoa, Tenn.; and addition of the Templin universal metal working or testing machine at Aluminum Research Laboratories, New Kensington, Pa. Work scheduled for completion later in 1941 and before the end of 1942 includes: Extensions to aluminum-producing facilities at Vancouver, Wash., Badin, N. C., Alcoa, Tenn., and Massena N. Y., and to alumina plants at East St. Louis, Ill., and Mobile, Ala.; the construction of a new large strong-alloy sheet mill of 60,000 short tons capacity a year at Alcoa, Tenn.; extension of the rolling mill at Edgewater, N. J., forging plants at Cleveland, Ohio, and Los Angeles, Calif., the wire, rod, and bar mill at Massena, N. Y., and the castings plant at Detroit, Mich.; hydroelectric projects at Glenville (27,000 kw.) on the Tuckasegee River in Jackson County, N. C., and at Nantahala (54,000 kw.) on the Nantahala River in Macon County, N. C.; the purchase of four foundry buildings in Bridgeport, Conn., to expand the company Fairfield (Conn.) operations; and the acquisition of six new ore-carrying vessels. Late in 1940 the company requested Bonneville power in addition to the 162,500 kw. already contracted for, but its request was refused. The company did obtain 10,000 kw. of additional power from Canada in 1940 but seeks more from this source as well as from the Tennessee Valley Authority. Completion of the Santee-Cooper hydroelectric project near Charleston, S. C., late in 1941 probably will provide the company with 30,000 kw. of electric energy. The company abandoned its intention to construct the Fontana hydroelectric project in February 1941 when the Federal Power Commission ruled that a license was required. If the additional power desired is obtained the Aluminum Co. of America will further increase its ingot production substantially at its Massena (N. Y.) and Alcoa (Tenn.) works.

A strike of workers at several Aluminum Co. of America plants was averted in July 1940, when a compromise wage increase of 2 cents an hour was effected for all employees whose wage-rate classification had not already been increased by that amount or more since October 1939. In October 1940 the company announced that employees drafted for military duty will receive 1 to 2 months' pay, depending on length of service, be permitted to accumulate seniority while on leave, and be reemployed after discharge from duty. Workers of the Congress of Industrial Organizations at the New Kensington sheet mill went on strike from November 21 to November 29, 1940, and at the Edgewater (N. J.) rolling mill from March 12 to March 24, 1941. The alumina plant at East St. Louis, Ill., was closed 37 days—from October 25 to November 30, 1940—by a strike of American Federation of Labor workers. The company made general wage increases to all employees in its 18 plants, effective April 26, 1941, which, when added to other increases made since October 1, 1939, will total 10 cents an hour. Salaried personnel also will receive increases.

The consolidated net income of the Aluminum Co. was $44,146,297 in 1940 compared with $36,633,389 in 1939.

The suit opened April 23, 1937, by the Department of Justice asking dissolution of the Aluminum Co. of America, charging that it is a monopoly in violation of the antitrust laws, continued from 1939 into 1940. On August 15, 1940, the Government and the defendants rested their cases, and Federal Judge Francis G. Caffey set December 2, 1940, for the filing of briefs and January 10, 1941, for the filing of reply briefs. On March 12, 1941, all hearings closed, and both sides awaited the judge's final decision. The long record is said to contain testimony approximating 41,700 pages and 1,800 exhibits of 15,000 pages.

In July 1940 the Reconstruction Finance Corporation authorized an industrial expansion loan of $15,800,000 to the Reynolds Metals Co., Federal Reserve Bank Building, Richmond, Va., for producing and processing aluminum. In November 1940 construction was begun at Lister near Sheffield, Ala., on plants capable of producing annually 100,000 short tons of alumina and 30,000 tons of aluminum. Operations commenced late in April 1941 at the alumina plant, and the aluminum-reduction plant is expected to be in production shortly thereafter. The company entered into a contract with the Tennessee Valley Authority in October 1940 for 60,000 kw. of electricity. In February and March 1941 the Bonneville Power Administration announced that it would grant the company 60,000 kw. of power for the production of 30,000 tons of aluminum in the Northwest, and the Reconstruction Finance Corporation advanced an additional $4,200,000. The reduction plant, to be at Longview, Wash., is scheduled to commence operations in August 1941 and will employ alumina shipped from Lister. A 10,000-ton reduction unit was transferred from Lister to Longview, thus making the Reynolds total aluminum-producing capacity 50,000 tons a year. The Soderberg continuous electrode furnace will be employed in both reduction plants.

With the aid of the Defense Plant Corporation, Reconstruction Finance Corporation subsidiary, the company is expanding its former aluminum-fabricating facilities and will operate a new $13,600,000 strong aluminum-alloy-sheet and shape plant at Lister with a capacity over 3,250 tons a month; a new $2,500,000 extrusion plant at Louisville, Ky., with a capacity of 2,000 tons a month; equipment added to the Louisville plant, increasing sheet-rolling capacity to 1,500 tons and rod-mill capacity to 750 tons a month at a cost of $3,000,000; and a portion of the foil-rolling mill at Richmond, Va., which will be converted to a strong alloy sheet mill. In addition to the Richmond plant the company operates aluminum-foil rolling mills at Louisville and at Glendale, Long Island, N. Y. The new strong alloy-sheet mill at Lister will be operated by a subsidiary, the Reynolds Alloys Co.

Up to May 1, 1941, the Reconstruction Finance Corporation had loaned Reynolds $20,000,000—including $13,500,000 for the Lister works and $6,500,000 for the Longview plants—and the Defense Plant Corporation had allotted $9,801,200 to the Lister alloy-sheet mill and $2,504,600 to the Louisville extrusion plant. In addition, the company is spending considerable sums from its own funds on an ambitious expansion program.

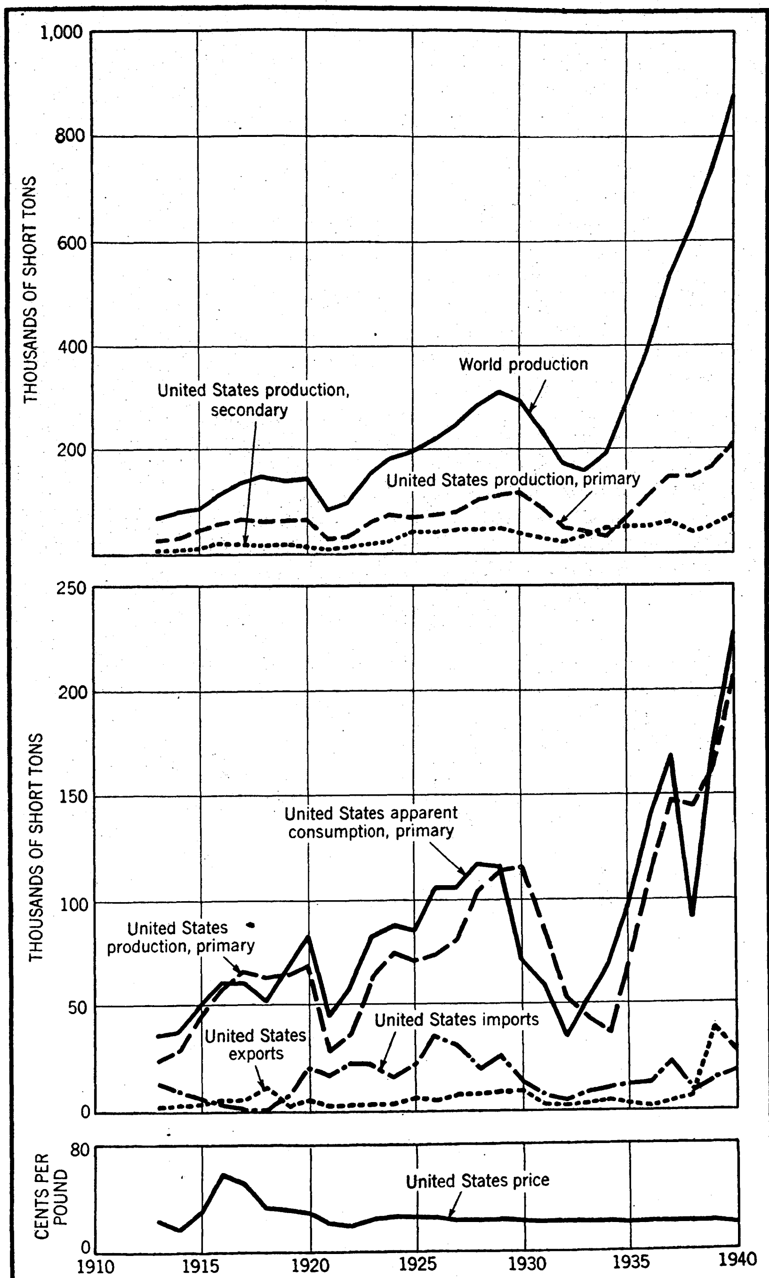

FIGURE 2.—Trends in production, imports and exports, apparent consumption, and average quoted prices of aluminum, 1913–40. Price is for No. 1 virgin 98–99 percent at New York through 1929, thereafter for 99-percent-plus virgin ingot, as reported by American Metal Market.

Reynolds will derive bauxite from Netherlands Indies, South America (Brazil and Surinam), and domestic deposits. The company has an exclusive contract with the Bauxite Co. of Alabama for its output and has organized two wholly owned subsidiaries—the Bauxite Corporation, to mine in Arkansas, and the Reynolds Ore Co., to mine in Alabama, Georgia, Tennessee, and Mississippi.

During 1940 Reynolds fabricated more than 20,000 tons of aluminum and earned a consolidated net profit of $2,428,277 compared with $1,526,891 in 1939.

Other concerns considering the domestic production of aluminum early in 1941 included the Standard Aluminum & Alloy Co., 11 South LaSalle Street, Chicago, Ill., which proposes to utilize the Seailles alumina process on low-grade or siliceous bauxite and the Ferrand aluminum-reduction cell; Kalunite, Inc., 81 Navajo Street, Salt Lake City, Utah, which owns patented processes for the recovery of alumina and potassium sulfate from alunite; and Aluminum, Inc., Marysvale, Utah, which also owns patents based upon alunite as raw material.

Secondary.—Complete data on the production of secondary aluminum in 1940 were not available when this report was prepared. A preliminary estimate places production at about 68,000 short tons in 1940. Of the 50,000 tons of secondary aluminum produced in 1939 by remelters, manufacturers, and foundries 34,900 tons (70 percent) were recovered from old scrap and 15,100 tons (30 percent) from new scrap. Further data on secondary aluminum in 1940 are given in the chapter on Secondary Metals—Nonferrous.

CONSUMPTION

In 1940 the apparent consumption of primary aluminum in the United States rose 35 percent above that in 1939 and in 1937—the two previous peak years (see fig. 2). The consumption of secondary aluminum also increased. Airplane makers used slightly more than four times the large quantity of metal consumed in 1939. The aircraft, ordnance, quartermaster, and other divisions of the Army and Navy placed large orders for air, land, and water transport equipment and for weapons, rolling field kitchens, mess kits, and other portable supplies requiring the use of aluminum because of its high strength and lightness. A 15-percent reduction in price made aluminum increasingly competitive with copper, steel, and other metals.

The United States produced 12,636 airplanes in 1940 (5,888 military and 6,748 commercial aircraft) compared with 5,856 in 1939 (2,141 military and 3,715 commercial aircraft). About 90 percent of the commercial planes are in the light-plane category, which consumes only minor quantities of aluminum, whereas most military planes use very large quantities of the metal. Of the finished weight of the average military airplane, aluminum comprises approximately 69 percent of the airframe, 23 percent of the engine, and 24 percent of the propeller.[5] Thus when the average monthly production of military aircraft advanced from 178 planes in 1939 to 490 in 1940 and approximately 1,100 in March 1941 it follows that increased consumption of aluminum in the aircraft industry alone has been enormous. Airplane output is expected to exceed 2,000 planes monthly by the end of 1941[6] and

[5] Brett, George, Procurement for Defense: Aviation, vol. 39, No. 8, August 1940, page 42.
[6] Fortune, How Many Planes When?: Vol. 23, No. 3, March 1941, pp. 82, 188, 190.

doubtless greater numbers of larger, heavier planes will be constructed, which will consume more aluminum per plane.

As long as aluminum remains on an industry-wide mandatory priority status new uses will be discouraged, and employment of the metal in some very important civilian fields must be discontinued in favor of substitutes. After the war is over capacity will be available to produce much more aluminum than ever before, and it is believed that the price will be lowered further to enable the metal to find new and more diversified markets.

Production, imports, exports, and apparent consumption of primary aluminum and production of secondary aluminum in the United States, 1936–40

Year	Primary aluminum					Secondary aluminum	
	Production		Imports (pounds)	Exports (pounds)	Apparent consumption [2] (pounds)	Pounds	Value [1]
	Pounds	Value					
1936	224,929,000	$41,612,000	[3] 25,562,571	1,605,753	275,443,818	103,000,000	$19,055,000
1937	292,681,000	55,609,000	[3] 45,178,069	5,383,516	335,958,553	125,120,000	23,773,000
1938	286,882,000	56,659,000	[3] 17,740,281	12,618,078	179,045,203	77,600,000	15,326,000
1939	327,090,000	64,600,000	18,579,940	73,264,458	335,291,482	100,000,000	19,750,000
1940	412,560,000	75,292,000	34,870,887	53,771,478	454,034,409	(4)	(4)

1 Based on average price of primary aluminum as reported to Bureau of Mines.
2 Data not available on fluctuations in consumers' stocks. Withdrawals from producers' stocks totaled 26,558,000 pounds in 1936, 3,483,000 in 1937, 62,886,000 in 1939, and 60,375,000 in 1940; additions to producers' stocks totaled 112,959,000 pounds in 1938.
3 Crude and semicrude, some of which may be secondary aluminum.
4 Figures not yet available.

The percentage of primary aluminum used by industry in the United States in 1940 was approximately as follows: Transportation (air, land, and water), 40 percent; foundry and metal working, 23; machinery and electrical appliance, 9; cooking utensil, 6; electrical conductor, 5; building construction, 5; chemical, 5; ferrous and nonferrous metallurgy, 4; food and beverage, 2; and general miscellaneous, 1.

PRICES

Contrary to the trend for many other materials greatly in demand for the rearmament program, the open-market quotations in New York for 99-percent-plus pure ingot aluminum, delivered, in lots of 10,000 pounds or more, declined 3 cents during 1940—from 20 cents a pound at the beginning of the year to 17 cents before the close of the year. The first 1-cent price reduction was effective March 25, the second August 1, and the third November 18, 1940. Quotations for smaller lots down to 1 ton demanded a ½-cent premium and for less-than-ton lots a 1-cent premium. The 1940 reductions also included a downward adjustment in prices of fabricated products. The Aluminum Co. of America announced that these price reductions followed the company policy of passing along to the public the benefits of research and economies of operation.

The three successive price reductions for primary aluminum brought about uncertain conditions in the secondary market, and in the summer of 1940 quotations on scrap and secondary aluminum were regarded as purely nominal. In consequence of the keen competition for aluminum in the fall of 1940, consumers offered dealers sizable premiums for the immediate delivery of primary metal, and remelters could sell secondary metal at prices several cents above the official quotation for primary. Toward the end of the year the secondary-aluminum market became completely disorganized. Remelters were paying dealers 17 cents and more for old sheet scrap, and in turn quotations were raised to 22.5 cents for 99-percent-plus remelt aluminum. Conditions became worse; even the high price level for scrap did not materially alleviate the demand, and early in 1941 remelters were bidding against each other, disregarding price. Endeavors by leading smelters to discourage the runaway market were of little avail, and early warnings by the Price Stabilization Division of the National Defense Advisory Committee were unheeded. On February 24 and March 6, 1941, the Priorities Division of the Office of Production Management instructed companies with certain high-grade alloy scrap (17S, 17S Alclad, 24S, 24S Alclad, and 52S) to return it to the original source of supply for toll fabrication while mixed and other scrap was to be released to secondary smelters. On March 3, 1941, 11 cents a pound was established as a top price for mixed aluminum scrap sold by airplane manufacturers. To maintain price stability and prevent excessive and speculative price increases, Leon Henderson, Director of the Price Stabilization Division, on March 24, 1941, set ceiling prices on all scrap and secondary aluminum that allowed scrap dealers a margin of 1 to 1½ cents a pound and remelters a spread of 3 to 4 cents a pound on secondary ingot. In April 1941 trading between scrap dealers and remelters was practically at a standstill, as dealers were unwilling to take losses on metal that had been collected at higher prices and remelters complained that their spread was too small and that the lack of metal was forcing a curtailment in operations.

According to Metal Statistics 1941, dealers' 1940 buying prices per pound in New York for the principal grades of domestic aluminum scrap averaged 8.95 cents for cast aluminum (7.47 cents in 1939) and 14.47 cents for new-aluminum clippings (13.90 cents in 1939). The average selling price of remelted metal, 98½- to 99-percent grade, was 18.74 cents (19.38 cents in 1939), and of No. 12 alloy, No. 2 grade, 14.66 cents (13.28 cents in 1939). The Government price schedule sets a maximum price of 11 cents on cast and forged scrap when sold by makers and 12 cents when sold by dealers and 13 and 14½ cents, respectively, on pure clippings and cable, f. o. b. point of shipment. The price on secondary aluminum ingot, 98-percent pure, is set at 17 cents, and on No. 12 alloy at 16 cents a pound. Some amendments to the price schedule became effective May 5, 1941.

FOREIGN TRADE

Imports of crude and semicrude aluminum were 26 percent greater in 1940 than in 1939. Early in 1941 Canada, which supplied 84 percent of the metal imported in 1940, reduced its stipulated regular monthly shipments to the Aluminum Co. of America (1,500 short tons of ingot) because of increased British requirements. In 1940 imports (exclusive of scrap) comprised only 8 percent of the apparent consumption of primary aluminum. Of the imports of crude (17,435 short tons) 15,053 tons came from Canada, 2,240 from France, and 133 from Norway; of scrap (648 tons), 265 came from France, 196 from Canada, and 160 from the United Kingdom; and of semicrude less than 1 ton was received. The value of aluminum manufactures imported decreased 69 percent.

Aluminum imported into and exported from the United States in 1940

Class	Imports for consumption		Exports	
	Pounds	Value	Pounds	Value
Crude and semicrude:				
Crude metal, ingots, and alloys	34,869,763	$4,628,601	24,453,795	$5,352,151
Scrap	1,296,738	108,035	1,910,723	331,757
Plates, sheets, bars, rods, etc	1,124	592	29,317,683	12,235,124
	36,167,625	4,737,228	55,682,201	17,919,032
Manufactures:				
Foil and leaf, etc	(1)	12,138	2,808,535	1,221,590
Powder	941,004	389,868	879,342	370,061
Table, kitchen, hospital utensils, etc	8,568	5,149	841,845	482,869
Tubes, moldings, castings, etc	(2)	(3)	2,465,068	1,273,793
Other manufactures	(2)	15,541	(2)	1,169,780
	(2)	422,696	(2)	4,518,093
Grand total	(2)	5,159,924	(2)	22,437,125

[1] 10,244,034 leaves, equivalent in pounds not recorded.
[2] Quantity not recorded.
[3] Included under "Other manufactures."

Exports of crude and semicrude aluminum in 1940 were exceeded only by the record shipments in 1939 and were 25 percent less than that record. Most of the exports were made during the first half of the year, when aluminum exports were under moral embargo only. On July 5, 1940, the exportation of aluminum and its products was specifically prohibited, except under license from the Administrator of Export Control. Of the exports of crude in 1940 (12,227 short tons) 4,533 tons went to the United Kingdom, 1,735 to China, 965 to Brazil, 859 to France, 788 to Sweden, 693 to Argentina, 594 to Rumania, 535 to Australia, and 476 to Switzerland; of scrap (955 tons) 559 tons went to Japan; and of semicrude (14,659 tons) 6,351 tons went to the United Kingdom, 4,846 to France, 1,126 to Australia, 843 to Canada, and 341 to China. The value of aluminum manufactures exported increased 61 percent.

TECHNOLOGIC DEVELOPMENTS

Although aluminum and its alloys now constitute the most important structural material in aircraft manufacturing, Jackman[7] reports that the use of aluminum-alloy castings is still increasing because industry has been able to develop more rigid manufacturing control, X-ray analyses of all major castings, and designs checked by casting destruction tests. The tensile and compressive strength of strong aluminum alloys used in aircraft has been increased by cold-working methods that involve prestretching and precompressing. Forging billets of new strong aluminum alloys now are hot-pressed or kneaded before being forged into propellers and other aircraft parts to produce a product with more uniform fine-grain structure. Some aircraft

[7] Jackman, K. R., Modern Aircraft Materials and Their Testing: Jour. Soc. Auto. Eng. (Trans.), vol. 47, No. 5, November 1940, pp. 461–473, 496.

makers employ the relatively new stamping process to manufacture aluminum-alloy-sheet parts in small lots, using rubber pads in conjunction with simple dies of wood and metal in large hydraulic presses.[8] To speed aircraft production, fabricators have developed new methods for spot-welding aluminum.[9]

NATIONAL DEFENSE AND PRIORITIES

Aluminum and its ore, bauxite, were transferred from the strategic-material list of the Army and Navy Munitions Board to the critical-material group in March 1940; yet, paradoxically enough, aluminum was the first metal upon which formal mandatory priorities were invoked, and on May 1, 1941, it ranked as one of five metals (aluminum, magnesium, nickel, nickel steel, and tungsten) so distinguished. Nevertheless, aluminum has always been regarded as a material essential to national defense, and although a normal supply now depends largely on imported bauxite, in time of war the supply could be obtained entirely within the continental limits of the United States. However, if domestic production of bauxite had not been supplemented by imported South American ore during the past decade and a half the very limited commercial ore reserves would have been depleted to a very dangerous point. Under the present accelerated aluminum-production program commercial domestic reserves would last only a few years if all demands were focused upon them. Larger quantities of lower-grade high-silica ore, at present uneconomical, are believed available and could be utilized at greater cost in an emergency.

At the request of the Office of Production Management the Bureau of Mines made a survey late in March 1941 to check the production, capacity, and proved reserves of domestic bauxite. This survey revealed that reserves of ore are adequate at present and that production could be multiplied several fold within a few months with present equipment at the mines or under construction. Thus, if the importation of bauxite should become disrupted industry could for a short time depend on domestic reserves and facilities, chiefly in Arkansas, largely by changing operations from a one-shift-a-day to a three-shift-a-day basis. In March 1941 domestic production of bauxite (55,000 long tons) was running about 50 percent ahead of the monthly average for 1940, and if that rate should continue the 1941 output will set a new high record.

As the demand for aluminum was enhanced early in 1940 by preparations for national defense and the wars abroad, the Aluminum Co. of America began to expand its production facilities. In the summer of 1940 the National Defense Advisory Commission, however, estimated that further increases in production would be necessary to meet requirements of the defense program, and the Commission recommended that the Tennessee Valley Authority [10] and other power facilities be increased. The Reynolds Metals Co. then announced its intention

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[8] Oliver, Frank J., Job-lot Aircraft Stampings: Iron Age, vol. 144, Nos. 16 and 17, October 19 and 26, 1939, pp. 50-55 and 43-47.
Chase, Herbert, Producing Aircraft Stampings in the Douglas Plant: Metals and Alloys, vol. 12, No. 4, October 1940, pp. 436-441.

[9] Wood, L. P., Welding in the Aircraft Industry: Welding Jour., vol. 19, No. 7, July 1940, pp. 476-481.

[10] Engineering News-Record, T. V. A. Rushes Power for National Defense: Vol. 126, No. 9, February 27, 1941, pp. 52-55.

to produce ingot. In the fall of 1940 the Commission stated that completed facilities and contemplated increases in the production of aluminum ingot and fabricated products would be adequate to meet military and civilian requirements. Consumers were cautioned, however, that temporary delays were to be expected in the supply of some fabrications, particularly forgings, extrusions, and castings. Toward the end of 1940 shortages of aluminum in the aircraft and other industries were publicized by the press, but official investigations showed no serious deficiency in supplies for aircraft and other military items. As the aluminum situation became "tighter" during the fall months, unofficial or cooperative priorities were invoked by the Aluminum Co. of America upon request of defense authorities. Consumers were asked to show the necessity for their aluminum requirements.

Despite previous predictions to the contrary, early in 1941 it became obvious that the supply of aluminum would not suffice for all defense and all civilian needs. Aluminum scrap had failed to flow back into the market as expected; the British increased their consumption of aluminum and reduced the 3,000,000-pound monthly importation of ingot into the United States from Canada; the expansion in fabricating facilities necessitated the accumulation of larger working stocks, and for protection many industrial users had begun piling up inventory and making forward orders; and the rising national income increased civilian purchases of aluminum products. On February 24, 1941, aluminum was put under industry-wide, formal mandatory priority control by the Priorities Division of the Office of Production Management. At the same time aluminum was placed on the Priorities Critical List, enabling the Army and Navy to issue preference ratings against it. The general preference order issued by the Division on March 21, 1941, went into effect in April, as the Government began rationing aluminum supplies; defense orders received A preference ratings, and nondefense orders were given ratings from B-2 to B-8 which allots manufacturers certain stipulated percentages of their 1940 average consumption of low- and of high-grade metal. The Division, however, reserved the right to issue higher ratings for very important civilian needs above less-important military needs. Aluminum producers were required to set aside, under a B-1 rating, a reserve pool of 1 percent of production each month for an emergency stock pile. Aluminum producers also were told to submit monthly their complete booking of orders for the ensuing month, so that the Division could determine the relative preferences to be accorded to customers. Equal standing was given orders to be used directly or indirectly in filling British and Army and Navy defense requirements. Consumers were ordered to file reports regarding consumption, uses, and inventories. Although it is expected that defense needs will require most of the high-grade aluminum for some time, efforts are being made to free as much secondary and low-grade metal as possible for civilian use. Chaos ruled the secondary-aluminum market late in 1940 and early in 1941 (see Prices).

During the first quarter of 1941 all nondefense users of aluminum were warned informally to find substitute materials, and on March 8, 1941, E. R. Stettinius, Jr., Director of Priorities, issued an order reducing the number of aluminum ice trays furnished domestic users to conserve aluminum.

It appears that, although the demand for bauxite in the manufacture of aluminum, chemicals, abrasives, and other products will increase materially, 1941 consumption requirements will be met by a domestic production exceeding 600,000 long tons and imports exceeding 1,000,000 long tons. With domestic aluminum production exceeding 300,000 short tons in 1941, supplemented by metal imported from Canada, the United States also should be able to meet military but not all civilian metal needs in 1941, provided military requirements are not greatly increased.

WORLD BAUXITE AND ALUMINUM INDUSTRIES

It is estimated that world production of bauxite in 1940 totaled approximately 4,627,000 metric tons—a 7-percent increase over the 4,306,000 tons estimated for 1939.

The world output of aluminum is believed to have totaled approximately 803,000 metric tons in 1940—a 20-percent increase over the 667,000 tons estimated for 1939.

World production of bauxite, 1936–40, by countries, in metric tons

[Compiled by L. P. Lounsbery]

Country	1936	1937	1938	1939	1940
Australia:					
New South Wales	----------	6,793	442	(1)	(1)
Victoria	752	1,097	1,341	820	[2] 1,000
Brazil (exports)	7,000	8,770	12,928	18,279	[2] 20,000
Czechoslovakia	----------	846	(1)	(1)	(1)
France	649,500	688,200	682,440	[2] 800,000	[2] 700,000
Germany	12,425	18,212	19,703	[2] 20,000	[2] 20,000
Greece	129,898	137,412	179,886	186,906	[2] 50,000
Guiana:					
British	172,884	305,533	382,409	483,653	[2] 700,000
Dutch (Surinam)	234,845	392,447	377,213	511,619	615,434
Hungary	329,091	532,657	540,718	485,000	[2] 700,000
India, British	3,702	15,393	15,005	9,121	[2] 15,000
Indochina	30	7,000	160	330	118
Italy	262,246	386,495	360,837	483,965	[2] 530,000
Netherlands Indies	133,731	198,970	245,354	230,668	274,345
Portuguese East Africa	29	----------	----------	180	(1)
Rumania	10,829	10,701	11,807	10,460	[2] 40,000
Unfederated Malay States: Johore	37	19,305	55,965	93,737	63,787
U. S. S. R.	203,200	[2] 230,000	[2] 250,000	[2] 270,000	[2] 300,000
United States (dried bauxite equivalent)	386,415	431,898	315,906	381,331	445,958
Yugoslavia	292,174	354,233	396,368	318,840	[2] 150,000
	2,829,000	3,746,000	3,849,000	[2] 4,306,000	[2] 4,627,000

[1] Data not available.
[2] Estimated production. Estimates for 1939 and 1940 by the authors.

World production of aluminum, 1936–40, by countries, in metric tons

[Compiled by L. P. Lounsbery]

Country	1936	1937	1938	1939	1940
Canada	26,200	41,700	66,000	75,000	[1] 110,000
France	29,700	34,500	45,300	50,000	[1] 50,000
Germany	97,200	127,200	161,100	[1] 200,000 (Germany and Austria)	[1] 240,000 (Germany and Austria)
Austria	3,300	4,400	4,500		
Hungary	800	1,000	1,500	1,500	[1] 2,800
Italy	15,900	22,900	25,800	34,200	[1] 40,000
Japan	7,000	10,000	17,000	23,000	[1] 35,000
Norway	15,400	23,000	29,000	31,000	[1] 15,000
Spain	600	----------	800	[1] 800	[1] 500
Sweden	1,800	1,800	2,400	2,700	[1] 1,400
Switzerland	13,700	25,000	27,000	28,000	[1] 28,000
U. S. S. R.	30,000	37,700	43,800	[1] 45,000	[1] 55,000
United Kingdom	16,300	19,300	23,300	25,000	[1] 35,000
United States	102,000	132,800	130,100	148,400	187,100
Yugoslavia	----------	200	1,200	2,400	[1] 2,800
	359,900	481,500	578,800	667,000	[1] 803,000

[1] Estimated production. Estimates for 1939 and 1940 by the authors.

REVIEW BY COUNTRIES

Foreign trade, production, and industrial data are not available for most countries for 1940 due to the hostilities in Europe and Asia. All "estimated" bauxite- and aluminum-production figures given in the foregoing tables for 1939 and 1940 are based upon various press releases and the personal opinion of the authors and others. Official data probably will not become available until after war ceases.

Australia.—The Australian Aluminum Co. Pty., Ltd., began to construct an aluminum strip and sheet rolling mill at Granville, New South Wales, in the fall of 1940. Although aluminum ingots will be imported for this mill another concern—White Metals (Australia) Pty.—plans to produce 2,000 tons of primary aluminum annually near Sydney, utilizing low-grade bauxite from New South Wales.

Brazil.—The Companhia Geral de Minas, through Byington & Co., has contracted to supply the Reynolds Metals Co. with 100,000 metric tons of aluminum-grade bauxite in 1941 and 1942 from its Poços de Caldas deposits in Minas Gerais. In the past the company has mined and processed ore chiefly for shipment to São Paulo and Buenos Aires for the manufacture of aluminum sulfate. Other producers of bauxite include Lindolpho Pio da Silva Dias, Poços de Caldas; M. C. Fonseca e Co., Muquy, Espirito Santo; and Co. Electro-Chimica Brasileira, Ouro Preto, Minas Gerais. The exportation of large quantities of bauxite from Brazil, though favored by large, high-grade ore reserves and low mining costs, has been hindered by high freight rates and the lack of transportation facilities. Exports to Argentina totaled 18,279 tons in 1939 and only 82 tons in 1940.

Canada.—It is understood that the Aluminum Co. of Canada, Ltd., has expansions underway at Arvida, Quebec, more than doubling its former aluminum-producing capacity. Although the British Ministry of Supply contracted for all of the exportable surplus aluminum for 1940 and 1941, on April 20, 1941, it was announced that the United States also would receive a share of the Canadian aluminum output for use in its defense program. On October 16, 1940, Canada prohibited the importation of aluminum and its products without a license from the Minister of National Revenue to help conserve the supply in the United States and to prevent confusion in the rationing regulations of Canada. Rigid control on aluminum not only applies to imports and exports, but domestic consumption for nonwar purposes also has been drastically curtailed. The basic price on 99-percent aluminum in 1-ton lots advanced from 20 cents to 22 cents a pound in November 1939 and to 23 cents in March 1941. During the first 4 months of 1940 Canada exported 25,588 metric tons of crude aluminum.

Germany.—By early 1941 Germany had gained control of the largest aluminum industry in the world; the conquest of France made available bauxite mines and alumina and aluminum plants, the occupation of Norway cheap hydroelectric power and aluminum plants, and the "protection" of Denmark large stocks of Greenland cryolite. Germany's dominating influence over Hungary, Italy, Rumania, Austria, and Switzerland also provides an adequate supply of bauxite and additional aluminum producing and fabricating works. After completion of its expansion program in 1939, making the total annual aluminum capacity exceed 200,000 tons, the German industry immediately proceeded with further extensions. The output of aluminum in 1940 probably was restricted somewhat by the limited facilities for transporting bauxite, the large demand for steam and hydroelectric power by other industries, and the British Royal Air Force bombing of aluminum works, railroads, and canals. Of the eight aluminum-reduction and five alumina plants in Germany and Austria,[11] at least the Rheinfelden, Lautawerk, Erftwerk, Lippewerk, and Bitterfeld works were British Air Force targets.[12] Large quantities of aluminum continued to be substituted for deficient metals. To simplify utilization of large quantities of scrap, German industry planned to standardize and reduce the number of aluminum alloys. On December 7, 1940, the basic price on aluminum, which had remained unchanged at 133 reichsmarks per 100 kilograms since 1938, advanced slightly.

Greece.—Inasmuch as large stocks of undisposed bauxite had accumulated by early 1941 and exports totaled only 1,000 tons during the first 9 months of 1940 it is reasonable to assume that bauxite mines suspended operations in Greece owing to the lack of shipping facilities.

Guiana, British.—It is estimated that in 1941 the Demerara Bauxite Co., Ltd. exported over 600,000 tons of bauxite to Canada, the United Kingdom, and the United States. It is understood that the Berbice Co., Ltd., is proceeding to construct a plant in British Guiana to process ore from its 4,000-acre concession.

Guiana, Dutch.—The new bauxite crushing and drying plant of the Surinaamsche Bauxite Maatschappij at Paranam commenced operations February 15, 1941. Ore is transported to the plant by rail from the newly developed mines about 7 miles away at Topibo Hill in the Para Creek district. The Paranam plant has a capacity for 150 tons of dried bauxite an hour, whereas the older company plant at Moengo Hill on the Cottica River can produce only 100 tons an hour. Early in 1941 the N. V. Billiton Maatschappij began to construct a plant on the Surinam River near Paranam for treating bauxite, which also will be mined and transported from the Para Creek district.

Hungary.—Another alumina plant, of 20,000 tons annual capacity, and an aluminum-reduction works, of 10,000 tons capacity, are to be erected at Ajka by the Hungarian Bauxite Mine, Ltd., and the United Incandescent Lamp & Electric, Ltd. A 250,000,000-kw. steam power plant is to be built at the same time and will commence operations in 1942.

India, British.—In July 1940 alumina was conditionally exempted by the Government from an import duty, apparently to encourage the production of aluminum at a plant proposed in Travancore by the Aluminium Production Co. of India, Ltd. The Aluminium Corporation of India, Ltd., did not complete construction of its aluminum works in 1940 in Bihar, using Indian bauxite, as the war delayed deliveries of equipment.

Italy.—In 1940 Italy produced an estimated 40,000 tons of primary and 10,000 tons of secondary aluminum, 178,500 tons of alumina, and 3,000 tons of artificial cryolite. Of the primary metal, Montecatini plants at Bolzano and Mori supplied 51 percent, the Soc. Alluminio Veneto An. plant at Porto Marghera 41 percent, and the Canadiain plant at Borgofranco 8 percent. On September 23, 1940, the Monte-

[11] Anderson, Robert J., The German Aluminum Industry: Mining Mag. (London), vol. 62, Nos. 4 and 5, April 1 and May 4, 1940, pp. 201-212, 274-284.

[12] Engineer (London), Air-force Targets in Germany: Vol. 170, Nos. 4423, 4424, and 4425, October 18, October 25, and November 1, 1940, pp. 252-253, 263-265, and 279-280.

~~catini and~~ Soc. Alluminio Veneto An. organizations were authorized to increase capacity further. A 450,000,000-kw. hydroelectric project at Bressanone began operations in September 1940, and a 600,000,000-kw. project at the Resia Lakes will be completed in 1941. Of the alumina produced in 1940, Montecatini's two works at Porto Marghera produced 42 percent, Soc. Alluminio Veneto An. works at Porto Marghera, Bussi, and Civitavecchia 56 percent, and the Soc. An. Industrie Chimiche at Traviglio 2 percent. The Civitavecchia works first began operations late in 1940. Early in 1940 experiments were begun at Bagnoli by the Soc. Italiana Potassa to recover alumina from leucite as the industry became apprehensive about the adequacy of the Istrian bauxite reserves and bauxite-mining operations had to be extended to southern Italy. The Soc. An. Leucite Potassa Alluminio is extending its alumina and potash plant at Castellina Chianti and expects to construct a new one at Orvieto based upon leucite raw material. Plans are to produce 50,000 tons of aluminum in 1941, 60,000 in 1942, and eventually 100,000. Aluminum plants at Porto Marghera are said to have been bombed in 1940 by the British Royal Air Force.

Japan.—Japanese industry claims that it would be impractical for the Government to carry out its proposed merger of the many small aluminum concerns into two big groups—one using imported bauxite and the other employing subsidized Empire alunite, alum shale, aluminiferous schist, clay, and phosphatic alum. Present alumina and aluminum producers using bauxite raw material are: Japan Electro-Industrial Co. (Ohmachi and Koyasu); Japan Aluminium Co. (Takao, Formosa Island and Kurosaki, Kyushu Island); Japan Soda Co. (Takaoka); Japan-Manchuria Aluminium Co. (Koriyama and Iwase); Sumitomo Aluminium Reduction Co. (Niihama); and the Japan Light Metals Co. (Higashi-Gambara). Although the Manchuria Light Metals Co. (Antung and Fushun, Manchuria) apparently is the only active metal producer using Empire raw material, the Kokusan Light Metals Co. (Toyama Prefecture), Toa (Asia) Light Metals Co., Korea Nitrogen Fertilizer Co. (Konan, Chosen), Korean Chemical Industrial Co. (Shingishu, Chosen), and the Korea Riken Metals Co. plan to employ it in the future. The Oriental Aluminium Co. (Kamioka and Omuta) and the Oriental Metals Co. (Yakushima) propose to use Palao or other bauxite and the North East Aluminium Development Co. (Koriyama) intends to purchase manufactured alumina. Bauxite shipments to Japan in 1940 aggregated 234,894 tons from the Netherlands Indies, 59,320 from the Federated Malay States (Johore), and possibly a small tonnage from Palao Island.

Netherlands Indies.—In 1940 the N. V. Billiton Maatschappij produced 275,345 tons of bauxite on the island of Bintan [13] and shipped 234,894 tons to Japan, 39,623 to the United States, and 14,469 to the United Kingdom. Construction of the new company power, alumina, and aluminum-reduction plants in Sumatra is expected to be completed in 1942.

Norway.—Operations are believed to have been curtailed severely in 1940 at the six aluminum-reduction plants owing to the lack of imported bauxite and alumina. Domestic labradorite has been mentioned as a possible raw material for the industry. Late in 1940, however, German interests organized the Nordische Aluminium

[13] Van Bemmelen, R. W., Bauxite in Netherlands Indies: Dienst van den Mijubouw in Nederlandsch-Indië No. 23 (Landsdrukkerij, Batavia), 1940, 115 pages.

Aktiengesellschaft to augment German aluminum supplies, and perhaps the plants now are being supplied with alumina. In April 1941 the British bombed the Hoyanger aluminum works. During the first quarter of 1940 Norway exported 9,647 tons of crude and 195 tons of semicrude aluminum.

Nyasaland.—Development work by the Anglo-American Corporation of South Africa reveals reserves of about 60,000,000 tons of commercial bauxite on Mlanje Mountain, southeastern Nyasaland.

Sweden.—Experiments by the Svenska Aluminiumkompaniet and the Boliden Mining Co. on the extraction of alumina from andalusite are said to have been successful, and an alumina plant to supply the Månsbo reduction works is contemplated. A scrap-collecting campaign conducted in the summer of 1940 netted considerable aluminum.

U. S. S. R.—The three Soviet aluminum-reduction plants operated at only partial capacity in 1940; it is estimated that, of the total metal output, Dnepr supplied 32,000 tons, Volkhov 13,000 tons, and the new partly completed Kamensk (Ural) works 10,000 tons. The present annual capacity of the Dnepr and Volkhov plants is believed to be 35,000 and 15,000 tons, respectively, and the final capacity of the Kamensk plant will be 50,000 tons. However, the total capacity of these plants is to be increased from 100,000 to 110,000 tons by 1942, and reduction plants are to be added at Kandalaksha (Karelia) and Rybinsk. The U. S. S. R. should be able to produce about 90,000 tons of metal in 1941 and 115,000 tons in 1942. The industry remains essentially dependent for raw material on bauxite, which apparently is not too plentiful. Soviet secondary-aluminum output in 1940 is estimated at 18,000 tons.

United Kingdom.—Aluminum production capacity is believed to have been greatly increased during 1940, as the reduction plant at Lochaber, Scotland, was extended and the new plant at Resolven, Wales, probably was completed. On August 14, 1940, the control of aluminum, bauxite, cryolite, and silicon was transferred from the Minister of Supply to the Minister of Aircraft Production and a licensing system put into effect on the use of secondary aluminum. All primary aluminum produced is sold to and distributed by the Ministry. The public appeal for pots and pans and other aluminum household articles in July 1940, the collection of aluminum from fallen German aircraft, and the careful sorting and melting of manufacturers scrap have yielded a substantial production and consumption of secondary aluminum. Virtually all of the output of aluminum is absorbed for aircraft and naval construction, and by September 1940 aluminum released for civilian use had been restricted to 46 tons or 2 percent of pre-war consumption.

In 1939 the United Kingdom imported 306,961 metric tons of bauxite—243,433 tons from France, 34,600 from Greece, 12,369 from British Guiana, and 16,559 from other countries. After the fall of France in June 1940 bauxite imports from that country ceased, and importations from Greece became negligible.

Yugoslavia.—In 1939 Yugoslavia exported 266,513 tons of bauxite, including 257,495 tons to Germany and 8,703 to Sweden. The production of bauxite declined appreciably in 1940, as exports to Germany were largely blockaded. Of the 1,642 tons of crude aluminum exported in 1939, 995 tons went to Japan. In 1940 the capacity of the aluminum-reduction works at Lozovac was increased to about 3,000 tons a year.

MERCURY

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

SUMMARY OUTLINE

The outstanding feature of the mercury industry in the United States in 1940 was the response of domestic mines to the record-breaking average price for the year. Under the stimulus of an average annual quoted price at New York of $176.87 a flask domestic output more than doubled, amounting to 37,777 flasks compared with 18,633 in 1939, and was the highest on record since 1883. This sharp advance was brought about by an increased rate of operations at producing properties, the reopening of idle mines, and the opening of new ones. In consequence, for the first time since the World War of 1914–18 (except in 1931) domestic mines filled domestic requirements and had a surplus for exportation. In 1931 the high price for mercury abroad coupled with the depressed condition of industry in the United States resulted in a price differential in favor of selling in world markets. In 1940 cartel-supported prices again sharply favored disposing of metal in the international market despite the record-breaking annual price in the United States, where the market is protected by a tariff of $19 a flask. Disruption of ocean transportation, scarcity of bottoms, and blockades caused by the war brought demand for United States metal in markets ordinarily supplied by the international cartel. Exports for the first 6 months of the year aggregated 5,469 flasks. By May shipments of domestic metal had risen to nearly 2,300 flasks, or to considerably more than the normal average monthly output of domestic mines. The May rate of exportation defeated the beneficial effects of increased domestic production and prompted consumers to draw on stocks to fill requirements. Although exports dropped to 1,383 flasks in June, domestic consumption plus exports continued above the increased supplies from domestic mines. On July 2 the President signed a measure placing certain strategic materials, including mercury, under export control. The effects of this measure were evident immediately. In May and June shipments to Japan totaled 1,265 flasks and in July 278 flasks; for the remainder of the year they were nonexistent. On the other hand, following the Government policy of all-out aid to the British Empire, exports to the United Kingdom were 2,507 flasks in the first half and 2,671 flasks in the latter half of the year. The export-control measure succeeded in curtailing total exports in the latter part of the year, and domestic production continued to rise, so that, temporarily, at least, the problem of adequate supplies of metal was solved. Producers' statements, however, disclosed that higher prices were enabling them to treat ores containing a lower average grade of metal, and several properties that were opened under the stimulus of high prices produced for a short time and quickly exhausted their ore reserves. Opinion varied as to whether or not peak effort at domestic mines was desirable when the country was not even at war. Some authorities felt that depletion of limited ore reserves was too high a price to pay for temporary self-sufficiency. On the other hand, the domestic industry has solved a critical problem of supply at a time when mercury was urgently needed and when adequate alternative sources of the metal were available only at much higher prices.

As in 1914, the first year of World War I, consumption did not advance appreciably over the average for the previous 5-year period. Large Navy purchases of mercuric oxide for antifouling paint in the first quarter of 1941 sent monthly consumption figures soaring. The average monthly consumption for 1940 was 2,200 flasks, but that for the first 3 months of 1941 was 3,900 flasks. Use of metal in filling Navy needs was almost completed in January-March 1941, however, and additional requirements for the current year were expected to be very small.

As a result of the large domestic production in 1940, the export-control provision that prevented expansion of shipments to some countries, and the failure of domestic consumption to increase appreciably, conditions of supply and demand were in satisfactory relationship despite the absence of normal imports, and stocks in consumers' and dealers' hands at the end of the year were higher than at its beginning.

Salient statistics of the mercury industry in the United States, 1936–40

[Flasks of 76 pounds]

	1936	1937	1938	1939	1940
Production flasks	16, 569	16, 508	17, 991	18, 633	37, 777
Number of producing mines	87	101	91	107	159
Average price per flask:					
New York	$79. 92	$90. 18	$75. 47	$103. 94	$176. 87
London	$64. 33	$69. 65	$66. 92	$88. 26	201. 10
Imports for consumption:					
Pounds	1, 374, 652	1, 437, 712	179, 522	265, 944	12, 971
Equivalent flasks	18, 088	18, 917	2, 362	3, 499	171
Exports:					
Pounds	19, 980	34, 485	54, 161	91, 789	730, 877
Equivalent flasks	263	454	713	1, 208	9, 617
Apparent new supply flasks	34, 400	35, 000	19, 600	20, 900	[1] 26, 600
From domestic mines percent	47	46	88	83	100
Stocks in warehouses (bonded) at end of year flasks	2, 513	4, 286	553	3, 110	901

[1] Actual consumption as reported by consumers.

Reserves.—At the request of the Office of Production Management the Bureau of Mines undertook a questionnaire survey of domestic mercury-ore reserves as of March 1, 1941. The reserves to be reported were those available at prices prevailing when the study was made (about $175 a flask) and were also to show their mercury content. Information was also requested on the amounts of production possible at various price levels, beginning at $100. It is a well-known geologic fact that mercury occurs too erratically to justify development of reserves in advance of production; consequently, engineers disagreed regarding the value of any data compiled on this subject. Nevertheless, mines that represented 78 percent of production in 1940—29,500 flasks—furnished data that could be translated into reserve estimates by making relatively conservative assumptions. For these properties a reserve of nearly 92,000 flasks at about $175 was indicated, or about 37 months' production at the 1940 rate. The total quantity reported was to come from ore averaging 4.5 pounds to the ton, whereas production for 1937–39 came from ore averaging 6.6 to 7.4 pounds; in 1940 it was from ore averaging 6.3 pounds. As reserves were distributed unevenly these figures do not indicate that output could be maintained at these properties for over 3 years at the 1940 rate. Of the 92,000 flasks, 56,000 were in California and 31,000 in Oregon. Statements for other areas were less complete than for those two States. Mines that contributed 61 percent of the 1940 production total attempted to estimate production at various price levels. They reported reserves of 80,000 flasks, of which only 8 percent would be available at less than $100, 36 percent at $100 to $150, and 56 percent at over $150. The compilations indicate the exceptionally pessimistic outlook of the industry for continuance of domestic production under more normal prices. Several producers felt that prices of about $175 a flask or more are needed to maintain their production at 1940 levels. This feeling apparently is at variance with opinion in the Price Stabilization Division of the National Defense Advisory Commission, which issued a statement on March 28, 1941, warning that prices for mercury were too high, after considering several factors in addition to domestic supply, such as the possibility of importation and substitution and alternative methods of price administration. One result of the study of reserves was to point out the effects of depletion at four mines that produced nearly 10 percent of the 1940 output but were idle in March 1941 due to exhaustion.

Procurement Division contracts.—During 1940 the Procurement Division of the Treasury Department signed contracts with producers for the delivery of certain quantities of mercury over about a year. The Procurement Division released no information on these purchases, but the technical press published a report that the New Idria Quicksilver Mining Co. had signed a contract to deliver 5,000 flasks of metal at $150 a flask. A company in Arkansas was unable to make deliveries against its contract, and the contract was canceled.

Monthly compilations.—With completion of final data covering 1940 production the Bureau of Mines was able to test the accuracy of its monthly reports on this phase of the industry. Addition of monthly figures indicated a production for the year of 36,300 flasks, and final figures were 37,777 flasks—a difference of 4 percent. Monthly output data were based upon reports from 36 to 59 mines that had produced 94 to 97 percent of the output in 1939 and from 4 to 14 new mines. The final canvass covered several hundred names; 159 mines reported production. Monthly consumption reports represent all that is available on the actual use of mercury in 1940. The same applies to consumers' and dealers' stocks, which represent figures given by reporting companies and which were increased so that they are believed to cover virtually all stocks of mercury in the form of metal available for consumption. Stocks in the hands of persons or companies not identified with the industry and metal in boilers and other plants that could be used if required are not covered by the Bureau of Mines figures. The assistance of D. E. Adams in the preparation of monthly reports is acknowledged.

Production, consumption, and stocks of mercury in the United States in 1940, by months, in flasks of 76 pounds

Month	Production	Consumption	Stocks at end of period		
			Consumers and dealers	Producers	Total
January	1,800	2,300	13,000	528	13,600
February	2,200	2,000	12,500	346	12,800
March	2,500	1,800	13,200	859	14,100
April	2,700	1,900	13,200	624	13,800
May	3,100	2,100	12,300	510	12,800
June	3,000	2,400	11,500	634	12,100
July	3,200	2,200	12,000	592	12,600
August	3,500	2,100	12,900	720	13,600
September	3,600	2,100	13,100	377	13,500
October	3,600	2,700	13,200	855	14,100
November	3,400	2,900	12,600	979	13,600
December	3,700	2,100	14,100	607	14,700
	36,300	26,600	14,100	607	14,700

Bureau of Mines and Geological Survey activity.—The Mining Division of the Bureau of Mines explored by bulldozing and surface sampling in the Bottle Creek district, Humboldt County, Nev. A small deposit of commercial ore was uncovered, which was estimated to contain a few thousand flasks of mercury, the quantity depending on the depth to which the deposit is ultimately found to extend. The investigation helped to add materially to previous knowledge of the conditions favorable to localization of ore shoots and to develop exploration technic. Plans were made for exploring mineral deposits at Coso Hot Springs, Inyo County, Calif., and for trenching and diamond drilling in two localities in Pike County, Ark., in 1941.

The mercury deposits in San Luis Obispo County and some in Monterey County, Calif., were studied by the Geological Survey. They investigated the Coso district, Inyo County, geologically and are cooperating in the drilling now being done there by the Bureau of Mines. Field work was begun in the New Idria district, San Benito County and preliminary work was done on several other quicksilver districts in California. Two reports on earlier studies by the Geological Survey are Bulletin 922–B on the Mount Diablo district and Bulletin 922–L on the Mayacmas and Sulphur Bank districts.

A preliminary study was made of prospects in the Steens and Pueblo Mountains, Harney County, Oreg. The Opalite, Bretz, and nearby mines in Malheur County and in the neighboring part of Nevada were also studied, as were several scattered mines in other parts of Oregon.

The Ivanhoe district (Elko County), Wild Horse district (Lander County), and Relief, or Antelope Springs, and Mt. Tobin districts (Pershing County), Nev., as well as some smaller districts, were studied. In addition, several mercury districts and scattered prospects were visited for the purposes of bringing up to date information acquired in previous investigations and of taking preliminary steps toward study of promising areas. Bulletin 922–E on the Buckskin Peak mercury mine (Humboldt County) and Bulletin 922–A on the Bottle Creek district (Humboldt County) were issued in 1940.

The deposits in and near Pike County, Ark., were studied by geologists of the Survey in connection with explorations by the Bureau of Mines.

PRICES

During the first half of 1940 domestic prices for mercury continued the uptrend begun in September 1939, when war was declared abroad, and only a minor set-back in April interrupted the steady advance. The monthly peak of $197.36 for a flask of 76 pounds, obtained in June, had been exceeded on only two previous occasions—January and February 1916—when the quoted averages were $231.50 and $283.50, respectively, for flasks containing 75 pounds.

With domestic production reaching high levels and with restrictions placed on exports early in July prices began to drop, trending downward throughout the second half of the year.

Although monthly prices for mercury in 1940 had been exceeded previously the annual average of $176.87 was the highest ever recorded. There can be little doubt that this high price enabled domestic mines to produce more than enough metal for domestic requirements during the year. In recent years it has been normal to import an appreciable part of domestic needs.

Average monthly prices per flask (76 pounds) of mercury at New York and London and excess of New York price over London price, 1938–40

Month	1938			1939			1940		
	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	$79.24	$64.31	$14.93	$77.44	$70.97	$6.47	$156.96	$169.50	[3] $12.54
February	76.46	64.54	11.92	85.23	75.21	10.02	178.00	207.00	[3] 29.00
March	72.44	63.61	8.83	87.28	77.81	9.47	180.92	207.00	[3] 26.08
April	71.02	63.07	7.95	90.80	82.40	8.40	173.54	181.32	[3] 7.78
May	74.64	65.63	9.01	86.77	79.87	6.90	181.54	168.34	13.20
June	80.73	68.98	11.75	86.62	76.09	10.53	197.36	189.44	7.92
July	76.86	68.58	8.28	86.96	76.21	10.75	194.42	207.36	[3] 12.94
August	75.50	67.90	7.60	84.41	76.08	8.33	184.11	216.84	[3] 32.73
September	74.42	66.83	7.59	140.00	90.78	49.22	173.33	219.86	[3] 46.53
October	73.48	68.90	4.58	145.60	108.00	37.60	168.85	219.78	[3] 50.93
November	74.07	68.81	5.26	134.98	109.75	25.23	168.39	219.94	[3] 51.55
December	76.77	70.99	5.78	141.20	136.00	5.20	164.96	206.79	[3] 41.83
Average	75.47	66.92	8.55	103.94	88.26	15.68	176.87	201.10	[3] 24.23

[1] Engineering and Mining Journal, New York.
[2] Mining Journal (London) prices in terms of pounds sterling converted to American money by using average rates of exchange recorded by the Federal Reserve Board, through August 1939 and from April 1940 to the end of that year; during the intervening period prices were quoted in American money.
[3] London excess.

London monthly quoted prices ranged from $13.20 a flask under the New York price in May to $51.55 over it in November. Except for May and June the London price was consistently larger than the domestic one; this condition prevailed despite the tariff of $19 a flask for metal imported into the United States. Mercurio Europeo continued to market metal in London for a few weeks in 1940, apparently because of difficulties attending the establishment of a new agency in a strategic location. Plans to sell mercury in Brussels collapsed, and the cartel began to sell mercury directly to customers. Later the Consortium International du Mercure, Basle, Switzerland, was formed to handle cartel metal. Early in 1940 cartel prices for mercury were quoted at $200 a flask f. o. b. ports of origin. In December the price was raised to $250 a flask.

CONSUMPTION

The Bureau of Mines has compiled monthly statistics covering actual consumption of mercury from September 1939 to date (May 1941). These indicate that consumption in 1940 totaled 26,600 flasks, whereas apparent consumption calculated by the conventional method of production plus imports minus exports would be 28,300 flasks. A comparison of the two totals for 1940 would indicate an increase in stocks, and consumers' and dealers' stocks actually did show a gain approximating the difference.

Supply of mercury in the United States, 1936–40

[Flasks of 76 pounds]

Year	Production (flasks)	Imports for consumption (flasks)	Exports (flasks)	Apparent new supply		
				Total (flasks)	From domestic mines (percent)	Imported (percent)
1936	16,569	18,088	263	34,400	47.4	52.6
1937	16,508	18,917	454	35,000	46.0	54.0
1938	17,991	2,362	713	19,600	88.0	12.0
1939	18,633	3,499	1,208	20,900	83.3	16.7
1940	37,777	171	9,617	[1] 26,600	100.0	----------

[1] Actual consumption as reported by consumers.

REVIEW BY STATES

Production of mercury in the United States in 1940 was double the quantity reported for 1939. Notable production gains were made in virtually all States. The principal producing mines in 1940 were as follows:

Arizona—Gila County, Ord group; Maricopa County, Pine Mountain mine.

Arkansas—Pike County, Parker Hill mine.

California—Contra Costa County, Mount Diablo mine; Lake County, Great Western, Mirabel, and Sulphur Bank mines; Napa County, Oat Hill mine; San Benito County, Aurora and New Idria (including San Carlos) mines; San Luis Obispo County, Klau mine; Santa Barbara County, Falcon (Santa Ynez) mine; Santa Clara County, New Almaden mine; Sonoma County, Cloverdale and Mount Jackson mines; Yolo County, Reed mine.

Idaho—Washington County, Idaho-Almaden mine.

Nevada—Churchill County, Wild Horse mine; Humboldt County, Blue Bird, Blue Can (including Baldwin), and Cahill mines; Mineral County, Mina Mercury (Lost Steers) mine; Pershing County, Mount Tobin mine.

Oregon—Douglas County, Bonanza mine; Jefferson County, Horse Heaven mine; Lane County, Black Butte mine; Malheur County, Bretz mine.

Texas—Brewster County, Chisos and Rainbow mines.

The 29 mines produced 86 percent of the United States total. The 16 most important mines in 1939 produced 88 percent of the total.

Mercury produced in the United States, 1937–40

Year and State	Producing mines	Flasks of 76 pounds	Value [1]
1937:			
Arizona	3	37	$3,337
California	54	9,743	878,624
Nevada	20	198	17,855
Oregon	14	4,264	384,527
Arkansas, Texas, and Washington	10	2,266	204,348
	101	16,508	1,488,691
1938:			
California	52	12,277	926,545
Nevada	17	336	25,358
Oregon	13	4,610	347,917
Alaska, Arkansas, Texas, and Washington	9	768	57,961
	91	17,991	1,357,781
1939:			
Arkansas	5	364	$37,834
California	59	11,127	1,156,540
Nevada	25	828	86,062
Oregon	14	4,592	477,293
Arizona, Idaho, and Texas	4	1,722	178,985
	107	18,633	1,936,714
1940:			
Alaska	1	162	28,653
Arizona	6	740	130,884
Arkansas	10	1,159	204,992
California	70	18,629	3,294,911
Nevada	42	5,924	1,047,778
Oregon	23	9,043	1,599,436
Utah	1	53	9,374
Idaho, Texas, and Washington	6	2,067	365,590
	159	37,777	6,681,618

[1] Value calculated at average price at New York.

Alaska.—Mellick & Halverson recovered 151 flasks of mercury in 1940 and 11 flasks in 1939 in a D retort at the Red Devil mine, Kuskokwim district. This was all included in 1940 totals.

Arizona.—The increased activity at mercury properties, mentioned in the chapter of this series covering 1939 operations, resulted in production at six mines in Gila and Maricopa Counties in 1940, notably the Ord group, Pine Mountain, and Sunflower. The output for the State totaled 740 flasks, the largest for any year since 1929. Ore at Pine Mountain was treated in a new Gould rotary furnace with a reported daily capacity of 40 to 45 tons of ore, which went into service in midyear. The Cornucopia, Slate Creek, and one other property contributed to Arizona production in 1940.

Arkansas.—Mercury production was reported by 10 mines in 1940—the largest number that has ever been active in Arkansas at one time. These mines recovered 1,152 flasks of metal from about 16,300 tons of ore and 7 flasks from dumps. The output represented the second highest annual total for the State. Active mines included the Caddo in Clark County, the Mid-Continent in Clark and Pike Counties, and the following in Pike County: Parker Hill, Big Six, Hales, U. S. Mercury, Lulu Bell, Jack Fork, Old Funk, and one other. S. L. Craig reported in February 1941 that ground was being broken for a new rotary furnace at the Jack Fork mine. A new Gould rotary furnace was installed at the Superior mercury mine property late in the year, and National Quicksilver Corporation stated that it planned to install a 3- by 48-foot rotary furnace of 50-ton estimated capacity. Some operators claimed that insufficient capital hampered development of the Arkansas mercury field.

California.—California maintained its predominant position among mercury-producing States in 1940, with an output that represented 49 percent of the total for the country. High prices for mercury brought sharper gains from other States, however, for in the 10-year period 1930–39 California's share of the total was 54 percent. The greater production in 1940 was due mainly to enlarged operations at the New Idria, Klau, Sulphur Bank, Oat Hill, New Almaden, Reed, and Falcon (Santa Ynez) mines and to reopening of the Mount Jackson and Cloverdale mines.

A recent report [1] covered two districts in the State.

The Mount Diablo mine in Contra Costa County again was operated by the Bradley Mining Co., and a large quantity of mercury was produced in a 50-ton rotary furnace. The greater part of production in 1940 was derived from surface deposits mined by power shovels and trucks. A Geological Survey report [2] issued in 1940 described the Mount Diablo district.

Lake County produced 4,943 flasks of mercury in 1940—a 20-percent increase over 1939. Thus Lake County, which led all counties in the United States in 1939, ranked below San Benito in California and Douglas in Oregon in 1940. The larger producing mines again included the Sulphur Bank, Mirabel, and Great Western, and the following contributed to the county total: Big Injun, Anderson Springs, Downey, Konocti, Helen, Otto and Bullion, Big Chief, Chicago, and Midway. There was much activity at the Abbott mine during the year, but this mine, which had a substantial output before 1900, did not begin producing until January 1941. A 10-ton rotary furnace installed during 1940 at the Chicago prospect was abandoned in July as unprofitable.

Ten mines in Napa County reported a total production of 1,478 flasks of mercury in 1940; chief among them was the Oat Hill mine operated by Gould interests. In October press reports credited this property with production at a monthly rate of 125 to 150 flasks. A 25-ton Cottrell furnace was installed at the Manhattan mine in 1940. Old waste and slag dump material at the Knoxville mine was treated in a rotary kiln and preparations were under way for reopening the mine. Operations proceeded almost without interruption at the Aetna mine, where mercury was recovered from ore and dump material in a 50-ton rotary furnace. Other producing mines included the Oat Hill Extension, Ivanhoe, Crona, and three operations on James Creek.

San Benito County had the largest county total in the United States in 1940, with a production of 6,021 flasks. Twelve mines contributed to the total output; but, as is well-known, the New Idria mine towered above all other producers. This mine and the Bonanza in Oregon were the two largest producing properties in the United States. Press reports credited the New Idria mine with a monthly output of well over 500 flasks in the latter part of the year.

The Aurora mine ranked next to the New Idria in San Benito County in 1940, with an output much greater than in 1939. The Valley View mine changed hands and was later operated as the Panoche mine. A new rotary furnace was installed.

Production in San Luis Obispo County totaled 1,464 flasks in 1940 and was made by 8 properties. The outstanding mine was the Klau, operated by Gould interests. The county output for 1940 was a marked advance over the 253 flasks reported for 1939. Before 1939, when it was closed, the Oceanic mine had dominated San Luis Obispo production in recent years. Sharply increased output at Klau in

[1] Ross, Clyde P., Quicksilver Deposits of the Mayacmas and Sulphur Bank Districts, California: Geol. Survey Bull. 922-L, 1940, pp. 327-353.

[2] Ross, Clyde P., Quicksilver Deposits of the Mount Diablo District, Contra Costa County, California: Geol. Survey Bull. 922-B, 1940, pp. 31-54.

particular, renewed production at Oceanic, and increases elsewhere were responsible for the large quantities of metal recovered in 1940.

Santa Barbara County produced 507 flasks of mercury in 1940—a sharp advance over output in 1939. The Falcon (Santa Ynez), Lion Den, and Red Canyon (Red Rock) mines were responsible for the entire production. A new 30-foot by 30-inch rotary kiln was added at the Falcon, doubling the plant capacity for that property, and a third unit of the same size was reported to be in prospect. The new 30-ton Gould rotary furnace at the Lion Den mine began operating in 1940. Additional retort capacity was installed at the Red Canyon (Red Rock) mine.

The outstanding development in Santa Clara County, where 1,026 flasks of mercury were produced in 1940, was the initiation of large-scale mining operations at the New Almaden mine, whose output in recent years has been almost exclusively from the working of old dumps. A new 5- by 60-foot rotary kiln went into steady production in December. A report to stockholders for December 1940 and January 1941 indicated that in the 2 months, 10,841 and 10,966 tons of waste were handled, 3,057 and 2,842 tons of ore treated, and 113 and 100 flasks of mercury produced. The reported production includes output from dump material. Independent production from part of the New Almaden dumps and production of the Guadalupe mine completed the activity in the county.

Reopening of the Mount Jackson mine on a large-scale basis featured mercury activity in Sonoma County in 1940. The county as a whole produced 1,146 flasks and six mines participated in the total. Local mining men operated the Mount Jackson mine early in the year; but a new company took it over, installed a Gould rotary furnace of 75 tons capacity, and began production in September. From September until the end of the year 425 flasks were recovered from 7,965 tons of ore and, in addition, 23 flasks from dumps. Another important development was reopening of the Cloverdale mine, in recent years the largest producer in the county but idle in 1939. A new 25-ton Cottrell furnace was installed at the Culver Baer mine in 1940. The Reed mine in Yolo County reported a continuous rate of output after the first quarter of the year.

Idaho.—Output at the Idaho-Almaden mine, west of Weiser was continuous throughout 1940. The monthly rate, however, was somewhat below the average for the period from May 1939 (when it began to produce) to the end of that year.

Nevada.—There was a greater proportionate increase in the production of mercury for 1940 in Nevada than in any other important State, as it rose from 828 flasks in 1939 to 5,924 flasks. Activity was widespread; six mines yielded more than 400 flasks each and one more than 1,000 flasks. A somber note is sounded, however, by the statement that three mines that were responsible for nearly half the total in 1940 were at least temporarily without reserves early in 1941. Two of these properties were recent developments and produced a relatively large quantity of metal before becoming exhausted. At the third property more hope is held for the development of new reserves in future. Humboldt County led in total production and was followed by Mineral, Churchill, and Pershing Counties.

The outstanding producing mine in Churchill County was the Wild Horse, where mercury was recovered in a 25-ton Gould furnace.

Production at the Mayflower and Wildhorse claims dominated activity in Elko County in 1940, although five other properties reported outputs. The county total was 341 flasks. A new 4- by 64-foot Gould rotary furnace was installed at the Governor mine in 1940. This plant was idle at the end of the year, pending development of higher-grade ore reserves.

The Red Rock and B. & B. mines in Esmeralda County produced mercury in 1940.

Humboldt County ranked fourth among the mercury-producing counties in the United States in 1940, and Bottle Creek ranked high among the districts. Production for Humboldt County totaled 2,713 flasks compared with 404 in 1939. Outstanding producers in the county were the Blue Can and Baldwin (operated as one property), White Peak and Red Ore (Scossa), Blue Bird, and Cahill mines. The Blue Can and Baldwin mine yielded 976 flasks, from 6,701 tons of ore, almost entirely from furnace operations between May 10 and October 21. After October 21 efforts were concentrated toward the development of additional reserves of ore, with little success. The Gould furnace, new in 1940, was credited with a daily capacity of 43 tons of ore. A comparatively steady rate of production was maintained in 1940 at the White Peak and Red Ore claims, where metal is recovered in a 20-ton Cottrell rotary furnace. The mines changed hands during the year. A Herreshoff rotary furnace of 30 tons daily capacity was completed at the Blue Bird mine early in August. The three properties briefly mentioned here are in the Bottle Creek district. The Bottle Creek district [3] was described in a recent article. The furnace at the Cahill mine treated 1,000 tons of ore to recover 490 flasks of metal in 1940. A Gould rotary furnace of 100 tons rated capacity was completed at the McCormick-Dermody mine, which was recently described.[4]

There was greatly increased activity in Mineral County in 1940, when nine mines produced 1,221 flasks compared with five mines and 26 flasks in 1939. The principal reason for the abrupt advance was the reopening on a large scale of the mine of the Mina Development Co. (including the Lost Steers group). A new Gould rotary furnace was installed at the mine, and trade reports indicated that, in midyear, capacity was about 150 flasks a month. The rotary furnace used at the Hitt property was installed in 1940.

The five mines that contributed the total mercury recovered in Nye County in 1940 were all relatively small producers.

Production of mercury in Pershing County rose to 646 flasks. A principal reason for the advance in 1940 was the showing made at the Mount Tobin (Miner's Dream) mine, where metal was recovered in a new 25-ton Gould rotary furnace. The Goldbanks and Eldorado mines also produced fair amounts; both used retorts.

Oregon.—Production of mercury in Oregon virtually doubled in 1940 and totaled 9,043 flasks compared with 4,592 flasks in 1939. This sharp increase was due largely to the more than doubled output at the Bonanza mine, Douglas County (the largest producer in the State and one of the two largest in the country), and to reopening of the Bretz mine, Malheur County. Output at the other two important

[3] Roberts, Ralph J., Quicksilver Deposits of the Bottle Creek District, Humboldt County, Nev.: Geol. Survey Bull. 922-A, 1940, 29 pp.

[4] Roberts, R. J., Quicksilver Deposit at Buckskin Peak, National Mining District, Humboldt County, Nev.: Geol. Survey Bull. 922-E, 1940, pp. 115-133.

producing mines—the Horse Heaven and Black Butte, in Jefferson and Lane Counties—was maintained throughout the year at about the 1939 rate. There was greatly increased activity in Crook County, but the average output per mine was small. Clackamas and Jackson Counties also contributed to the total.

Twelve properties in Crook County produced 299 flasks of mercury in 1940 compared with six mines and 117 flasks in 1939.

As already stated, the Bonanza mine in Douglas County was the largest producing mine in Oregon and one of the two largest in the country. Two new Gould rotary furnaces were installed at the mine in 1940 (one in the early part and one late in the year), supplementing the 40-ton Herreshoff plant already there. The Mining Journal of Arizona, November 30, 1940, stated that the Bonanza mine produced 2,622 flasks of mercury in the first 6 months of the year. The Red Cloud mine used a 25-ton Lacy furnace for production.

The Horse Heaven mine in Jefferson County was one of the largest producers in the State and in the country. The Axehandle mine produced mercury in a 20-ton Lacy rotary furnace.

Black Butte, in Lane County, was again one of the principal producing properties in Oregon although output trended downward from recent records.

The Opalite plant, which burned in December 1938, was rebuilt in the spring of 1940 and treated ore from both the Bretz and Opalite mines in Malheur County, of the Bradley Mining Co. This plant has a capacity of 40 to 100 tons a day, depending on the type of ore treated.

Texas.—Mercury was again recovered at the Chisos and Rainbow mines, where production was continuous throughout the year. The Big Bend and Texas Almaden mines, also in Brewster County, were reopened during 1940 by the Texas Mercury Co. Another property to enter production was the Fresno mine in Presidio County 102 miles south of Alpine, where ore was treated in a retort. A new rotary furnace is under construction there. The paper by Ross [5] on the mercury deposits of the Terlingua region, referred to on page 672 of Minerals Yearbook, 1940, was published in 1941.

Utah.—The Utah Quicksilver Co. produced 53 flasks of mercury from 200 tons of ore treated in a rotary furnace in 1940. Operations at this Tooele County mine were discontinued on September 30 because the property was worked at a loss.

Washington.—The Roy Mining Co. (2 miles from Morton, Lewis County) treated 1,000 tons of ore in retorts and recovered 65 flasks of mercury.

FOREIGN TRADE [6]

Imports of mercury for consumption in 1939 totaled 3,499 flasks; more than 3,000 covered the period that followed the beginning of hostilities abroad in September. They amounted to only 147 flasks in January 1940 and to 24 flasks in the next 3 months, but were nonexistent from May throughout the remainder of the year. Meanwhile general imports, which are a measure of metal actually entering the country during a given period, aggregated 1,861 flasks in all of 1940;

[5] Ross, Clyde P., The Quicksilver Deposits of the Terlingua Region, Texas: Econ. Geol., vol. 36, No. 2, March–April 1941, pp. 115–142.

[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.

1,535 flasks were entered during the first 4 months. The failure of imports during a period when increased consumption was anticipated is not surprising if price movements are considered. During most of 1940 prices for mercury in the international market were substantially above the domestic price, including the import duty of $19 a flask. Nonetheless, domestic prices had risen enough to stimulate domestic production to a point where consumers' immediate needs were filled, with an excess for exportation. Exports aggregated 9,617 flasks—the only important shipments from the country (except for those in 1931) since 1919. In 1931 the high price maintained for metal abroad, coupled with the depression in the United States, resulted in a price differential in favor of selling in the London market, and 4,984 flasks of mercury were exported.

In 1940, Mexico supplied 128 flasks of the mercury imported for consumption, Spain 40 flasks, and Italy 3. Of general imports, 1,471 flasks were received from Mexico and 390 from Italy. In addition to the mercury imported from Mexico as metal nearly 1,300 flasks were produced in the United States from antimony-mercury concentrates received from that country. Data covering this class of imports are not shown separately in customs statistics.

Mercury imported into the United States, 1939–40, by countries

Country	1936		1937		1938		1939		1940	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Hong Kong			5	$5					3	$6
Italy	491,714	$385,236	747,266	649,406	84,454	$50,434	25,528	$29,818	228	316
Mexico	26,393	21,708	116,497	104,730			42,745	61,313	9,698	13,681
Spain	774,785	544,072	535,156	440,804	95,068	82,176	197,671	245,613	3,042	3,958
United Kingdom	81,760	66,801	38,788	33,046						
	1,374,652	1,017,817	1,437,712	1,227,991	179,522	132,610	265,944	336,744	12,971	17,961

The possible increase in imports of mercury compounds, suggested in the chapter of this series for 1940, failed to materialize when virtually all movement of mercury-bearing materials from Italy and Spain to the United States ceased in 1940. The imports for February were approximately the totals for the entire year.

Mercury compounds imported for consumption in the United States, 1939–40

Compound	1939		1940	
	Pounds	Value	Pounds	Value
Chloride (mercuric) (corrosive sublimate)	300	$174		
Chloride (mercurous) (calomel)	6,850	5,011	19,513	$16,374
Mercury preparations (not specifically provided for)	15,061	8,755	21,863	15,362
Oxide (red precipitate)	18,200	14,948	9,000	9,234
Vermilion reds (containing quicksilver)	22,624	19,755	14,332	13,114
		48,643		54,084

As already indicated, exports of mercury totaled 9,617 flasks in 1940; in May 2,277 and in June 1,383 flasks were exported. This large movement from the country of a metal designated by the Army and Navy Munitions Board as strategic did not meet the approval of the Government. In July mercury was placed under export-control provisions, and thereafter shipments to foreign countries slowed; those to certain countries, including Japan, ceased.

Mercury exported from the United States, January–June and July–December 1940, by countries of destination

Country	January–June (pounds)	July–December (pounds)	Total	
			Pounds	Value
North America:				
Canada	20,941	37,982	58,923	$145,063
Other North America	4,914	6,088	11,002	25,133
	25,855	44,070	69,925	170,196
South America:				
Brazil	5,827	2,394	8,221	20,002
Colombia	6,480	6,032	12,512	28,608
Venezuela	1,718	2,017	3,735	9,580
Other South America	1,746	4,970	6,716	16,800
	15,771	15,413	31,184	74,990
Europe:				
United Kingdom	190,540	202,952	393,492	970,533
Other Europe	6,028	1,142	7,170	15,879
	196,568	204,094	400,662	986,412
Asia:				
Japan	100,338	21,128	121,466	254,890
Other Asia	6,493	7,273	13,766	31,056
	106,831	28,401	135,232	285,946
Africa:				
Union of South Africa	29,086	1,180	30,266	71,780
Other Africa	3,663	5,571	9,234	20,271
	32,749	6,751	39,500	92,051
Oceania:				
Australia	35,676	14,972	50,648	124,642
Other Oceania	2,201	1,525	3,726	8,912
	37,877	16,497	54,374	133,554
	415,651	315,226	730,877	1,743,149

Metal withdrawn from warehouse for export, re-exports not included above, totaled 3,899 flasks in 1940.

WORLD PRODUCTION

The following table shows available data on world production of mercury by countries from 1936 to 1940.

Canada.—No statistics covering production of mercury in Canada in 1940 are available. Such information as was released during the year makes it appear that the new discovery of mercury at Pinchi Lake in the Omineca mining division of British Columbia not only has become the principal source of mercury in the British Empire but that it has already contributed an important quantity. The mercury deposits of British Columbia were recently described by Stevenson.[7]

China.—Persistent rumors concerning sharp advances in production of mercury in China yielded to established fact during 1940. A source

[7] Stevenson, John S., Mercury Deposits of British Columbia: British Columbia Dept. of Mines Bull. 5 1940, 93 pp.

believed to be reliable indicated that output of mercury in China in 1939 was probably about 5,000 flasks or more. It stated that properties in Kweichow and Hunan, idle for years, had reopened and were producing in that year. Shipments of metal were going into foreign markets from French Indochina in 1940 and were expected to go through India following reopening of the Burma road. Official figures on exports showed that a negligible amount—13 flasks—left the country in 1939 but indicated that shipments abroad had jumped to 6,260 flasks in 1940. This mercury was reported to be chiefly for consumption in the United Kingdom, Australia, and U. S. S. R.

World production of mercury, 1936–40, by countries

[Compiled by L. P. Lounsbery]

[1 metric ton=29.008 flasks of 76 pounds]

Country	1936		1937		1938		1939		1940	
	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons
Algeria	102	3.5	140	4.8	191	6.6	(1)	(1)	(1)	(1)
Australia: Queensland	78	2.7	9	.3	--------	--------	3	.1	(1)	(1)
Bolivia [2]	224	7.7	16	.6	--------	--------	9	.3	(1)	(1)
Canada	--------	--------	--------	--------	10	.3	6	.2	(1)	(1)
China [2]	2,460	84.8	1,736	59.8	65	2.2	13	.4	6,260	215.8
Chosen	2	.1	2	.1	(1)	(1)	(1)	(1)	(1)	(1)
Czechoslovakia	1,876	64.7	2,750	94.8	2,900	100.0	(1)	(1)	(1)	(1)
Germany	1,093	37.7	[3] 1,775	[3] 61.1	[3] 1,750	[3] 60.2	(1)	(1)	(1)	(1)
Austria	3	.1	134	4.6	(1)	(1)	(1)	(1)	(1)	(1)
Italy	42,732	1,473.1	66,963	2,308.4	66,748	2,301.0	67,154	2,315.0	(1)	(1)
Japan	429	14.8	580	20.0	592	20.4	(1)	(1)	(1)	(1)
Mexico	5,307	183.0	4,936	170.2	8,519	293.7	7,376	254.3	11,653	401.7
New Zealand	--------	--------	18	.6	10	.3	--------	--------	(1)	(1)
Rumania	2	.1	4	.1	--------	--------	(1)	(1)	(1)	(1)
Southern Rhodesia	--------	--------	--------	--------	--------	--------	(4)	(4)	(1)	(1)
Spain [2]	43,424	1,497.0	28,357	977.5	[3] 40,000	1,378.9	53,441	1,842.3	(1)	(1)
Tunisia	62	2.1	25	.9	270	9.3	(1)	(1)	(1)	(1)
Turkey	815	28.1	483	16.7	597	20.6	359	12.4	(1)	(1)
U. S. S. R.	8,700	[5] 300.0	8,700	[5] 300.0	8,700	[5] 300.0	(1)	(1)	(1)	(1)
United States	16,569	571.2	16,508	569.1	17,991	620.2	18,633	642.3	37,777	1,302.3
Total [6]	123,878	4,270.7	133,136	4,589.6	148,343	5,113.7	(1)	(1)	(1)	(1)

[1] Data not yet available.
[2] Exports.
[3] Estimated.
[4] Production less than 1 flask or 0.1 metric ton.
[5] Production figure published by Metallgesellschaft.
[6] Sum of figures given in table only.

Germany.—Mercury is one of the commodities of which the Axis powers have a plentiful supply. Recent data indicate that Italy's annual output was not much below 70,000 flasks. Spain, a friendly power, has exceeded that quantity and is believed to be able to produce considerably more than that in future. These two countries dominate world production, and the close ties between them have made it easy to dictate the price for the metal in the international market. Consumption of mercury in the two countries is small. For the 4-year period, 1935–38, Germany imported an average of nearly 26,000 flasks a year. In the first 7 months of 1939 imports totaled nearly 14,000 flasks or nearly the annual rate indicated for previous recent years. Consequently Germany, undoubtedly having first call on the yield of the two leading sources of the world, is more than amply supplied with this commodity. Data from unofficial sources on Spanish and Italian exports of mercury from August 1 to December 31, 1940, indicated that in that period nearly 42,000 flasks went to Germany; most of it had been ordered before August 1. This source claimed that Germany's consumption of mercury in 1940 was almost double normal consumption on account of a very heavy but nonrecurrent demand for the installation of plants to manufacture artificial rubber.

Italy.—The chapter of this series in Minerals Yearbook, 1940 indicated that Italy dominated the world mercury situation in 1939 for the third successive year, partly or largely as a result of temporary conditions. The largest and highest-grade mercury-ore reserves are in Spain, and for many years the two countries have alternated as leaders in production. No data are available concerning the rate of production maintained in 1940, and such information as could be obtained on exports from Spain and Italy are given in the discussion on Spain.

Mexico.—Disturbed world conditions in 1940 focused the attention of the United States on the Western Hemisphere for prospective sources of strategic materials. Mexico, for years the second largest producer of mercury in the area, appeared to be the country's most promising potential source of appreciable quantities. Production in Mexico increased sharply in 1940 and totaled 11,653 flasks compared with 7,376 in 1939; it did not show an increase of consequence until late in the year, however, lagging greatly behind the United States in its response to high prices for the metal. The average rate of output during the first 11 months of 1940 was 875 flasks, but official reports credited the country with 2,023 flasks in December. Failure of Mexican mines to respond more quickly to increased prices probably was attributable to lack of organization in the industry, to widespread and disputed ownership of properties, to lack of capital for development of mines and installation of reduction equipment, and in part at least to political conditions within the country. Inefficient reduction methods and equipment are said to cause losses approaching 50 percent.

From January to August 1940, 89 percent of the total exports went to the United States (believed to be largely transshipments to the United Kingdom), 8 percent to Japan, and the remainder to other countries. In the period September to December, 32 percent went to the United States and 66 percent to Japan. Total exports in 1940 aggregated 11,560 flasks compared with 7,168 in 1939. Of the quantity for 1940, 7,112 flasks went to the United States but were largely reshipped to the United Kingdom and elsewhere, 4,146 flasks went to Japan directly, 97 to Manchuria, 79 to Norway, 54 to Sweden, 32 to New Guinea, 30 directly to the United Kingdom, and 10 to Nicaragua. It was rumored that metal sold to Japan in the latter part of 1940 was chiefly at $190 to over $200. Occurrences of mercury in Mexico are widespread, and reorganization of the industry is said to promise largely increased output.

Mercury-antimony concentrates shipped from the Huitzuco mine to Los Angeles for reduction totaled 714 short tons that yielded 1,286 flasks of mercury in 1940 compared with 942 tons that yielded 2,005 flasks in 1939. Ore milled at the mine in Mexico totaled 45,776 short tons containing 163,318 pounds of mercury on which a 66.37-percent recovery was obtained. The 714 tons of concentrates shipped to the

United States contained 106,281 pounds of mercury; a 92-percent recovery.

Spain.—Since the beginning of the civil war in Spain, now ended, very little authentic data on production have been available to the public. The increasing scope of war activities in Europe has accentuated this already difficult situation. Information from one source in 1940 stated that an "average" rate of production was believed to have been maintained during the year. Just what an "average rate" would indicate is open to question, however. The average annual figure for the 5-year period 1932–36 was about 31,000 flasks; that for the preceding 5-year period, 1927–31 (which cut across some boom and some depression years), amounted to about 49,400 flasks. The report mentioned stated that year-end stocks were believed to have been large. Another authority supplied figures covering exports of mercury from Spain and Italy to Germany and Central European countries from August 1 to December 31, 1940, which claimed that exports to Germany during that period were 41,800 flasks and to other Central European countries 500 flasks. It said also that during that period the two countries exported 20,422 flasks to Japan. Of the above total to Germany and other European countries, 22,100 flasks were credited to the Almaden mine, Spain, and 14,676 to the Monte Amiata and 5,560 to the Siele mines, Italy. Of exports to Japan 12,246 flasks were from the Almaden mine and 8,176 from the Monte Amiata. Thus, the above data indicate that 34,346 flasks of mercury were exported from the Almaden mine, 22,852 flasks from the Monte Amiata, and 5,560 flasks from the Siele mines, from August 1 until December 31, 1940.

Data covering the movement of Spanish and Italian metal to foreign countries during the early months of 1940 are not available. In addition to the quantities already reported for Japan 7,000 flasks purchased late in 1939 were said to have been delivered in 1940.

TIN

By E. W. Pehrson and John B. Umhau

SUMMERY OUTLINE

The outstanding feature of the tin industry in 1940 was the aggressive action taken by the United States Government to improve its vulnerable position with respect to tin supplies. Not only was the stock-piling program, initiated in 1939 under the Strategic Materials Act, greatly expanded by direct negotiation between the Reconstruction Finance Corporation and the International Tin Committee, but a substantial tonnage of Bolivian ore was contracted for and steps were taken to build a large domestic tin smelter to treat it. In addition, rigid export-control measures were adopted, surveillance over uses was carried on by the defense agencies to conserve supplies, and investigation of domestic tin occurrences was continued. Although substantial progress has thus been made toward meeting the emergency, as of May 1941, adequate security was not in sight owing chiefly to the late date at which stock-piling was begun. Because the Western Hemisphere is far from self-sufficient in tin, the success of the program depends largely on the maintenance of capacity operations and exports from southeastern Asia until stock-piling objectives are achieved. The recent movement of Japan southward, plus her pact with the Axis signed in September, raises a question as to how long free movement of tin from southeastern Asia can be relied upon. Fortunately, industry has been accumulating stocks for the past few years so that the total amount of tin now held publicly and privately represents well over a year's supply.

Statistically, new world mine production and export records were established in 1940, and smelters outside of continental Europe were operated near maximum capacity. Although statistics are not available, smelter output likewise must have exceeded previous records. Despite large increases in production and exports, world consumption in 1940 advanced only 2 percent over 1939 and according to trade reports was 15 percent below the peak established in 1937.

The excess of supply over consumption was used to build up large stocks in the United States and the British Empire. Estimates of consumption for the United States, United Kingdom, and Japan indicate sizable advances over 1939, whereas tin used in Axis-controlled Europe and the U. S. S. R. is reported to have declined. Shortage of tin in Germany was partly relieved by stocks acquired when the Netherlands, Belgium, and France were occupied, and some tin is believed to have reached Germany via Japan and the U. S. S. R.

Prices fluctuated within remarkably narrow limits, considering the trend in international affairs. A comparatively stable market in New York during the first 4 months of the year gave way to a mild panic when Germany invaded the Low Countries early in May, reaching a peak in mid-June with the defeat of France. A sharp downward trend the latter half of June was followed by the announcement on July 1 that for 1 year the United States Government would buy all surplus tin on the market at 50 cents a pound. This action virtually resulted in a pegged price, and for the latter half of the year open-market fluctuations had minor significance. The average New York price for Straits tin in 1940 was slightly lower than in 1939. The London quotation for standard tin, in sterling, was considerably higher in 1940 than in 1939, but owing to the decline in foreign exchange the dollar equivalent of the 1940 quotation was only moderately higher.

Salient statistics for tin in the United States, 1925–29 (average) and 1936–40

	1925–29 (average)	1936	1937	1938	1939	1940
Production—						
From domestic mines……long tons..	24	101.0	168.4	95	34	[1] 44
From secondary sources……do….	30,600	25,000	27,100	21,000	26,000	(2)
Imports for consumption (metal)……do….	78,009	76,029	88,115	49,699	70,102	124,810
Exports (domestic and foreign)……do….	1,740	[3] 386	[3] 313	[3] 205	[3] 2,105	[3] 2,664
Monthly price of Straits tin at New York:						
Highest……cents per pound..	70.67	51.85	62.71	46.23	63.50	54.54
Lowest……do….	39.79	42.22	42.85	36.84	45.62	45.94
Average……do….	56.64	46.42	54.24	42.26	50.18	49.82
World production……long tons..	163,000	179,000	208,100	159,900	172,700	231,700
Ratio—United States imports to world production……percent..	48	42	42	31	41	54

[1] Subject to revision.
[2] Data not available.
[3] Figures for 1936–40 cover foreign only; domestic not separately recorded.

Appointment of tin consultant.—The outstanding success of Germany's assault on Belgium, the Netherlands, and northern France in May 1940 provided the incentive for a greatly intensified national defense effort in the United States. The emergency agencies created to accomplish this objective are described in the chapter of this volume entitled "Review of the Mineral Industries in 1940." On June 17, 1940, Erwin Vogelsang, formerly president of the New York Metal Exchange and National Metal Exchange, Inc., and American representative of the London firm of Malcolm Bowley & Son, metal dealers, was appointed consultant on tin to the Advisory Commission to the Council of National Defense.

Government stock-piling program.—At the beginning of 1940 the Procurement Division of the Treasury Department was acquiring a stock pile of tin under the provisions of the Strategic Materials Act

(Public, No. 117, 76th Cong.), as described in Minerals Yearbook, 1940. The Navy Department already had completed purchase of a small quantity of tin under the stock-piling program authorized in its appropriation bills for the fiscal years 1938, 1939, and 1940. With inauguration of the intensified defense effort, it was evident that the funds provided in Public 117 and the procedure prescribed for purchasing were inadequate and that the acquisition of stock piles would have to be speeded up. These results were accomplished by transferring to the Metals Reserve Co. the purchase of some of the major items on the strategic materials list, including tin.

As the quantity of tin available for purchase was limited by the production quotas established under the Tin Control Scheme, the Government entered into negotiations with the International Tin Committee with a view to removal of restrictions on production by the latter in exchange for a guarantee that the United States would purchase all surplus tin at a stipulated price. The discussions were successful, and on July 1, 1940, the terms of the agreement were announced. The International Tin Committee agreed to raise production quotas from the 80 percent established for the second quarter of 1940 to 130 percent for 1 year beginning July 1, which was understood to represent virtually unrestricted production. The United States contracted to purchase all surplus tin offered up to 75,000 tons, at not less than 50 cents a pound, c. i. f. domestic ports, purchases to be made for 1 year or until June 30, 1941. Tin so acquired will be held for not less than 3 years from January 1, 1941. Thereafter it may be liquidated upon written notice to the International Tin Committee, provided that 3 months after such notice has been given not more than 5 percent of the total stocks or a maximum of 5,000 tons can be liquidated in any 3-month period. Tin purchasable under the contract includes the brands acceptable under Procurement Division specifications of December 15, 1939 (see Minerals Yearbook, 1940, p. 679), but the company may purchase other qualities with appropriate price differentials.

News of this contract was well-received by the trade, particularly the announcement that the Government would coordinate its buying program with that of industry to minimize competition for available supplies. Demand from consumers was to be met before the Government would negotiate purchases. During the first few months of the contract most of the increase in imports was absorbed by industry, and Government acquisitions were relatively small. Some authorities felt that a price of 45 cents a pound would have been ample to assure capacity production, but in general there was satisfaction at the prospect of a partly stabilized price around 50 cents. The provision permitting liquidation of the stock pile after 3 years was a keen disappointment to those who had labored for 20 years to have the Government adopt a policy of establishing permanent stock piles as insurance against a war shortage. Present difficulties in obtaining adequate supplies of strategic and even nonstrategic raw materials may demonstrate the wisdom of holding indefinitely any tin that may be left at the close of the emergency as a protection against future contingencies.

In May 1941 the Metals Reserve Co. contract with the International Tin Committee was extended to July 1, 1942.

Additional purchases of tin are contemplated under Government loans to China to be repaid by deliveries of tin, tungsten, antimony, and other commodities. As of May 1, 1941, $90,000,000 had been loaned for this purpose, but no deliveries of tin had as yet been reported.

At the close of 1940 the Government stock pile contained 21,419 long tons of tin, of which the Metals Reserve Co. held 13,985 tons, the Procurement Division 5,479 tons, and the Navy Department 1,955 tons. The Procurement Division inventory included 89 tons of tin produced in the United States from Bolivian ores.

Government purchases of Bolivian ores.—As stated in Minerals Yearbook, 1939, the permanent smelting of Bolivian tin ores in the United States cannot be justified solely as a national defense measure because the higher smelting costs here compared to Europe would increase the cost of the resultant metal to domestic consumers. Events in 1940, however, clearly demonstrated the necessity for just such action as an emergency measure, regardless of costs. German occupation of the Netherlands and Belgium and the British blockade of Germany cut off markets for substantial quantities of Bolivian ore, and the vulnerability of British smelters to aerial attack raised doubts as to the continuation of those outlets. As sales of tin ore constitute an important part of the national income of Bolivia, its internal economy was seriously threatened by actual and possible loss of these markets. By contracting for the erection of a tin smelter, thereby providing a market for surplus Bolivian ores, the United States acted in a manner wholly consonant with its "Good Neighbor" policy and at the same time, in view of the small domestic reserve stocks, took a realistic step toward ameliorating the potential threat to the democracies' tin supply arising from Japan's tie with the Axis and its aggression in southeast Asia.

On November 4, 1940, the Metals Reserve Co. contracted to buy ore from several Bolivian producers, including Compagnie Aramayo de Mines en Bolivie, Compania Minera de Oruro Group, Compania Minera Unificada del Cerro de Potosi, Associacion Nacional de Mineros Medianos, and Banco Minero de Bolivia. For 5 years the United States agrees to purchase annually ores containing approximately 18,000 tons of tin. The contract provides a market for a major share of the lower-grade Bolivian ores containing 18 percent or more tin. Patino Mines & Enterprises, Inc., which produces a large part of the higher-grade ores, was not a party to the agreement because its output is obligated to British smelters under a 10-year contract.

The agreement stipulates that if production quotas are reduced below 130 percent of standard tonnages by the International Tin Committee contract shipments to the Metals Reserve Co. will be reduced proportionately. The contract has been guaranteed by the Bolivian Government, which will determine the shipments to be made by the individual producers.

During the first year tin will be paid for at 48.5 cents a pound less treatment charges, penalties, and smelting losses. Thereafter the base price will be 1.5 cents below the Metals Reserve Co. buying price established under agreements with the International Tin Committee, or, in the absence of such agreement, 1.5 cents below the average American Metal Market New York quotation for Straits tin, prompt and 3 months forward delivery.

The agreement contains an elaborate schedule of treatment charges and penalties based upon the various grades of ore acceptable for delivery, details of which are published in the December 1940 issue of Engineering and Mining Journal.

Government tin smelter.—The possibility that the United States might establish a tin-smelting industry to provide a market for Latin American tin ores was discussed at the meeting of the foreign ministers of the American republics at Havana, Cuba, in July 1940. Soon thereafter the Government, acting through the Advisory Commission to the Council of National Defense, solicited suggestions from industry on construction of the smelter. By October proposals had been received from Williams, Harvey & Company, Ltd., of Liverpool; the Billiton interests (operators of the Arnhem smelter in the Netherlands); Guggenheim Bros.; Phelps Dodge Corporation; American Metal Co.; American Smelting & Refining Co.; Hooker Chemical Co.; and the Port Wentworth Corporation of New York. Plans were reviewed by a technologic committee on tin smelting appointed October 10 by the Advisory Commission and the Reconstruction Finance Corporation; and, after considerable negotiation and investigation, it was announced in February 1941 that a tentative agreement had been reached with the Billiton interests. The Tin Processing Corporation of New York—a subsidiary of N. V. Billiton Maatschappij of Batavia, Netherlands Indies—will build the plant at Texas City, Tex., at an estimated cost of $3,500,000. The smelter will have capacity to treat 50,000 tons of concentrates a year and produce 18,000 long tons of fine tin. The plant will be owned by a subsidiary of the Reconstruction Finance Corporation but will be managed by the Billiton group. The contract contains a clause permitting the Government corporation to take over the plant or change the management. The Tin Processing Corporation will receive a construction fee of 4 percent on the cost of the plant and a management fee of a little less than 1 percent of the value of the finished tin produced. The Army and Navy Munitions Board and the National Resources Planning Board recommended that the smelter be established in the Gulf area. The plant will be erected on land donated by the Texas City Terminal Co. The deciding factors in locating the plant at Texas City were cheap gas for fuel; hydrochloric acid for ore treatment, available at low cost from a nearby refinery; good terminal, port, and warehouse facilities; a large movement of foreign cargo ships into the Galveston-Houston marine district, making it possible to handle less than cargo lots of tin concentrates coming from South America; and availability of barge transportation of finished tin to market. Construction will require the better part of a year, and production is expected in 1942. Direct freighter service between Gulf Coast ports and the West coast of South America for the transportation of tin concentrates from Bolivia will be inaugurated by the Grace Line.

The agreement actually involved two contracts for the Netherlands interests—one with the Defense Plant Corporation, which advanced the loan for plant construction, and one with the Metals Reserve Co., covering management and operation. G. Temple Bridgman, consulting mining engineer, was engaged as technical advisor to the Metals Reserve Co. and later became its vice president.

Reclamation and conservation.—Looking forward to possible need for conserving tin, the Advisory Commission to the Council of National

Defense promptly began investigating various means of accomplishing it and held informal conferences with various branches of the tin-consuming industry to initiate planning along this line. In March 1941 a Conservation Unit was established in the Production Division of the Office of Production Management to direct the conservation, reclamation, and substitution of scarce materials. In April 1941 representatives of can-making companies advised the Office of Production Management that if necessary a 10-percent reduction in the weight of the tin coating of cans could be made safely for about 95 percent of all tin-can uses. At the same time, a committee of the National Academy of Sciences estimated that a maximum of 12,000 long tons of tin might be reclaimed annually from used tin cans, but it advised against Government financing of new detinning plants for such operations unless the emergency developed to a point where it became imperative to conserve tin, regardless of cost.

Investigations of domestic tin deposits.—The investigation of domestic tin deposits authorized by the Strategic Materials Act was continued by the Bureau of Mines and the Geological Survey in 1940. In March 1941 the Bureau of Mines issued a progress report [1] on its exploration of tin deposits, which contained the following conclusion:

> These early results tend to strengthen the conviction that no appreciable part of the tin required by American industry can be supplied from known domestic sources, regardless of how great the stringency or how high the price. Stockpiling, the discovery of new deposits, and the development of substitutes appear to be the only alternatives for insurance against acute shortage should access to overseas supplies be denied.

The same report describes the results of work completed at Tinton, S. Dak., and in the Taylor Creek district, New Mexico; Fries [2] discusses the tin deposits of the latter.

A preliminary manuscript report on the tin deposit at Majuba Hill, Pershing County, Nev., was prepared by the Geological Survey and placed in its open files at Washington, D. C. In 1938 the Bureau of Mines conducted concentrating tests on samples of tin ore from Majuba Hill.[3]

Selected copper-rich sulfides from material gathered from a mine shaft and six mine dumps at Goldfield, Nev., reported to contain tin, were analyzed by the Geological Survey. The available evidence does not indicate that the tin content would add enough value to the copper ores to warrant mining from known bodies or searching for richer ores at lower levels. Reports by the Geological Survey covering work done on the tin deposits of Irish Creek, Va.; the tin belt of North and South Carolina in the vicinity of Gaffney, Lincolnton, and Kings Mountain; the Temescal district and the Bernice group of claims in California; at Spokane, Wash.; and in Lander County, Nev., are in process of publication. New geologic studies of areas in western Seward Peninsula, Alaska, that have especial importance as possible sources of tin are being made by the Alaskan Branch of the Geological Survey.

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[1] Mining Division, Bureau of Mines, Strategic Minerals Investigations, Progress Report on Exploration of Tin Deposits: Inf. Circ. 7154, 1941, 5 pp.

[2] Fries, Carl, Jr., Tin Deposits of the Black Range, Catron and Sierra Counties, N. Mex.—a Preliminary Report: Geol. Survey Bull. 922–M, 1940, 15 pp.

[3] Metallurgical Division, Progress Reports—Metallurgical Division. 27. Ore-Testing Studies, 1937–38: Bureau of Mines Rept. of Investigations 3425, 1938, p. 86–87.

H. R. 10641, introduced October 21, 1940, authorizing an appropriation of $2,000,000 for exploration and development of Alaska tin deposits, was reintroduced January 3, 1941, in the 77th Congress, first session, as H. R. 96 and referred to the Committee on Mines and Mining.

Licensing of exports.—Export restrictions were extended to tin products other than tin-plate scrap in 1940. Section 6 of "An Act to expedite the strengthening of the national defense" (54 Stat., 712, 714), approved July 2, 1940, authorized the President to control exports of munitions, materials, and machinery essential to national defense. Determination of the commodities subject to the controls provided for in the Act was delegated to the Office of Administration of Export Control, although the Department of State actually issues the licenses. Tin and tin manufacturers were included in the first proclamation and became subject to export control after July 5, 1940. Tin plate (December 30, 1940) and brass and bronze (February 3, 1941) later were added to the list of commodities subject to export restrictions.

Before this act was passed a "moral embargo" on tin had been in effect as a result of Government warnings against the exportation of strategic materials. On October 11, 1939, the Army and Navy Munitions Board issued a statement condemning the re-export of such materials as being detrimental to the stock-pile program. The warning was repeated January 19, 1940, following large exports of pig tin in December 1939. Shipments continued large during January 1940 but fell in February and March and thereafter comprised only small quantities sent to countries within the Western Hemisphere.

DOMESTIC PRODUCTION

Mine output.—Only 44 long tons of tin were produced in 1940—an increase, however, of 29 percent from 1939. Alaska again supplied virtually all the output. According to the Federal Geological Survey, tin mining in Alaska in 1940 was confined mainly to placer deposits that have been developed in the western part of the Seward Peninsula, but small amounts of stream tin were recovered in the course of placer-gold mining in the Ruby and Hot Springs districts of the Yukon region. No lode tin was mined during 1940 from any Alaska deposits. H. R. 96, of January 3, 1941, which has been referred to the Committee on Mines and Mining, authorizes an appropriation of $2,000,000 for the exploration and development of Alaska tin deposits.

In addition to Alaska, small quantities were reported produced in South Dakota, Montana, and New Mexico in 1940. Producers included the Black Hills Tin Co. and the Dakota Tin & Gold Co.—both near Tinton, S. Dak.; George A. Mayer, near Basin, Mont.; and Paul Bellamy, Hardcastle Creek area, and the Tin Gulch placer mine, Squaw Creek area, Catron County, N. Mex.

The Bear Creek mine near Tinton, S. Dak., formerly operated by the Fansteel Mining Corporation, has been abandoned.

A historical table of mine production of tin in the United States, by States, from 1910 to 1939, inclusive, was published in Minerals Yearbook, 1939, page 679.

Mine production of tin (content) in the United States, 1936–40, by States

Year	Long tons				Value
	Alaska	South Dakota	Other States [1]	Total	
1936	101	(2)		101	105,000
1937	166	0.8	1.6	168.4	205,300
1938	94	1		95	90,000
1939	33	.5	.5	34	38,400
1940	[3] 41	2	1	[3] 44	[3] 48,900

[1] 1937: South Carolina, New Mexico, and Wyoming; 1939–40: Montana and New Mexico.
[2] Less than 0.1 ton.
[3] Subject to revision.

Domestic tin smelting.—Tin ores are now treated on a small scale by several plants in this country. In 1940 these plants produced 1,746 long tons of tin, including 510 tons in the form of pig tin and 1,236 tons in the form of alloys (mostly solder) made direct from the ores. The ores treated in 1940 were obtained chiefly from Latin American countries, principally Bolivia, although small quantities produced by domestic mines were also purchased. Companies reporting the recovery of tin from ores in 1940 included Phelps Dodge Corporation, American Metal Co. (tin smelter at Carteret, N. J.), American Smelting & Refining Co., Nassau Smelting & Refining Co., Kansas City Smelting Co., Metal & Thermit Corporation, and Vulcan Detinning Co.

The 1940 Annual Report of the Phelps Dodge Corporation contains the following statement regarding its "P. D." tin:

> Construction of the experimental tin-smelting plant at Laurel Hill was completed, and it was put into operation during August. Early results have been encouraging, but certain details of the process have not been fully worked out, and it will require additional time to determine the possibilities of the plant. Both electrolytic and fire-refined tin have been produced from low-grade Bolivian concentrates. Small tonnages of both grades of tin have been sold and have been well-received by consumers.

The Vulcan Detinning Co. stated in its 1940 report that:

> The Company has continued to smelt selected high-grade Bolivian and other tin ores and has renewed its research work in the smelting of all grades of tin ores; but until methods of recovering high-quality tin from the more refractory ores upon a cost basis competitive with foreign smelters under peace-time conditions are developed, or protective import or excise taxes are imposed, the heavy investment required to properly treat inferior grades cannot be considered.

Secondary tin.—Complete statistics on the recovery of secondary tin in 1940 were not available when this summary was written. Over 40 percent of the secondary tin produced in the United States is recovered from industrial or new scrap, and curtailment in the consumption of virgin tin is thus reflected immediately in secondary-tin production figures. Moreover, a large proportion of the secondary tin reported statistically is contained in copper alloys of relatively low tin content made from scrap from which it is impractical to separate the tin on account of the high cost of such an operation. Because of these facts, the significance of secondary tin from the standpoint of national defense frequently has been overemphasized. Should foreign sources of tin be cut off the quantity of secondary tin available soon would shrink to small proportions. Although the reclamation of tin is highly desirable as a conservation measure it should be borne in mind that it is not to be depended on for large tonnages of metal in an emergency. Most of the uses of tin are dissipative, and there is no great store of metal in use that could be tapped should regular imports stop. Additional information on secondary tin is given in the chapter on Secondary Metals (Nonferrous).

Secondary tin recovered in the United States, 1925–29 (average) and 1936–40

Year	Tin recovered at detinning plants			Tin recovered from all sources			
						Total	
	As metal (long tons)	In chemicals (long tons)	Total (long tons)	As metal (long tons)	In alloys and chemicals (long tons)	Long tons	Value
1925–29 (average)	900	2,000	2,900	7,500	23,100	30,600	$38,034,120
1936	2,300	1,500	3,800	6,500	18,500	25,000	25,621,500
1937	2,500	1,500	4,000	7,400	19,700	27,100	32,124,100
1938	2,200	1,300	3,500	4,300	16,700	21,000	19,284,600
1939	3,600	600	4,200	4,000	22,000	26,000	29,276,600
1940	3,700	600	4,300	(1)	(1)	(1)	(1)

1 Data not yet available.

CONSUMPTION

Apparent consumption.—The apparent consumption of primary pig tin is determined by adding domestic smelter production to net imports. As there was no smelter output from 1925 to 1939, inclusive, the apparent consumption for this period was equivalent to net imports. The computation does not consider fluctuations in dealer and consumer stocks (information on which is not always available) nor the large accumulation in Government stocks in 1940; consequently, the figures do not reveal the actual trend in consumption. Nevertheless, statistics on apparent consumption have been useful in determining long-time trends. A table giving these data from 1910 to 1938 was published in Minerals Yearbook, 1939, page 680.

The apparent consumption of primary pig tin, computed by the above formula, reached an all-time record of 123,892 tons in 1940—an 82-percent increase over the 67,997 tons consumed in 1939—but, as indicated above, the 1940 figure exaggerates actual consumption because of very large increases in consumers' and Government stocks. Although the actual consumption of primary tin in 1940 probably was substantially higher than in 1939, it was, nevertheless, considerably below the all-time peak established in 1929.

Consumption by uses.—The following tables show the actual consumption of primary and secondary tin as reported to the Bureau of Mines. Final figures for 1940 were not available when this manuscript was prepared. The items included in the table of consumption by uses represent the products of the first cycle of manufacture. In computing the figures shown in the table, any virgin tin emerging from the first stage of manufacture as scrap was recorded as secondary metal. The figures thus understate consumption of primary tin, and much of the secondary tin listed duplicates the virgin metal shown because it is reclaimed from such byproducts as tin-plate clippings and virgin drosses from tin-plate and tinning mills and other plants consuming virgin tin. In 1939, for example, domestic consumers purchased 70,732 tons of virgin metal, of which 3,149 tons were added to inventories and 67,583 tons processed. Of the tin processed, about 2,000 tons were sold as scrap, lost, or added to stocks of metal in process, and the remainder emerged from the first stage of manufacture in the products shown in the following tables.

Consumption of primary and secondary tin in the United States, 1937–39, in long tons

	1937	1938	1939
Stocks on hand Jan. 1	17,978	25,984	25,260
Net purchases during year [1]	101,354	[2] 61,431	89,018
Available supply	119,332	[2] 87,415	114,278
Stocks on hand Dec. 31	25,984	[2] 25,260	29,025
Total processed during year	93,348	[2] 62,155	85,253
Intercompany transactions in scrap (tin content)	2,782	[2] 2,122	2,390
Total consumed in manufacturing	90,566	[2] 60,033	82,863
Plant losses	436	[2] 259	435
Tin content of manufactured products	90,130	[2] 59,774	82,428
Primary	72,928	[2] 48,116	[3] 66,583
Secondary	17,202	[2] 11,658	15,845

[1] 1937: Primary, 82,946; secondary, 3,461; terne, 1,052; scrap, 13,895. 1938: Primary, 50,052; secondary, 1,983; terne, 787; scrap, 8,609. 1939: Primary, 70,732; secondary, 4,976; terne, 1,171; scrap, 12,139.
[2] Revised figures.
[3] Includes small tonnage secondary pig tin.

Consumption of tin in the United States, 1937–39, by finished products (tin content), in long tons

Product	1937			1938			1939		
	Primary	Secondary	Total	Primary	Secondary	Total	Primary	Secondary	Total
Tin plate	[1] 39,221	-------	39,221	[1] 23,545	-------	23,545	[1] 36,640	-------	36,640
Terneplate	382	1,015	1,397	264	743	1,007	317	1,137	1,454
Solder	12,026	7,832	19,858	7,590	5,208	12,798	9,578	7,70[illegible]	17,279
Babbitt	4,501	2,272	6,773	2,893	1,264	4,157	3,850	1,598	5,448
Bronze and brass	3,712	2,784	6,496	2,334	1,598	3,932	3,385	3,051	6,436
Collapsible tubes	3,571	(2)	3,571	3,427	-------	3,427	3,507	(2)	3,507
Tinning	2,585	67	2,652	1,738	35	1,773	2,165	172	2,337
Foil	1,456	4	1,460	[3] 2,283	(2)	[3] 2,283	2,001	(2)	2,001
Chemicals (other than tin oxide)	171	1,331	1,502	166	910	1,076	167	288	455
Pipe and tubing [4]	1,278	18	1,296	948	(2)	948	606	(2)	606
Tin oxide	793	411	1,204	547	444	991	651	359	1,010
Type metal	221	1,140	1,361	134	978	1,112	149	990	1,139
Galvanizing	997	(2)	997	792	-------	792	1,028	-------	1,028
Bar tin	652	174	826	456	213	669	1,100	241	1,341
Miscellaneous alloys	482	24	506	238	19	257	404	45	449
White metal	374	33	407	390	44	434	466	42	508
Miscellaneous	506	97	603	371	[3] 202	[3] 573	569	221	790
	72,928	17,202	90,130	48,116	11,658	59,774	66,583	15,845	82,428

[1] Includes small quantity of pig tin derived from detinning operations; Bureau of Mines not permitted to publish separate figures.
[2] Small quantity included under "Miscellaneous."
[3] Revised figures.
[4] In 1937 pure tin tubing required 1,286 tons and tin-lined tubing 10 tons; not reported separately after 1937.

Tin is employed principally in the manufacture of tin plate. Normally this industry consumes approximately half of the virgin tin used in the United States. The production of tin plate (which was the largest in history) increased 3 percent in 1940 compared with 1939. and was attributed to an increase in the total food pack and the 23-percent increase in exports of tin plate.

According to the American Bureau of Metal Statistics, the use of virgin tin in various other products increased as follows in 1940: Solder, 13 percent; babbitt, 10 percent; bronze, 40 percent; and collapsible tubes and foil, 7 percent.

FOREIGN TRADE

The principal items in the foreign trade of the United State in tin are imports of pig tin (which supply virtually all the domestic tin requirements) and exports of tin plate. Of minor importance are the import and export trade in tin-plate scrap; exports of tin-plate circles, strips, cobbles, etc.; and exports of waste-waste tin plate. There is also an appreciable export of miscellaneous tin manufactures, tin-plated hollow ware, and tin compounds.

Imports of metallic tin in 1940 were 78 percent greater than in 1939, establishing an all-time record. Ninety-one percent of the total imports came from Asia, 4 percent from Europe, 4 percent from Africa, and 1 percent from other sources. Receipts from Asia more than doubled, whereas shipments from Europe dropped 62 percent owing to restrictions on exports from the United Kingdom and occupation of the Low Countries by German military forces. For the most part, shipments from the Belgian Congo have been diverted from Belgium to the United States. Imports of tin concentrates, although small, were the largest since 1923; they came largely from Bolivia and were consigned for treatment in private plants in this country. No shipments were made from Bolivia during 1940 for treatment by the new smelter to be built by the Government. Receipts of Bolivian ore will be much larger in 1941.

Foreign trade of the United States in tin and tin concentrates, 1936–40

Year	Imports				Exports of tin (metal)[1] (long tons)
	Tin (metal)		Tin concentrates (tin content)		
	Long tons	Value	Long tons	Value	
1936	76,029	$75,450,941	179	$94,738	386
1937	88,115	104,284,762	151	132,810	313
1938	49,699	44,860,324	(2)	298	205
1939	70,102	70,590,764	500	418,004	2,105
1940	124,810	128,294,410	3,000	2,687,154	2,664

[1] Imported as pigs, bars, etc., and exported as such.
[2] Less than 1 ton.

Tin [1] imported for consumption in the United States, 1939–40, by countries

Country	1939		1940	
	Long tons	Value	Long tons	Value
Argentina	251	$256, 516		
Australia	250	256, 498	711	$760, 641
Belgian Congo	100	123, 220	4, 899	5, 527, 493
Belgium	1, 320	1, 429, 471	40	42, 560
British Malaya	46, 785	47, 139, 136	96, 454	98, 606, 535
Canada	3	2, 358	7	2, 036
China	3, 259	3, 015, 954	3, 889	3, 591, 865
Hong Kong	1, 062	999, 133	480	415, 452
Indochina, French	25	24, 877	1, 241	1, 340, 956
Mexico			23	18, 333
Netherlands	1, 008	1, 018, 181	10	5, 086
Netherlands Indies	5, 316	5, 442, 528	12, 101	12, 916, 449
Panama	(2)	91	(2)	98
Portugal	25	27, 227	104	86, 044
United Kingdom	10, 698	10, 855, 574	4, 851	4, 980, 862
	70, 102	70, 590, 764	124, 810	128, 294, 410

[1] Bars, pigs, blocks, grain, granulated, or scrap, and alloys, chief value tin, n. s. p. f.
[2] Less than 1 ton.

Foreign trade in tin plate, taggers tin, and terneplate in various forms, 1936–40, in long tons

Year	Tin-plate scrap		Tin-plate circles, strips, cobbles, etc., exports	Waste—waste tin plate, exports	Tin plate, taggers tin, and terneplate	
	Imports	Exports			Imports	Exports
1936	9, 873	14, 375	(1)	[1] 44, 621	233	238, 880
1937	12, 916	14, 126	13, 062	26, 259	246	360, 683
1938	10, 444	12, 495	4, 467	7, 254	109	161, 576
1939	12, 633	10, 204	6, 552	9, 132	99	311, 016
1940 [2]	16, 615	3, 536	4, 590	6, 091	137	383, 328

[1] Tin-plate circles, strips, cobbles, etc., included in waste—waste tin plate.
[2] In addition, 15,153 long tons of terneplate clippings and scrap valued at $474,374 were exported in 1940, not separately classified before January 1, 1940.

Foreign trade in miscellaneous tin manufactures and tin compounds, 1936–40

Year	Miscellaneous tin manufactures		Tin compounds (pounds)	
	Imports [1]	Exports [2]	Imports	Exports
1936	$86, 962	$1, 295, 484	5, 959	344, 578
1937	50, 545	2, 532, 747	1, 715	218, 006
1938	19, 453	2, 064, 515	865	172, 467
1939	20, 106	1, 098, 140	5	204, 362
1940	12, 429	706, 425	271	131, 019

[1] Includes tin manufactures, n. s. p. f.; tin foil, tin powder, flitters, and metallics.
[2] Includes tin dross and tin-bearing scrap material other than tin-plate scrap.

Exports of tin plate, etc., increased 23 percent in 1940, chiefly on account of purchases by Latin America, formerly supplied in large part by European manufacturers. During the latter half of the year export demand slackened and by the end of 1940 had reached small proportions. Shipments to Latin America and Canada, which represented 47 percent of the total, increased 34 percent in 1940. Those to Europe (22 percent of the total) increased 13 percent owing to increased shipments to Russia, Greece, Italy, and Switzerland, formerly supplied largely by Germany and England. There was also a 7-percent increase in exports to Asiatic countries (comprising 21 percent of the total); China, India, and Japan received more than in 1939. Exports to the Union of South Africa almost doubled, while shipments to Egypt and Syria declined.

Tin plate, terneplate (including long ternes), and taggers tin exported from the United States, 1939–40, by principal countries and customs districts

Country and customs district	1939		1940	
	Long tons	Value	Long tons	Value
COUNTRY				
Argentina	9,838	$1,150,280	35,037	$4,097,755
Belgium	9,118	974,065	3,271	401,745
Brazil	39,300	4,178,659	56,902	6,495,308
British Malaya	10,827	1,061,607	8,613	1,020,259
Canada	33,283	3,769,152	26,524	2,955,990
Chile	8,172	848,527	8,332	939,107
China	12,520	1,305,364	19,610	2,038,933
Colombia	5,544	620,279	4,173	497,180
Cuba	10,516	1,172,546	10,918	1,315,679
Egypt	8,179	871,062	6,282	748,146
Greece	1,178	120,260	4,106	440,210
Hong Kong	5,403	520,453	3,339	340,387
India, British	1,648	167,548	8,573	1,003,567
Indochina, French	7,396	735,036	2,002	215,918
Italy	----------	----------	3,817	514,171
Japan	287	29,126	9,471	1,112,349
Mexico	16,213	1,854,404	14,769	1,782,045
Netherlands	32,784	3,511,715	16,633	2,158,170
Netherland Indies	10,498	1,056,749	7,349	818,676
Norway	6,714	651,750	5,664	617,428
Peru	2,775	279,664	5,215	562,483
Philippine Islands	16,298	1,685,486	13,947	1,536,056
Portugal	6,256	658,545	15,622	1,906,663
Spain	2,725	281,327	9,083	1,072,987
Sweden	13,069	1,269,567	12,100	1,271,691
Switzerland	1,302	165,030	7,678	1,054,833
Syria	3,769	361,025	962	87,692
Turkey	3,289	342,575	1,774	201,939
Union of South Africa	12,563	1,307,478	24,604	2,754,358
U. S. S. R.	----------	----------	3,348	509,483
Uruguay	6,610	752,093	15,694	1,848,135
Venezuela	1,712	179,196	2,237	261,992
Other countries	11,230	1,152,264	15,679	1,793,560
	311,016	33,032,832	383,328	44,374,895
CUSTOMS DISTRICT				
Buffalo	9,653	1,100,024	6,623	725,085
Chicago	7,173	721,511	1,872	198,722
Dakota	6,817	799,893	8,439	978,882
Florida	1,517	162,395	2,430	282,651
Maine and New Hampshire	290	39,854	2,133	267,375
Maryland	130,690	13,402,067	135,007	14,911,145
Michigan	9,960	1,098,984	6,136	626,747
Mobile	2,526	264,558	1,369	166,050
New Orleans	8,180	866,947	7,195	807,022
New York	117,669	12,793,821	193,844	23,213,471
Philadelphia	10,830	1,133,081	12,119	1,482,326
Other districts	5,711	649,697	6,161	715,419
	311,016	33,032,832	383,328	44,374,895

PRICES

The average price of Straits tin for prompt delivery in New York in 1940 was slightly below that in 1939 and 8 percent below the 1937 average, which was the high for the last decade. At the beginning of 1940 the quotation was 48.75 cents a pound, having dropped 0.25 cent over the New Year holidays. Lack of demand for tin in this country was evidenced by the downward trend of prices during the early part of the year. The action of the International Tin Committee in the latter part of February in lowering production quotas for the second quarter from 120 percent to 80 percent effected a rise in price to 49 cents on March 11. New sterling exchange regulations effective March 25 required all sales from British sources to be based upon the official rate of $4.04. As importers were no longer able to take advantage of free sterling (at that time about $3.74) some confusion in markets resulted. However, during the latter part of March, prices began to decline and reached the low for the year—44.75 cents—on April 1. The decline was prompted by heavy sales in the East in anticipation of an announcement of an additional export duty of 2½ percent ad valorem to be levied in Malaya on companies not registered in the United Kingdom.

Early in April 1940 uncertainty regarding war developments stimulated a demand for tin, and by April 11 the quotation had risen to 47.50 cents. Something of a panic occurred in May, when the German army overran the Low Countries, causing fear that Germany might obtain control of Netherlands Indies and curtail tin supplies from that source. The price rose from 47.625 cents on May 9 to 53.50 cents on May 10 and to 54.00 cents on May 13. The market soon recovered, however, and for a short time prices trended downward, only to advance again as the defeat of France became imminent and Italy's entrance into the war was announced. By June 13 the price had risen to 58.00 cents—the high of the year. A few days later markets eased, when it was realized that tin supplies to Italy and France would be stopped by the British blockade, and broke sharply on June 18, when France capitulated.

By July 1, when the United States Government announced that it had contracted for 75,000 tons of tin at 50.00 cents, the New York quotation had declined to 52.25 cents a pound. For the remainder of the year the price fluctuated between 50.05 and 52.75 cents; the latter was in effect late in July, when there were threats of short supplies of prompt metal in the Far East. A quotation of 51.875 cents was reached October 10 to 15, following the announcement that Japan had joined the Axis. At the close of the year the price stood at 50.10 cents.

In London the monthly average price for standard tin, spot delivery, in 1940 ranged from £240.7 a long ton in January to £273.4 in June. It was £257.0 in December; the average for the year was £256.4 compared with £226.3 in 1939. Based upon Federal Reserve Board averages of the free rate of sterling exchange the London quotations for standard tin were equivalent to 44.8 cents a pound in 1939 and 43.9 cents in 1940. New York quotations for Straits tin for the same periods were 50.2 and 49.8 cents, respectively. Normally Straits tin commands a premium of about 1 cent a pound over the standard tin market in London.

Tin price data, 1925–29 (average) and 1936–40

	1925–29 (average)	1936	1937	1938	1939	1940
Average prices:						
New York: [1]						
Straits tin............cents per pound..	56.64	46.42	54.24	42.26	50.18	49.82
99.75-percent tin (English refined)....do....	(2)	46.29	54.06	42.07	[3] 47.84	[4] 48.79
99-percent tin.............do....	55.50	45.72	53.01	40.84	[5] 46.35	[4] 49.98
London: [6]						
Standard tin.............£ per long ton..	254.6	204.6	242.3	189.6	226.3	256.6
Do.............cents per pound [7]..	55.17	45.40	53.48	41.39	44.81	[8] 43.87
Premium allowed over standard:						
Straits.............£ per long ton..	5.1	2.6	3.0	4.3	(2)	(2)
Banka.............do....	6.9	1.7	....	....	(2)	(2)
English.............do....	−.7	−.4	.4	1.3	(2)	(2)
Price indexes (1925–29 average=100):						
Straits tin (New York)............	100	82	96	75	89	88
Copper (New York)............	100	65	90	70	75	77
Lead (New York)............	100	63	80	63	68	69
Nonferrous metals [9]............	100	72	91	74	79	82
All commodities [9]............	100	82	88	80	79	80

[1] American Metal Market.
[2] Data not available.
[3] 10-month average.
[4] 7-month average.
[5] 9-month average.
[6] Metal Bulletin, London, as compiled by International Tin Research and Development Council.
[7] Conversion of British quotations into American money based upon average rates of exchange recorded by the Federal Reserve Board of the Treasury.
[8] Based upon free exchange rate.
[9] Based upon price indexes of U. S. Department of Labor.

Monthly price of Straits tin for prompt delivery in New York, 1938–40, in cents per pound [1]

Month	1938			1939			1940		
	High	Low	Average	High	Low	Average	High	Low	Average
January..........	42.87½	40.00	41.52	46.80	45.15	46.38	48.75	45.12½	46.72
February..........	42.62½	40.50	41.27	46.37½	45.00	45.62	48.00	45.00	45.94
March..........	42.00	38.00	41.15	46.70	45.75	46.21	49.00	45.62½	47.09
April..........	39.90	36.60	38.34	49.25	46.10	47.20	47.50	44.75	46.82
May..........	38.25	35.00	36.84	49.25	48.70	49.02	55.00	47.12½	51.48
June..........	43.00	37.50	40.35	49.10	48.25	48.85	58.00	42.12½	54.54
July..........	44.25	42.60	43.37	48.75	48.40	48.52	52.75	51.00	51.59
August..........	43.90	42.80	43.26	49.50	48.12½	48.76	52.62½	50.50	51.18
September..........	44.50	42.65	43.38	75.00	50.00	63.50	51.50	50.05	50.32
October..........	46.40	43.50	45.22	56.00	55.00	55.25	51.87½	51.00	51.49
November..........	46.70	45.60	46.23	54.00	50.00	52.24	51.00	50.20	50.56
December..........	46.75	45.85	46.18	52.25	49.00	50.64	50.20	50.05	50.11
Year..........	46.75	35.00	42.26	75.00	45.00	50.18	58.00	44.75	49.82

[1] Metal Statistics, 1941, pp. 419 and 421.

STOCKS

Total stocks of virgin tin on hand in the United States at the end of 1940, including all metal afloat but excluding Government stock piles in the United States, increased 109 percent over 1939. Visible supplies rose almost 100 percent and consumers' stocks 116 percent. Metal on hand at the end of the year, including tin afloat, was equivalent to a 12.5-month supply at the average rate of consumption in 1940. Government buying for national defense purposes is reflected in the exceedingly high rate of increase in metal afloat and at landings. At the close of the year the various Government agencies acquiring tin for stock-piling purposes had 21,419 tons of metal on hand.

World visible supply, exclusive of consumers' stocks, increased 17 percent in 1940, as the accompanying table shows. These data do not include stocks of metal accumulated by various countries as war reserves.

Stocks of virgin pig tin in the United States, December 31, 1936–40, in long tons

	1936	1937	1938	1939	1940
Location of stocks:					
Afloat to United States [1]	10,857	7,678	4,150	12,663	22,627
At landings in New York [1]	4,990	4,106	1,837	2,415	6,106
In licensed warehouses in New York [1]	105	2,279	3,320	887	3,073
Total visible supply [1]	15,952	14,063	9,307	15,965	31,806
Consumers' stocks [2]	10,238	17,678	[3] 17,851	[3] 21,111	[4] 45,500
Total stocks on hand	26,190	31,741	27,158	37,076	77,306

[1] As reported by Commodity Exchange, Inc.
[2] As reported to the Bureau of Mines; does not include tin in process or secondary pig tin.
[3] Revised figures.
[4] Partly estimated.

Visible stocks of tin in the world and in the United States at end of each month, 1925–29 (average) and 1936–40, in long tons [1]

Month	1925–29 (average)		1936		1937		1938		1939		1940	
	World[1]	U. S.	World[1]	U. S.	World[1]	U. S.	World[1]	U. S.	World[1]	U. S.	World[1]	U. S.
January	18,912	2,986	19,652	2,985	29,099	5,478	30,493	4,866	39,100	4,624	35,573	1,749
February	19,620	3,027	19,291	3,525	26,341	4,956	29,002	5,116	40,035	5,486	33,148	2,078
March	18,312	2,803	21,448	3,968	27,526	5,731	34,872	4,458	37,788	5,806	32,339	2,635
April	17,765	2,189	19,004	2,713	27,168	4,741	35,359	4,447	37,224	3,385	32,149	2,964
May	19,085	2,384	21,147	2,941	27,320	5,144	33,051	3,679	33,715	3,387	30,562	3,677
June	18,250	2,390	18,583	3,054	27,073	4,810	35,844	4,247	30,039	4,388	31,869	5,300
July	18,164	2,675	18,027	2,151	28,938	6,193	39,119	4,071	29,615	5,339	38,736	6,567
August	18,339	2,450	19,229	3,095	29,371	5,850	41,701	5,232	26,338	3,613	38,040	6,583
September	18,317	2,425	18,403	2,860	26,099	3,538	40,544	4,573	31,168	3,413	39,450	9,438
October	18,356	2,899	20,726	3,315	24,858	3,280	38,945	4,500	38,206	3,536	40,631	6,623
November	19,058	2,373	25,333	3,030	26,176	5,285	37,145	5,060	38,035	3,283	40,046	4,362
December	20,557	2,277	26,846	5,095	29,416	6,385	37,712	5,157	38,280	3,302	44,678	9,179
Average	18,744	2,573	20,641	3,228	27,449	5,116	36,149	4,617	34,962	4,130	36,435	5,096

[1] Metal Statistics, 1941; pp. 411 and 413. In this table figures for world stocks, 1936–40, include carry-over in the Straits Settlements (on lighters and warrants) and carry-over at principal European smelters.

During 1940 the Bureau of Mines canvassed tin consumers on a monthly basis to determine stocks and rate of use for the national defense agencies. According to these preliminary reports the consuming industry had 45,500 tons of virgin pig tin on hand in the United States at the end of 1940, of which 34,200 tons were held by tin-plate manufacturers. The industry also had 1,300 tons of secondary pig tin in stock at the end of the year.

WORLD ASPECTS OF TIN INDUSTRY

World mine production.—World mine production of tin established a new record in 1940; it was estimated at 231,700 long tons—an increase of 34 percent over 1939 and 11 percent above the previous record established in 1937. Statistics for production represent exports for some countries; therefore the figure for 1940 output probably overstates actual mine activity, as mine stocks were depleted to a considerable extent in that year. Production in the countries participating in the International Tin Control Scheme in 1940 was 43 percent higher than in 1939, whereas that elsewhere was 10 percent lower. The output of the unrestricted producers comprised 11 percent of the total in 1940 compared with 16 percent in 1939, 19 percent in 1938, and 11 percent form 1925 to 1929.

World mine production of tin (content of ore), 1925–29 (average) and 1936–40, by countries, in long tons

[Compiled by L. P. Lounsbery]

Country	1925–29 (average)	1936	1937	1938	1939	1940
Restricted production:						
Belgian Congo	967	6,301	8,084	8,820	9,663	[1] 7,600
Bolivia [2]	37,169	24,052	25,128	25,484	27,211	37,923
Indochina	691	1,381	1,577	1,599	1,470	1,560
Malay States:						
Federated	54,606	64,680	75,117	41,206	49,525	
Unfederated	2,206	1,979	2,075	2,041	1,994	85,384
Straits Settlements	25	58	72	114	206	
Netherlands Indies	33,266	30,728	39,133	27,299	27,755	44,447
Nigeria	8,319	9,648	10,782	8,977	9,427	12,012
Portugal	(3)	858	(3)	(3)	(3)	(3)
Thailand (Siam)	8,204	12,633	15,786	14,704	[2] 17,325	17,447
United Kingdom	(3)	2,099	(3)	(3)	(3)	(3)
Total signatory countries	145,453	154,417	177,754	130,244	144,576	206,400
Unrestricted production:						
Argentina	32	940	1,423	1,886	1,682	[1] 1,600
Australia	2,830	3,027	3,256	3,329	3,500	(4)
Burma	2,228	4,546	4,636	4,412	4,500	[1] 5,500
Cameroun, French	-------	217	231	242	255	(4)
China [2]	7,085	11,082	12,871	11,605	10,422	6,349
Germany	98	50	[1] 100	[1] 300	[1] 300	(4)
Italy	-------	36	131	271	229	(4)
Japan	625	2,382	2,175	2,186	[1] 1,700	(4)
Mexico	2	368	373	249	289	(4)
Morocco, French	4	25	14	27	(4)	(4)
Peru	-------	97	173	103	39	70
Portugal	625	(5)	1,095	1,037	1,486	(4)
Portuguese East Africa	5	15	6	4	7	(4)
Rhodesia:						
Northern	-------	5	5	3	-------	(4)
Southern	15	47	139	267	451	(4)
Somaliland, Italian	-------	-------	-------	-------	[1] 40	(4)
South-West Africa	149	162	169	164	156	137
Spain	145	104	127	110	(4)	(4)
Swaziland	138	128	108	122	114	103
Tanganyika	22	207	243	241	229	(4)
Uganda	98	409	361	399	346	(4)
Union of South Africa	1,174	634	537	558	482	[1] 500
United Kingdom	2,658	(5)	1,987	1,999	1,710	[1] 1,800
United States	24	101	168	95	34	44
Total nonsignatory countries	17,957	24,582	30,328	29,609	28,100	25,300
Grand total	163,000	179,000	208,100	159,900	172,700	231,700

[1] Estimated.
[2] Exports.
[3] See entry under "Unrestricted production."
[4] Estimate included in total.
[5] See entry under "Restricted production."

World smelter production.—The European War has altered the flow of tin ores to some extent. The smelter at Arnhem, Netherlands, was partly shut down in September 1939 and presumably has been idle since the German invasion in May 1940. Ore from the Netherlands Indies, formerly smelted at this plant, has been diverted to smelters in British Malaya, while smelting capacity in the Netherlands Indies is being increased. Some Bolivian ore formerly was smelted in Germany, but the Allied blockade has stopped this flow. The greater part of the Bolivian output has been moving to the United Kingdom, although small tonnages come to the United States. Flow to the United States is increasing and will assume substantial proportions in 1941 in anticipation of the new smelter to be built. Smelting facilities in the Belgian Congo were enlarged to treat local ores that formerly were shipped to Belgium.

International tin control scheme.—During the first quarter of 1940 countries signatory to the production-control scheme were operating under quotas representing 120 percent of standard tonnages. On February 26 production quotas for the second quarter were established at 80 percent and on May 27 those for the third quarter at 100 percent. However, to provide for accumulation of the reserve stock of 75,000 tons of tin by the Metals Reserve Co. under its agreement with the International Tin Committee, this quota was revised on July 8 to 130 percent, to remain in force for 1 year from July 1, 1940.

World smelter production of tin, 1925–29 (average) and 1936–40, by countries, in long tons

[Compiled by L. P. Lounsberry]

Country	1925–29 (average)	1936	1937	1938	1939	1940
Argentina		591	734	1,093	1,080	(1)
Australia	2,952	2,717	2,907	3,229	3,300	(1)
Belgian Congo		1,955	2,313	2,283	2,124	(1)
Belgium [2]	720	5,100	4,900	6,800	3,100	(1)
British Malaya [3]	88,855	84,591	95,372	63,746	81,536	(1)
China	[4] 7,080	10,400	11,100	11,200	10,850	(1)
Germany [5]	3,444	2,293	2,671	3,000	(1)	(1)
Italy		286	75	271	229	(1)
Japan	606	1,841	1,850	1,900	[2] 1,700	(1)
Netherlands [2]	[6] 1,000	20,900	26,600	26,400	14,600	(1)
Netherlands Indies [4]	14,749	12,854	13,757	7,207	14,788	(1)
Norway	(1)	233	241	254	(1)	(1)
Portugal	[7] 2			39	(1)	(1)
Thailand (Siam)	[8] 113	(9)	(9)		(1)	(1)
United Kingdom [2]	45,800	34,200	33,800	36,200	37,400	(1)
	165,000	178,000	196,300	163,600	170,700	(1)

[1] Data not yet available.
[2] Estimated.
[3] Exports plus difference between carry-over at end and beginning of year.
[4] Exports.
[5] Includes production of some secondary tin.
[6] Estimated production in 1929.
[7] Average for 1926–27.
[8] Average for 1926–28.
[9] Less than 1 ton.

The 130-percent quota was designed to permit virtually full capacity operations, but despite this action the signatory countries were unable to meet the permissible tonnages so established. Estimates indicate that for the entire year exports were 31,817 tons less than allotments. The discrepancy between exports and quotas would have been greater had not substantial quantities of ore in stock at mines been available in some countries, which permitted immediate increases in smelter output that would not have been possible otherwise, owing to the delays incident to bringing idle properties into production. Moreover, in Malaya full use of facilities was not possible because of the abnormal conditions resulting from military preparations for defense. In some quarters it has been claimed that the 100-percent excess profit tax on British companies has slowed expansion because such expansion merely would result in the depletion of the companies' principal asset with no benefit accruing to the owners.

On March 20, 1941, the International Tin Committee decided that the quota should continue at 130 percent for the remainder of 1941 and that the present control agreement (which expires at the end of 1941) is to be extended 5 years.

No official data for 1940 are available on production in the principal tin-smelting countries of the world. Output in 1939 was 170,700 long tons. Substantial curtailment of smelting in the Netherlands and China in 1940 doubtless was more than offset by increases elsewhere, so that a decided advance for 1940 over 1939 may be assumed.

World consumption.—Apparent world consumption of tin in 1940 totaled 169,500 tons—a 2-percent increase over 1939—according to a preliminary estimate of the Metal Bulletin (London) based upon data issued by the Tin Research Institute.

Apparent tin consumption of the world, 1926–29 (average) and 1936–40, by countries, in long tons [1]

Country	1926–29 (average)	1936	1937	1938	1939	[2] 1940
Belgium	1,231	1,336	1,520	1,618	1,217	900
Canada	2,346	2,164	2,625	2,355	2,601	3,000
Czechoslovakia	1,513	1,684	1,731	1,560	(3)	(3)
France	10,260	9,748	9,175	9,049	8,300	6,000
Germany [4]	12,444	9,164	12,368	13,774	13,000	10,000
India, British	2,704	2,293	2,595	2,494	3,131	3,500
Italy	4,268	3,928	3,601	4,618	4,750	4,000
Japan	4,506	6,403	8,190	10,963	11,184	12,500
Netherlands	980	1,284	1,470	1,400	1,220	1,000
Poland	589	1,322	1,272	1,819	(3)	(3)
Spain	1,565	661	942	1,082	(3)	(3)
Sweden	1,373	1,692	1,889	2,883	2,500	1,500
Switzerland	1,742	1,109	1,100	1,259	1,101	800
United Kingdom	21,988	21,860	25,971	18,290	27,279	32,000
U. S. S. R.	3,791	9,664	25,125	16,174	10,000	8,000
United States	76,539	73,039	86,663	50,724	70,460	76,000
Other countries	15,036	12,549	12,863	11,438	[5] 1,816	(3)
	162,875	159,900	199,100	151,500	166,500	169,500

[1] As estimated by the Tin Research and Development Council.
[2] Metal Bulletin estimate based on figures of Research Institute.
[3] Estimate included in total.
[4] Includes Austria; also the Saar 1936–40.
[5] Denmark and Norway only. Other countries included in total.

REVIEW BY COUNTRIES

Argentina.—According to C. W. Wright[4] the present tin output of Argentina is about sufficient for domestic consumption, and the main placer deposits that supply the smelter are nearing exhaustion, although the tailings might be reworked to yield about half the present output. As regards future operations he states:

Tests of the placer tailings thus far sampled show 1,187,900 cubic meters with a content of 0.905 kilo of 60 percent tin concentrate. There is at least an equal amount of workable tailings still to be tested. A transportable plant to treat about 3,000 tons a day is being studied, and it is estimated that there is a sufficient tonnage of tailings for about 5 years.

At the mine the developments of the sulfide zones in depth are expected to keep the mill plants in operation for about 2 years.

Belgian Congo.—According to a report by Jacques Relecom submitted before the National Colonial Congress at Brussels in April 1940, the Congo is likely rapidly to reach an annual output of 30,000 tons of metallic tin.[5]

Bolivia.—The tin content of ore exported from Bolivia in 1940 was 37,923 long tons compared with 27,211 in 1939. Despite the 39-percent increase, exports were 15,018 tons under the permissible quota of 52,941 tons allowed under the control scheme. The greater portion of the exports went to Great Britain. In an effort to increase exports the Bolivian Government on May 15, 1940, granted concessions on foreign exchange regulations and taxation. This move apparently met with some success because monthly exports increased considerably during the latter part of the year.

At the close of 1940, 20,000 tons of Bolivian tin ore were reported to be in Chilean and Peruvian ports awaiting shipment; a large proportion presumably was destined for smelting in the United States under the new ore-purchasing contract previously mentioned.

The Patino interests, while not participants in the ore contract, have indicated an interest in plans for tin smelting in the United

[4] Wright, C. W., Mineral Resources, Production, and Trade of Argentina: Bureau of Mines Foreign Minerals Quarterly, vol. 3, No. 3, July 1940, pp. 20–25.
[5] The Metal Bulletin (London), No. 2487, May 7, 1940, p. 6.

States. The 1940 annual report of Patino Mines & Enterprises Consolidated, Inc., states:

> With regard to the smelting of tin in the United States, this Corporation gave assurances to the agencies of the United States Government in Washington of its readiness to cooperate and submitted more than one proposal for the construction of a smelting plant of adequate capacity. For this purpose it would have the cooperation of the technical staff of Consolidated Tin Smelters, whose long experience is unequaled in any country, in the treatment of the complex minerals produced by Bolivia. In spite of the fact that this matter appears to have been definitely closed, the corporation will be happy to cooperate at any time, should our cooperation be requested.

The company produced ores containing 12,978 long tons of tin in 1940 compared with 7,017 tons in 1939.

British Malaya.—The 1940 quota for Malaya under the Tin Control Scheme was 88,935 long tons; 85,384 tons were exported, leaving an underexport of only 3,551 tons. Exports—the highest ever recorded—were 52 percent greater than in 1939. Mine production likewise reached an all-time peak in 1940. In the Federated Malay States production totaled 80,651 tons compared with 49,525 in 1939 and the previous peak of 75,117 in 1937.

During the latter part of 1940 there was in effect in Great Britain a 100-percent excess profit tax, which left little financial incentive to expand production because mining companies were reluctant to deplete their ore reserves without benefit to the stockholders. On the grounds that special consideration should be given to concerns working wasting assets, the law has been amended, effective April 1, 1941, so that 20 percent of the tax paid becomes a post-war credit to be refunded when the war is over.

Ores imported for reduction in smelters of the Straits Settlements from Netherlands Indies, Burma, Siam, Indochina, Japan, and Africa totaled 45,576 tons in 1940—an increase of about 10 percent over 1939. Toward the latter part of the year imports from Indochina ceased.

Apparently official consideration of the Fermor report, which was summarized in last year's chapter, has been postponed until the war is over.

China.—Shipments from China declined 39 percent in 1940, apparently due mainly to transportation difficulties, as the mines at Kokiu were reported to be working day and night to accelerate production.

The extent of Japanese control over tin-mining areas appears to have been overstated in Minerals Yearbook, 1940. From a source believed to be reliable it has been ascertained that only the tin-mining areas in the coastal region of Kwangtung Province, which produce about 100 tons of tin annually, have been occupied by the invaders. Tin mining in Kiangsi and Kwangsi Provinces has not been affected. These two Provinces normally contribute about 20 percent of China's tin.

Extensions and improvements were reported to be under way at the smelting plant of the Yunnan Tin Corporation at Kokiu, but it is not known whether the work was completed. Late in the year dispatches indicated that large tin refineries at Kokiu were either destroyed or seriously damaged by Japanese bombs. The Yunnan Tin Corporation plant has been producing 2,500 to 3,000 tons of tin slabs annually or about one-third of the total output of Kokiu. There are about 60 native smelting places in the area, which supply the remainder. For a while tin from Kokiu was being shipped through Indochina by rail to Haiphong, but this route eventually was cut off by the Japanese. With the reopening of the Burma Road in October some tin may now be exported by way of Burma, but the quantity is believed to be small.

Up to May 19, 1940, the United States, through the Metals Reserve Co., had arranged for purchases of wolframite, antimony, and tin from the National Resources Commission of China to the total value of $90,000,000, to be delivered during the next few years.

Germany.—Apparent consumption of tin in Germany amounted to 10,000 tons in 1940 compared with 13,000 tons in 1939, according to estimates of the Metal Bulletin (London). A. Strauss & Co., Ltd., of London, stated on August 1, 1940, that

> Substantial stocks of tin were in Holland, Belgium, and France when the German conquest of those countries took place. Contrary, therefore, to the rather wishful-thinking statements that have been made in some quarters concerning the famine of tin in Germany, there can be no acute shortage there at the moment.

According to reports, the German army secured 5,600 tons of tin in the Netherlands and France when it overran those countries.

For several years Germany has been seeking substitutes for tin. Sheet iron coated with a phosphate film by the Bonder rustproofing process has been developed to replace tinplate in the manufacture of tin cans. A new kind of collapsible tube using cellulose plastic and metal sheet is being produced in limited quantities, and another type made manually on a small scale from plastics has been in commercial use for some time. Plastic bearings and tooth gears are playing an increasingly important role in replacing bronze, and aluminum and magnesium alloys are used extensively instead of bronze in the manufacture of worm gears.

Italy.—The small quantity of tin produced in Italy in recent years has been derived largely from tin cans and other scrap, although some is obtained from tin deposits and ore dumps in Tuscany and Sardinia. Domestic sources are insufficient to meet requirements, which are supplied largely by imports. According to trade reports, consumption declined more than 15 percent in 1940. During the year the shortage in tin plate affected operations of small canneries. To conserve stocks of tin plate the Government limited nonmilitary uses and restricted the size of containers.

Japan.—Consumption in Japan is estimated to have increased 12 percent in 1940 inasmuch as imports were at a much greater rate. A. Strauss & Co., Ltd., of London, comments on the larger imports as follows:

> These have risen from 800 to 900 tons a month to 1,500 tons from the Straits Settlements and the Netherlands East Indies combined. It is important to know the final destination of this metal. Is it the Japanese armament workshops, or does the metal go through Russia to Germany? The Ministry of Economic Warfare have no doubt got their eye on this matter. It is obviously necessary to give it close and constant attention.

Netherlands Indies.—The permissible export quota of Netherlands Indies for 1940 was 44,914 long tons; 44,447 tons were exported, leaving an underexport of only 467 tons. Shipments in 1940 were 42 percent more than in 1939. From January to April Banka produced 7,187 tons of tin, while Billiton and Singkep produced 5,266; figures for the remainder of the year have not been published.

United Kingdom.—Tin consumption established a new peak in 1940. Although official statistics are not available, the Metal Bulletin of London estimates that 32,000 tons were used—a 17-percent increase over the 27,279 tons reported for 1939. This sharp rise in consumption was accompanied by sizable declines in deliveries of metal to the United Kingdom from foreign sources and in receipts of English tin in the United States. Imports of ore from Bolivia and Nigeria apparently were higher in 1940 than in 1939; but substantial stocks, particularly of the lower-grade ores, were accumulated during the year. Visible stocks were considerably higher at the end of 1940 than at the beginning. The data at hand suggest an increase in smelter output in 1940. The mines of Cornwall produced 1,800 tons of tin, 5 percent more than in 1939.

During the latter part of the year relatively large quantities of 99-percent tin smelted in the United Kingdom from low-grade ore normally treated in the Netherlands were shipped to the United States. Supplies evidently were expanded sufficiently to permit authorities to grant export licenses more freely. Tin, and various alloys containing tin, require licenses for export from the United Kingdom to any destination. In June 1940 imports of tin metal and alloys also became subject to license. Imports of tin ores and concentrates, and residues from any source, do not require license.

The United Kingdom ranks second among the world producers of tinplate, most of which it usually exports, but restrictions on the use of steel have curtailed production. In July 1940 the use of tinplate in the manufacture of containers for home use was placed under control. Its employment for "dry" packs of food, certain toilet preparations, tobacco, trays, counter displays, oil cabinets, and similar uses is prohibited. Canned foods must be packed in specified can sizes. The smaller sizes and freak shapes not representing the most economical use of tinplate are banned. Manufacture for export was not affected by regulations prescribed in 1940. The new restriction will save 40,000 to 50,000 tons of tinplate and sheet steel annually for munitions. It has been estimated that owing to this urgent need for steel the South Wales tinplate industry will reduce its output to 45 percent.

U. S. S. R.—Tin production statistics for 1940 for U. S. S. R. are not available. Consumption, however, decreased 20 percent—from 10,000 tons in 1939 to 8,000 tons in 1940, according to estimates of the Metal Bulletin (London). The Third 5-Year Plan calls for a large increase in tin production by 1942, which will require new construction and improved operations in existing enterprises. Little has been done to date toward developing deposits discovered by Russian geologists, although trade reports indicate that exploitation was expected to begin in 1940 in eastern Siberia. Detailed prospecting work is reported to be far behind geological discovery. Insufficient mine production appears to have resulted in shortages of ore supplies available for smelting operations. According to Soviet reports, a rich tin-bearing region has been discovered near the headwaters of the Bureya River in the Khabarovsk Kray.

During the year some supplies of tin were reported to have been transshipped from the United States and Japan to Germany via Russia.

ARSENIC AND BISMUTH

By Herbert A. Franke [1]

SUMMARY OUTLINE

ARSENIC

Domestic and world output of white arsenic in 1940 exceeded all previous records. Production in the United States advanced 12 percent. Domestic producers sold more arsenic than ever before and received a price slightly above the low of 1939 as competition from European sources of supply diminished. Of the total arsenic consumed, imports comprised but 31 percent compared with 43 percent in 1939. Consumption dropped 7 percent, because farmers employed less calcium arsenate in destroying the cotton boll weevil and Government agencies used smaller quantities of arsenicals in their war on insect pests. White arsenic quotations rose from 3 to 3½ cents a pound.

Salient statistics for arsenic in the United States, 1925–29 (average) and 1937–40

	1925–29 (average)	1937	1938	1939	1940
WHITE ARSENIC					
Domestic sales: [1]					
Crude short tons	2,364	10,903	9,428	17,070	16,688
Refined do	10,035	6,733	3,732	5,369	6,651
Imports for consumption do	10,769	19,256	14,238	14,674	9,929
Apparent consumption [2] do	(3)	34,692	25,098	33,913	31,668
Average value for domestic sales: [1]					
Crude cents per pound	2.69	1.33	1.40	1.00	1.10
Refined do	3.57	1.86	1.73	1.42	1.47
OTHER ARSENICALS					
Imports for consumption:					
Metallic arsenic pounds	208,672	150,659	16,868	39,197	13,228
Sulfide (orpiment and realgar) do	575,506	502,418	241,602	656,498	220,445
Arsenic acid (H_3AsO_4) do	14,692	684	55	210	----------
Calcium arsenate do	1,452	796,243	400,000	1,627,193	432,785
Lead arsenate do	[4] 2,133	551	----------	11,557	----------
Sheep dip do	135,929	208,060	168,932	306,900	341,556
Paris green and london purple do	4,402	108,825	103,556	45,823	25,603
Sodium arsenate do	82,105	13,482	11,881	7,482	----------
Exports:					
Calcium arsenate do	[5] 2,159,168	5,383,365	5,242,882	6,731,103	4,879,391
Lead arsenate do	[5] 1,328,828	1,042,880	1,021,345	1,712,583	2,900,250

[1] Includes sales by domestic producers for export.
[2] Adjusted for exports by domestic producers.
[3] Complete data not available.
[4] 10,467 pounds in 1925 and 200 pounds in 1929; no imports from 1926 to 1928, inclusive.
[5] Average for 1928–29; exports of calcium arsenate and lead arsenate not separately recorded by Bureau of Foreign and Domestic Commerce prior to 1928.

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

PRODUCTION

Influenced by national defense demands for nonferrous metals in 1940, domestic smelters and refineries recovered and also sold more white arsenic than in any year in the history of the industry. White arsenic (As_2O_3) production increased 12 percent over the record 1939 output. As heretofore, the Anaconda Copper Mining Co., American Smelting & Refining Co., and United States Smelting Refining & Mining Co. recovered all of the domestic arsenious oxide as a byproduct, chiefly from complex copper, lead, and gold ores.

Crude and refined white arsenic produced and sold by producers in the United States, 1936–40

Year	Crude			Refined			Total		
	Production (short tons)	Sales		Production (short tons)	Sales		Production (short tons)	Sales	
		Short tons	Value [1]		Short tons	Value [1]		Short tons	Value [1]
1936	9,937	8,755	$266,113	5,442	6,826	$352,713	15,379	15,581	$618,826
1937	9,936	10,903	290,733	6,878	6,733	250,822	16,814	17,636	541,555
1938	12,619	9,428	264,004	4,066	3,732	129,018	16,685	13,160	393,022
1939	17,499	17,070	343,000	4,842	5,369	152,500	22,341	22,439	495,500
1940	18,241	16,688	365,700	6,742	6,651	195,600	24,983	23,339	561,300

[1] Partly estimated.

Production, as reported by the Bureau of Mines, is measured after the low-grade flue dusts containing 20 to 30 percent As_2O_3 are subjected to a roasting or preliminary refining process. This crude arsenic usually contains 97 to 98 percent As_2O_3. Most of the crude arsenic and a small quantity of better-grade arsenic obtained in certain parts of smelter flue systems are marketed without further refining. Some crude arsenic is refined further. Bureau of Mines statistics on refined arsenic include only products containing 99 percent or more As_2O_3. The arsenic reported as a refined product is not duplicated in the crude arsenic statistics.

Metallic arsenic, formerly imported from Germany, France, and Belgium, was produced in the United States for the first time in many years. The Anaconda Copper Mining Co. began production on a small scale at Anaconda, Mont., in March 1940, utilizing a process somewhat similar to that employed by Hoskins in 1920.[2] The metal was marketed during the year by Philipp Bros., Inc., 70 Pine Street, New York, N. Y., and was used chiefly as a flux, alloy, and metal hardener in lead, copper, brass, white bearing, and other metals.

Only in recent years has the United States produced artificial red and yellow arsenic sulfide (As_2S_2 and As_2S_3), which are used as depilatories in tanning, as pigments in paints, and in the manufacture of rubber, chemicals, and pyrotechnics. The Rare Metal Products Co., Belleville, N. J., now produces these arsenic sulfides, formerly imported from France, Belgium, and Germany.

[2] Jones, Chester H., Pure Metallic Arsenic: Chem. and Met. Eng., vol. 23, No. 20, November 17, 1920, pp. 957–960.

CONSUMPTION

Domestic white arsenic sold during 1940 not only rose 4 percent over that in 1939 but netted a better price per pound. Both advances are attributed to the great decline in imports and the less severe competition. Imports comprised only 31 percent of the consumption in 1940, compared with 43 and 57 percent in 1939 and 1938, respectively. Imports of arsenicals other than white arsenic also decreased (see details in table of salient statistics). Apparent domestic consumption of white arsenic (sales plus imports minus approximate exports) declined 7 percent and totaled only 31,668 short tons compared with 33,913 in 1939. Nevertheless, consumption ranked fourth highest in the history of the United States and was exceeded only by the greater use of arsenic during 1937, 1939, and 1936. Of the domestic arsenic sold, 72 percent was crude and only 28 percent refined. The distribution in sales of domestic arsenic in the United States in 1940 was approximately as follows: Insecticides, 68 percent; weed killer, 19; glass manufacture, 3; wood preservative, 2; and miscellaneous (including arsenical drugs), 1. Exports comprised 7 percent.

The principal arsenical insecticides are lead and calcium arsenate, sodium arsenite, paris green, and london purple. In 1939 the production of lead arsenate totaled 59,568,596 pounds (63,291,440 in 1937), of calcium arsenate 39,281,788 pounds (37,001,959 in 1937), and of paris green 2,040,307 pounds (1,834,340 in 1937).[3] Large stocks of arsenical insecticides, particularly calcium arsenate, were carried by manufacturers from 1939 over into 1940, as insect infestations were not serious during 1939. Demands for insecticides also were not heavy during 1940, as southern cotton fields were not greatly troubled with boll weevils, except in Texas and parts of the Gulf Coast States. Cotton-leaf worms were not abundant. Consumption of lead arsenate probably remained steady (at about 60,000,000 pounds) in 1940, as it was necessary to spray fruit and shade trees to exterminate codling and gypsy moths and to treat soil in the East to destroy the Japanese beetle grub. In August 1940 the Federal Security Agency accepted the recommendations of the United States Public Health Service and doubled the permissible tolerance of lead-arsenic spray residue on apples and pears. Nevertheless fruit growers must continue to wash their produce, inasmuch as the spray residue usually exceeds the new tolerances—0.025 grain of As_2O_3 and 0.05 grain of lead per pound of fruit. Although Federal and State agencies consumed larger quantities of arsenicals to fight Mormon crickets in the West and white-fringed beetles in the South, they used less insecticide in 1940 than in 1939 to kill grasshoppers in the western United States. The Department of Agriculture reports that in 1940 Federal and State agencies consumed 700,000 gallons of liquid sodium arsenite in grasshopper bait (550,000 gallons estimated for 1941), 105,000 pounds of dry sodium arsenite in combatting Mormon crickets (120,000 pounds estimated for 1941), and 718,000 pounds of calcium arsenate and 93,000 gallons of liquid sodium arsenite in destroying white-fringed beetles (410,000 pounds and 56,000 gallons estimated

[3] U. S. Department of Commerce, Census of Manufactures, 1939, Insecticides, Fungicides, and Related Industrial and Household Chemical Compounds (Prel. Rept.): Industry No. 933, December 23, 1940, 2 pp.

for 1941). Sodium fluosilicate, largely imported from Europe in the past, probably would replace much of the sodium arsenite now used by the agencies if more of it were available. Truck gardeners may be forced to employ larger quantities of arsenicals in 1941, inasmuch as the war has made difficult the importation of the rotenone-bearing root poisons grown in Asia and South America, which only recently were largely substituted for arsenic. The warm winter of 1940–41 and heavy early rains in Texas also can be expected to increase the cotton boll-weevil population of the South in 1941.

Manufacturers and distributors sold 13,371,490 doses of arsenical drugs for treatment of syphilis in 1940 compared with 12,390,837 in 1939.

The consumption of white arsenic in 1941 may be greater than in 1940, in view of prospective insect infestations and the efforts being made to produce as much food as possible to feed the British. Railroad and highway departments probably will decide to kill more weeds with sodium arsenite so that labor may be employed on more important jobs. The use of arsenic to manufacture chemical warfare materials may become necessary. It should be possible, however, to meet all civilian and defense arsenic requirements in 1941 from accumulated stocks and a slight increase in domestic byproduct arsenic production (though it was near capacity in 1940), plus imports from Mexico and Canada. Any great increase in demands would necessitate the construction of additional recovery plants to treat the abundant reserves of arsenic-bearing ore.

PRICES

Quotations on domestic white arsenic at New York rose in July 1940 from 3 to 3¼ cents and in November 1940 to 3½ cents a pound, packed in barrels, carlots. These price increases are attributed to the decline in European arsenic imports and the subsequent removal of cut-price competition, thereby permitting domestic prices to rise slightly from the previous low level. To meet competition from European sources on arsenic for domestic delivery, American producers had been obliged to accept offers substantially less than the nominal quoted price of 3 cents a pound. During 1940 the average selling value was only 1.10 cents a pound for crude and 1.47 cents for refined arsenic—an increase of only 10 and 4 percent, respectively, over the record low values of 1939. Minimum quotations during 1940 on calcium arsenate were reduced from 6¾ to 6 cents a pound and on lead arsenate from 10 to 8½ cents a pound as a result of the price war among manufacturers that developed in March. The minimum price, however, was raised ½ cent on calcium arsenate in May and on lead arsenate in November and December 1940. No official prices were quoted for arsenic metal throughout 1940, but the nominal price is reported at 75 cents a pound. The red arsenic quotations given are only for the period from January 29 to May 20, 1940.

The great rise in price for white arsenic in London in 1939 from £12 a long ton to £22 in October and £31 in December for Cornish brands declined and leveled off during 1940 as Swedish and Mexican arsenic at £29 to £30 and Cornish brands at £31 per long ton in January 1940 were largely replaced by American arsenic in February 1940, which sold during the year at £14 to £25 for crude and £20 to £30 a long ton for refined.

Range of quotations on arsenic and its compounds at New York (or delivered in East), 1939–40, in cents per pound [1]

	1939	1940
Arsenic metal, lump, cases	40.00–60.00	(2)
White arsenic (As_2O_3), domestic, kegs, carlots	3.00	3.00– 3.50
Red arsenic (As_2S_2), imported, cases	15.75–20.00	17.50–18.00
Calcium arsenate, wholesale, drums, carlots	6.75– 7.25	6.00– 7.25
Lead arsenate, wholesale, drums, carlots	10.00–11.50	8.50–11.00
Sodium arsenate, wholesale, drums	8.00	7.00– 8.00
Sodium arsenite, dry, works, drums, white	9.00–11.00	8.00– 8.75
Sodium arsenite, dry, works, drums, gray	7.50– 9.50	6.50– 7.50

[1] As reported by Oil, Paint, and Drug Reporter.
[2] Not quoted.

FOREIGN TRADE

The 32-percent drop in imports of white arsenic into the United States in 1940 is attributed to the diversion of Mexican supplies to the United Kingdom, South America, and Africa and to the curtailment of shipments from Europe because of the war. Imports of Mexican arsenic declined 7 percent. Of the 1940 imports, Mexico supplied 76 percent, France 17 percent, and Canada, Japan, and Sweden virtually all of the remaining 7 percent.

The table on salient statistics contains data on the foreign trade in arsenical compounds other than white arsenic. Arsenic metal imports (13,228 pounds—all from Belgium) declined 66 percent and arsenic sulfide imports (220,445 pounds—121,230 from France and 99,125 from Belgium) also declined 66 percent. Imports of calcium arsenate (chiefly from Japan) and of paris green and london purple (from France and the United Kingdom) dropped 73 and 44 percent, respectively, whereas shipments of sheep dip (from the United Kingdom) advanced 11 percent.

Official white arsenic export data are not available, but domestic producers report the shipment of only about 1,600 tons for export in 1940 compared with 3,200 tons in 1939. Calcium arsenate exports (4,879,391 pounds) declined 28 percent and went chiefly to Peru (3,702,300 pounds), Mexico (498,752), Colombia (130,000), Argentina (121,115), Venezuela (107,000), and Nicaragua (100,050). Exports of lead arsenate (2,900,250 pounds), however, increased 69 percent and went chiefly to Brazil (1,538,313 pounds), Argentina (420,012), the Union of South Africa (293,602), Chile (154,360), and Colombia (135,084).

White arsenic imported for consumption in the United States, 1936–40, by countries

Country	1936		1937		1938		1939		1940	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Australia	690	$30,500								
Belgium	1,000	30,433	708	$20,373	565	$16,100	323	$10,098	15	$1,152
Canada	378	25,908	599	48,896	689	29,854	471	24,760	339	18,016
France	44	1,419	828	18,838	1,176	30,843	2,200	50,224	1,654	25,799
Germany	23	2,213	7	663	112	5,656	(1)	4		
Japan	887	41,957	798	37,380	482	17,199	963	30,079	224	10,307
Mexico	8,174	426,590	11,500	556,097	8,422	415,180	8,124	377,568	7,520	393,413
Norway									1	187
Sweden	6,390	182,204	4,816	138,617	2,792	93,197	2,593	69,304	176	4,156
	17,586	741,224	19,256	820,864	14,238	608,029	14,674	562,037	9,929	453,030

[1] Less than 1 ton.

WORLD PRODUCTION AND CONSUMPTION

Capacity operation of nonferrous smelters is believed to have increased world production of marketable white arsenic from an estimated 58,000 metric tons in 1939 to 65,000 or more in 1940. Official data are available only for Brazil, Mexico, and the United States; these countries increased their output 53, 31, and 12 percent, respectively.

Brazil.—The St. John d'el Rey Mining Co. at Nova Lima, Minas Gerais, and the Companhia Minas da Passagem at Passagem, Minas Gerais, gold-mining companies, recover arsenic from arsenical pyrite tailings.

Italy.—During 1940 the S. A. Stabilimenti di Rumianca of Borgaro, Turin, largest Italian producer of white arsenic, began producing about 100 kilograms of metallic arsenic monthly at Pieve Vergonte (Novara). A new plant at Apuania, to begin operations late in 1941, is expected to produce 2,000 kilograms of metal monthly.

Mexico.—White arsenic export declarations in 1940 totaled 9,204 metric tons; 8,027 tons were consigned to the United States, 648 to the United Kingdom, 351 to the Union of South Africa, 150 to Argentina, and 28 to Cuba.

Portugal.—White arsenic was produced in 1940 at the newly reopened Pintor mine, which is owned by a sheep-dip firm locally known as "Cooper's." Imports of white arsenic totaled 24 metric tons and of arsenic acid 35 tons.

Sweden.—Unsubstantiated rumors report the movement of large quantities of white arsenic from Sweden to Germany. The Bolidens Gruv A.-B. is operating about 12 arsenic-impregnating timber plants in Sweden, in addition to some in Norway and Finland. A new process is employed whereby zinc and chromic arsenates are introduced into the wood to protect it against decay and insects.

U. S. S. R.—The plant recently built in the mountains of Svanetia, Caucasus, to recover white arsenic from a rich body of arsenic-bearing ore is expected to be expanded further.

United Kingdom.—Arsenic requirements are being met with the domestic output of Cornwall supplemented by imports from Mexico, the United States, Australia, Canada, and Portugal.

World production of white arsenic, 1936–40, by countries, in metric tons [1]

[Compiled by L. P. Lounsbery]

Country	1936	1937	1938	1939	1940
Australia:					
New South Wales	124			(2)	(2)
Western Australia	3,526	2,087	4,063	1,439	(2)
Belgium-Luxemburg Economic Union (exports)	2,731	3,039	2,706	3,332	(2)
Brazil	732	717	519	713	1,088
Canada	619	630	987	790	(2)
China	(3)	(3)	(2)	(2)	(2)
Chosen	230		(2)	(2)	(2)
France	9,750	6,501	(2)	(2)	(2)
Germany (exports)	2,739	2,852	2,845	(2)	(2)
Greece	85	234	77	113	(2)
Hungary		100	(2)	(2)	(2)
Italy			810	(2)	(2)
Japan	2,629	(2)	(2)	(2)	(2)
Mexico	8,527	10,762	8,894	7,063	9,268
Portugal	150	112	1	(2)	(2)
Rumania		6	3	(2)	(2)
Southern Rhodesia			19		(2)
Sweden (sales)[4]	8,647	(2)	(2)	(2)	(2)
United Kingdom	155	97	66	(2)	(2)
United States	13,952	15,253	15,136	20,267	22,664
	55,700	(2)	(2)	(2)	(2)

[1] Arsenic is also believed to be produced in Czechoslovakia, Peru, Turkey, and U. S. S. R. Production figures are not available for these countries.
[2] Data not available.
[3] Data not available. Estimate included in total.
[4] Arsenic content of ores mined is as follows: 1936, 23,312 tons; 1937, 20,954 tons; 1938, 21,480 tons; 1939 and 1940, data not available.

BISMUTH

Production of bismuth in the United States paced the increased smelter-refinery output of lead and copper during 1940. Although complete data are lacking, it is believed that domestic consumption remained about the same as in 1939. Consumers used stocks accumulated in 1939, and thus producers' stocks were enlarged by an output that was greater than sales. Exports were heavy early in 1940 but declined later in the year as shipments to many European countries were discontinued. New York prices remained at $1.25 a pound throughout 1940. Quotations on bismuth compounds also were unchanged.

World bismuth output probably advanced, but consumption is believed to have dropped slightly in 1940 as the European and Asiatic Wars cut off supply routes and thereby forced the employment of substitutes, expecially in important pharmaceutical applications.

PRODUCTION

In 1940 the American Smelting & Refining Co., Anaconda Copper Mining Co., and United States Smelting, Refining & Mining Co. substantially increased the domestic production of bismuth obtained as a byproduct in smelting lead and copper ores mined in and imported into the United States. The American Smelting & Refining Co. was assigned new patents for the recovery of bismuth from lead,[4] one of which involves the addition of organic compounds in the debismuthization of lead. Bunker Hill & Sullivan Mining & Concentrating Co. did

[4] U. S. Patents 2,205,387 and 2,213,197.

not produce any refined bismuth during the year in its new hydro-, pyro-, and electro-metallurgical plant for the treatment of complex silver ores. The Argenta Mining & Milling Co., Dillon, Mont., recovered 7,000 pounds of bismuth concentrates. As heretofore, the Cerro de Pasco Copper Corporation supplied the domestic market with considerable metal imported from Peru.

CONSUMPTION

Purchase of bismuth was heavy early in 1940, presumably because consumers feared a runaway market; but when it became evident that no price rise was imminent a slack period averaged up sales. Actual domestic consumption probably continued around the 500,000-pound mark in 1940 as consumers used up large stocks that had been accumulated in 1939 and early in 1940 in anticipation of a price increase similar to that which occurred in the World War of 1914–18. Bismuth used in alloys increased owing to business activity, whereas that consumed as salts in the manufacture of pharmaceuticals shrunk as the war restricted export trade and encouraged the use of substitutes.

The low-melting-point and nonshrinking bismuth alloys were used more widely during 1940 in such national defense industries as the manufacture of machine tools and dies, aircraft, alloys, and automobiles. For instance, "Cerrobend," a low-melting-point alloy of bismuth, lead, tin, and cadmium, was used extensively in bending thin-walled aluminum alloy aircraft oil and gas tubes. When molten bismuth alloy is poured into tubing, it reveals any holes that may be present, because the metal will squeeze out. As the filler metal solidifies during cooling, any weak seams in the tubing will split open because the bismuth alloy expands slightly in cooling from the liquid to the solid state. After bending, the alloy can be melted out of the tubing in a steam or boiling water bath and reused. Considerable progress was made during 1940 on experiments covering the use of bismuth alloys for centering machine-tool bearings and making spotting or fender die fixtures.

According to the Census of Manufactures, the production of bismuth subnitrate increased 39 percent from 1937 (262,867 pounds) to 1939 (365,522 pounds), the production of bismuth subgallate advanced 6 percent from 1937 (40,861 pounds) to 1939 (43,347 pounds), and the output of bismuth subcarbonate declined 2 percent from 1937 (247,609 pounds) to 1939 (241,817 pounds). The average value of these three leading bismuth compounds advanced 13, 95, and 15 percent, respectively; the increases were due in part to the 5-cent and later 15-cent rise in the price of bismuth during 1939. The various bismuth compounds, salts, and mixtures are utilized in indigestion remedies, antiacid compounds, ointments, salves, dusting powders, venereal disease doses, and other medicinal applications. Early in 1941, the Army and Navy began to make heavier purchases of bismuth pharmaceuticals.

PRICES

New York quotations for bismuth metal remained firm at $1.25 a pound, ton lots, throughout 1940, according to the Engineering and Mining Journal Metal and Mineral Markets. Consumers' fears of a runaway price market, similar to that which occurred in the World War of 1914–18, when bismuth was quoted as high as $4.00 a pound, did not develop during 1940 or early 1941. According to the Oil, Paint, and Drug Reporter, prices for bismuth compounds also were steady during 1940; bismuth subcarbonate was $1.73 a pound (fiber drums), subnitrate $1.48, subgallate $1.68, and subsalicylate $2.50 (where it had advanced early in the year).

FOREIGN TRADE

The quantity of bismuth metal imported in 1940 (all from Peru) declined 32 percent compared with that in 1939. Imports of compounds, mixtures, and salts of bismuth were virtually nonexistent as the customary shipments from Germany ceased. Imports not valued chiefly for lead in 1940 totaled 189,906 pounds (264,782 in 1939), of which 90,816 pounds (176,135 in 1939) comprised metals other than lead. This classification included shipments from Peru, the United Kingdom, and Germany (Belgium, Peru, and the United Kingdom in 1939). Of the 148,762 pounds from Peru (81,573 in 1939), only 66,704 were lead (36,300 in 1939); probably the remainder was chiefly bismuth.

Official data on the export of bismuth metal are not available, but it is reliably estimated that 1940 shipments totaled over 600,000 pounds. The bulk of the metal was shipped to the United Kingdom, the U. S. S. R., and France. The export of bismuth compounds and medicinals probably advanced because of larger markets in South America resulting from curtailment of supplies from Germany and other European countries. Effective July 2, 1941, bismuth was subject to export license.

Bismuth and "compounds, mixtures, and salts of bismuth" imported for consumption in the United States, 1936–40

Year	Bismuth		Compounds, mixtures, and salts of bismuth	
	Pounds	Value	Pounds	Value
1936	113,443	$86,722	564	$4,807
1937	67,225	54,007	3,145	9,117
1938	92,298	74,583	2,004	3,387
1939	182,832	154,339	297	649
1940	123,880	118,260	4	31

WORLD PRODUCTION AND CONSUMPTION

World production of bismuth in 1940 probably was in the neighborhood of 3,000,000 pounds, or more than ample to supply the demand. The United States, Peru, Canada, and Mexico continued to supply the bulk of the output, and Bolivia, Spain, Japan, China, Yugoslavia, Sweden, Argentina, Belgium, the U. S. S. R., Australia, France, the Union of South Africa, and Germany produced most of the remainder. Europe is the largest world consumer of bismuth and normally takes about 1,500,000 pounds annually. In 1940, Germany and Italy probably found it difficult to meet all demands as the British-influenced cartel refused to sell them bismuth and they probably had to depend on small importations from Japan and the U. S. S. R., plus the minor production of countries under their control.

North America.—Mexico produced 408,810 pounds of bismuth in 1940 (360,859 in 1939). Data are not available for Canada, where the metal is derived chiefly from the treatment of silver-lead ores by the Consolidated Mining & Smelting Co. at Trail, British Columbia, and of silver-cobalt ores by the Deloro Smelting & Refining Co., Ltd., at Deloro, Ontario.

South America.—The 1940 output of the Cerro de Pasco Copper Corporation in Peru, one of the largest producers of bismuth in the world, included 757,061 pounds of refined bismuth (886,320 in 1939) and 155,966 pounds of bismuth-lead bullion containing 86,562 pounds of bismuth (89,820 pounds of bullion with 71,620 pounds of bismuth in 1939). Exports from Peru comprised 760,434 pounds of refined bismuth in bars (848,182 in 1939), of which 574,791 pounds went to the United States, 185,230 to the United Kingdom, and 412 to Chile; and 86,562 pounds of bismuth in lead (171,385 in 1939), all to the United States. The Peruvian Government imposed an export tax on bismuth and its crude products in June 1940 which amounts to 5 percent ad valorem when the New York quotation on the metal does not exceed $1.00 a pound and to 10 percent when the quotation is above that. The Fabulosa Mines Consolidated, in Bolivia, increased its production of bismuth ore in the Carmen mine from 4,868 pounds in 1938 to 11,967 in 1939. Bolivian exports of bismuth in concentrates totaled 41,230 pounds in 1940 (28,660 in 1939).

Europe.—Since the war Germany and Italy have probably obtained small supplies of bismuth from Spain and Sweden. However, the fall of France in June 1940 is believed to have yielded the Axis Powers large stocks of the metal. Control over Yugoslavia early in 1941 gave Germany the Trepca lead mines and their byproduct bismuth output. Such export data as are available indicate that the United Kingdom probably imported substantial quantities of bismuth from Peru, Mexico, the United States, and Canada in 1940. Another new bismuth plant is reported to have begun operations in the U. S. S. R.—at Adrasinan, in Tadzhikistan.

Africa, Asia, and Australia.—In 1939 the Union of South Africa produced 4,398 pounds of bismuth ore containing 69 percent bismuth. A small quantity of bismuth was produced in China, and doubtless the bismuth-tungsten and tungsten-molybdenum mines in Queensland, Australia, continued to produce bismuth as a byproduct during 1940.

MAGNESIUM

By Herbert A. Franke and M. E. Trought

SUMMARY OUTLINE

Despite the fact that production of primary magnesium in 1940 was the largest in the history of the domestic industry, national defense requirements for the metal were so great that early in 1941 it became necessary to place it under a mandatory priority status. Production in 1940 exceeded the 1939 peak output by 87 percent. The Dow Chemical Co. again was the sole domestic producer, as has been the case since 1927. This company expects to more than double its 1940 output in 1941 by producing 30,000,000 pounds of magnesium, and its plants in Midland, Mich., and Freeport, Tex., are to be expanded further to produce at a rate of 52,500,000 pounds annually by early 1942. The chemical engineering division of the Todd-California Shipbuilding Corporation plans to commence production in August 1941 at its Permanente plant near San Jose, Calif., with the expectation that an annual rate of 24,000,000 pounds will be attained by 1942. A much greater expansion of domestic production through Government-financed facilities is contemplated.

Apparent consumption of magnesium in 1940 rose 73 and 310 percent above that in 1939 and 1938, respectively. A much larger increase was prevented by the limited supply of metal available. The extraordinary growth in demand is attributed to the requirements of the aircraft industry for structural materials of high strength and low weight characteristics and of the munitions industry for pyrotechnic materials. Although larger quantities of magnesium-rich alloys now are used per airplane, aluminum-base alloys continue to comprise by far its major structural weight. These aluminum alloys, however, contain small percentages of magnesium and represent a substantial quantity of the lighter metal. Of the magnesium actually consumed by industry in the United States during 1940, 64 percent was used in the manufacture of magnesium-rich alloy structural products, 32 percent in aluminum, zinc, and other alloys, and 4 percent as a scavenger and deoxidizer in metallurgical works and in pyrotechnic, chemical, and other uses. The fabrication of magnesium-alloy structural products rose 132 percent and of magnesium nonstructural products 50 percent. Of the structural products sold or used, the aircraft industry took 75 percent; the automotive industry 10 percent; the portable machine, equipment, and tool industries 6 percent; and the textile, foundry equipment, and other industries 9 percent.

Salient statistics of the magnesium industry in the United States, 1938–40

	1938	1939	1940
Production of primary magnesium pounds	6,433,390	6,700,122	12,521,726
Quoted price per pound[1] cents	30.0	27.0	27.0
Imports pounds	60	76	
Exports do	[2]2,100,000	[2]4,200,000	1,718,444
World production (estimated) short tons	27,200	34,200	44,000

[1] Lowest nominal price (New York) for primary metal ingot 99.8 percent pure, carlots.
[2] Estimated.

There were no imports of magnesium in 1940, and exports declined 59 percent compared with those estimated for 1939. The nominal quoted price for the metal at New York remained unchanged at 27 cents a pound throughout the year.

World production of magnesium in 1940 is believed to have increased about 29 percent. Although most of the metal was used in the construction of military airplanes, a substantial quantity also was employed in the manufacture of incendiary bombs, flares, and other munitions.

PRODUCTION

Primary magnesium.—Production of primary magnesium in the United States totaled 12,521,726 pounds in 1940 compared with 6,700,122 and 6,433,390 pounds in 1939 and 1938, respectively. The Dow Chemical Co.—the only domestic producer—recovered all the metal from brine containing 3.2 percent $MgCl_2$ (0.8 percent magnesium), pumped from underground wells near Midland, Mich. Here the bromine and the sodium and calcium salts first are removed by evaporation, filtration, and fractional crystallization; chlorine is added during the process. The purified magnesium chloride solution remaining is concentrated further by crystallization, and the $MgCl_2 \cdot 6H_2O$ thus formed is partly dried. Molten magnesium chloride with some added sodium chloride then is electrolyzed in rectangular cast-steel cells. Production at Midland was doubled in February 1940, when capacity was increased to 13,000,000 pounds a year. In April 1941 capacity again was enlarged, this time to 15,500,000 pounds.

A new plant at Freeport, Tex., with an unlimited supply of raw materials began to produce in January 1941 and probably will attain its originally rated annual capacity of 13,000,000 pounds in May 1941. With the expansion program under way this plant should reach a production rate of 19,000,000 pounds in September 1941 and 37,000,000 pounds early in 1942, giving Dow a total magnesium-producing capacity of 52,500,000 pounds. The last 18,000,000-pound addition is being constructed for Dow operation at a cost of about $8,000,000 by the Defense Plant Corporation, a Reconstruction Finance Corporation subsidiary. At Freeport, magnesium is recovered from sea water containing 0.48 percent $MgCl_2$ (0.12 percent magnesium). Milk of lime, obtained by adding water to calcined oyster shells, precipitates magnesium hydroxide (milk of magnesia) from sea water. The magnesium hydroxide is thickened, filtered, and treated with hydrochloric acid to produce magnesium chloride, which is made nearly anhydrous and electrolyzed by the same method employed at Midland. In addition to magnesium, Dow produces caustic soda, ethylene dibromide, and ethylene glycol at Freeport.

In February 1941 the Reconstruction Finance Corporation approved a loan of $9,250,000 to the chemical engineering division of the Todd-California Shipbuilding Corporation for the construction of magnesium producing and fabricating facilities at Permanente (near San Jose), Calif., the cost of which will total about $11,500,000. The company was immediately advanced $3,500,000, and erection of an 8,000,000-pound production unit was begun in March 1941 which the company expects will be in operation beginning August 1941. Capacity ultimately will be increased to 24,000,000 pounds or more a year. Magnesite and brucite occurring near Luning, Nev., will be calcined and the magnesium oxide treated by the relatively new Hansgirg direct electrothermal reduction process. The company also plans to employ magnesium oxide recovered from sea water by the Westvaco Chlorine Products Corporation near Newark, Calif. Reduction with carbon will take place in an electric arc furnace at about 2,000° C. The resultant metal vapor will be chilled suddenly and condensed at about 200° C. in natural gas instead of hydrogen which was formerly used in Austria where the process was developed.

Early in 1941, several other well-established chemical, metallurgical, and mining companies were considering domestic production of magnesium, using various raw materials [1] and processes.[2]

On January 30, 1941, the United States, through the Department of Justice, indicted the Aluminum Co. of America, American Magnesium Corporation, Magnesium Development Corporation, Dow Chemical Co., I. G. Farbenindustrie A. G., and the General Aniline & Film Co. for violating the antitrust laws and hampering the defense program. It charged the first four American firms with retarding and stifling production by pooling patents, maintaining high prices, limiting consumers to one domestic source of supply, and making unlawful agreements pertaining to foreign sales and output in the United States. The case probably will be tried in the fall of 1941 in the District Court of the United States for the Southern District of New York. In answer to the charges, the American Magnesium Corporation stated that patents have not restricted the domestic fabrication of magnesium metal into armaments for national defense or industrial purposes. The firm also stated that its affiliate, the Magnesium Development Corporation, formed in 1931 by the I. G. Farbenindustrie A. G. and the Aluminum Co. of America as a magnesium patent-holding company, does not restrict its licenses to any responsible and competent concern. The Dow Chemical Co. reports that its magnesium production process does not depend on foreign patents but admits that it has procured licensing rights on some fabricating methods that it has made available to industry without royalty.[3]

Secondary magnesium.—Substantial quantities of new and old magnesium scrap (chiefly the former) were consumed during 1940. The new scrap essentially is primary metal circulating in the consuming industry and has already been recorded as primary metal. Old scrap consumed in 1940 totaled 557,000 pounds, which is equivalent to 507,000 pounds of magnesium if one assumes that it consisted chiefly of alloy averaging 91 percent magnesium. Only one concern operates a secondary magnesium remelting plant exclusively on scrap. Most scrap is utilized by foundries manufacturing magnesium alloy sand castings from primary metal as well as scrap.

CONSUMPTION

In 1939 and 1940, after years of research and education, the aircraft, textile, portable tool and equipment, automotive, and other industries became more firmly convinced of the advantages of the light weight and high strength, machinability, and chemical and physical characteristics of magnesium-alloy products and consequently increased consumption of these alloys. In 1940, the huge Army, Navy, and

[1] Franke, Herbert A., Magnesium: Its Production and Use: Chem. and Met. Eng., vol. 48, No. 3, March 1941, pp. 75-77.
[2] Pannell, Ernest V., How Europe Produces Its Magnesium: Chem. and Met. Eng., vol. 48, No. 1, January 1941, pp. 78-81.
[3] Grant, L. B., Magnesium: Metals and Alloys, vol. 12, No. 6, December 1940, pp. 762-763.

British aircraft-construction program was set in motion, and demand soon overtook the supply of metal. Late in the fall of 1940 the aircraft industry was demanding virtually all of the magnesium produced, which discouraged the other newly developed commercial uses. Sales projects involving months of negotiation, designing, discussions, and testing had to be shelved, which adversely affected manufacturers of textiles, shoes, carpets, rubber goods, foundry equipment, optical apparatus, business machines, motor trucks, photoengravers' etching plates,[4] and other commodities.[5] Airplane makers meanwhile specified magnesium products for such new applications as oil tanks, baggage floors, landing-wheel dust covers, wheel fairings, conduit fittings, ventilating ducts, partitions, seat and instrument panels, carburetor bodies, and other parts, which involved the production of more sand and die castings, extrusions, and sheet.

Apparent domestic consumption of primary magnesium in 1940 increased 73 percent over the previous peak reached in 1939.

Production, sales, imports, exports, and apparent consumption of primary magnesium, in the United States 1938–40, in pounds

Year	Production	Sales	Imports	Exports	Apparent consumption[1]
1938	6,433,390	4,819,617	[2] 60	[3] 2,100,000	2,719,700
1939	6,700,122	10,650,121	[2] 76	[3] 4,200,000	6,450,200
1940	12,521,726	12,823,633	----------	[4] 1,668,765	11,154,868

[1] Does not consider fluctuations in consumers' stocks and metal derived from scrap. Withdrawals from producers' stocks totaled 3,949,999 pounds in 1939 and 301,907 pounds in 1940; additions to producers' stocks totaled 1,613,773 pounds in 1938.
[2] Includes alloys and scrap (magnesium content).
[3] Estimated.
[4] Of the 1,718,444 pounds of metal exported, 49,679 pounds consisted of magnesium alloy.

In addition to the 11,154,868 pounds of primary magnesium ingot and stick delivered by the producer to domestic industry in 1940, consumers withdrew 68,632 pounds of metal from stocks, making a total of 11,223,500 pounds of primary metal actually entering domestic consumption during the year. Of this, approximately 7,363,000 pounds were used directly in making magnesium-rich alloys or in sweetening such alloys in remelting operations in fabricating plants; 3,215,000 pounds were used directly in aluminum-rich alloys; 357,000 pounds in wire, ribbon, powder, shavings, and sawdust; and 288,500 pounds for other purposes.

Magnesium-rich alloys are used chiefly in the manufacture of structural products, such as castings, extruded shapes, and sheet. Some alloy, largely scrap, is used in making aluminum and other alloys, chemicals, and as a scavenger and deoxidizer. Wire, ribbon, powder, shavings, and sawdust are intermediate products, which eventually are consumed in the pyrotechnic, chemical, metallurgical, and other industries. Because of the complexity of intercompany sales of alloy ingot, scrap, and intermediate products, it is difficult to show statistically the flow of primary magnesium into the final products of manufacture. Moreover, in the process of manufacture primary metal merges with old scrap returning from use. In 1940, 507,000 pounds of magnesium contained in old scrap were consumed

[4] Wood, Robert T., Magnesium Alloys for Photoengraving: Metals and Alloys, vol. 11, No. 2, February 1940, pp. 33–41.
[5] Mathes, John C., Magnesium Alloys in Industry: Metals and Alloys, vol. 13, No. 1, January 1941, pp. 23–29.

by industry, making a total of 11,730,500 pounds of primary and secondary metal entering consumption during the year, of which actual returns received from 157 consumers accounted for 11,531,000 pounds. This metal was used as follows:

Actual consumption of primary and secondary magnesium in 1940, by uses, in pounds

Use	Quantity	Use	Quantity
Structural products [1]	7,363,200	Pyrotechnics	43,500
Aluminum alloys	3,556,500	Chemicals	70,200
Zinc alloys	68,000	Other	50,400
Other alloys	17,600		
Scavenger and deoxidizer	361,600	Total	11,531,000

[1] Castings, sheet, extruded shapes, forgings, etc.

From 7,363,200 pounds of magnesium used in the manufacture of structural products, 5,383,670 pounds emerged in finished items. As magnesium oxidizes readily at temperatures above the melting point, the remaining 1,979,530 pounds (or 27 percent) of the metal consumed by this industry were lost or burned in the manufacturing process while molten. The gross weight of finished structural products was 5,916,120 pounds, of which 5,475,530 pounds were sold or used.

Structural magnesium alloy and nonstructural magnesium products manufactured and sold in 1940 rose 125 percent over those in 1939. Sales of structural products increased 132 percent and of nonstructural products 50 percent. Of the structural products sold or used, sand and permanent mold castings (chiefly the former) comprised 73 percent, die castings 13 percent, extruded products 7 percent, sheet 6 percent, and forgings and other structural products 1 percent. The value of sand and permanent-mold castings in 1940 averaged $1.85 a pound; die castings, $0.93 a pound; and all castings, $1.71 a pound (compared with $1.31 in 1939). The increase in values is attributed to the greater production of more complicated aircraft parts.

Magnesium products (other than ingot and stick magnesium [1]) manufactured in the United States and sold or used by the companies manufacturing the products, 1938–40

Product	1938		1939		1940	
	Pounds	Value	Pounds	Value	Pounds	Value
Structural products:						
Castings:						
Sand and permanent mold	1,067,310	$1,392,882	1,321,080	$2,030,175	3,973,757	$7,345,050
Die			525,372	385,770	699,212	653,289
Sheet	124,930	79,764	180,896	116,287	322,664	246,476
Structural shapes, rods, tubing (extrusions)	80,206	49,972	308,443	185,746	410,912	349,123
Forgings	5,924	6,541	17,065	26,925	25,938	34,602
Other structural			3,404	2,553	43,047	134,251
Total structural products	1,278,370	1,529,159	2,356,260	2,747,456	5,475,530	8,762,791
Nonstructural products:						
Powder, shavings, wire, ribbon, and sawdust	184,223	259,256	232,244	228,129	349,429	410,859
Total nonstructural products	184,223	259,256	232,244	228,129	349,429	410,859
Grand total	1,462,593	1,788,415	2,588,504	2,975,585	5,824,959	9,173,650

[1] 435,483 pounds of stick manufactured and sold or used in 1940.

The number of fabricators of magnesium products increased from 22 in 1939 to 30 in 1940. In addition to the manufacturers mentioned in Minerals Yearbook, 1939 (pp. 708–709) and 1940 (p. 721), the following companies produced magnesium products in 1940: Aluminum Industries, Inc., 2438 Beekman Street, Cincinnati, Ohio; Carnes Artificial Limb Co., 904 East 12th Street, Kansas City, Mo.; General Electric Co., Schenectady, N. Y.; Hines Flask Co., 1324 Hird Avenue, Cleveland, Ohio; Lestershire Spool & Mfg. Co., Johnson City, N. Y.; Los Angeles Die Casting Co., 240–246 Crocker Street, Los Angeles, Calif.; Permold Co., 6700 Grant Avenue, Cleveland, Ohio; Port Huron Brass Foundry Co., Port Huron, Mich.; and Superior Bearing Bronze Co., 42–43 10th Street, Long Island City, N. Y.

The American Magnesium Corporation, which has been in the magnesium business since 1917 and is the largest producer of magnesium products, began tripling its fabricating capacity in the fall of 1940. At that time most of its plants were operating on a three-shift-a-day, full-capacity basis. Plants are situated at Cleveland, Ohio (sand, die, and permanent mold castings, forgings, powder, wire, ribbon, etc.); Buffalo, N. Y. (capacity for 225,000 pounds of sand castings monthly); Los Angeles, Calif. (sand castings); Garwood, N. J. (capacity for 30,000 pounds of die castings monthly); New Kensington, Pa. (extrusions and capacity for 10,000 pounds of sheet monthly); Edgewater, N. J. (pressings); and Bridgeport, Conn. (sand castings). Operations were first started at the Buffalo foundry in July 1940, at the New Kensington sheet mill in March 1940, and at Garwood in August 1940, but operations at Bridgeport will not begin until about September 1941. On February 6, 1941, the Aluminum Co. of America purchased the other half interest in the American Magnesium Corporation that had been owned by the General Aniline & Film Corporation and announced further expansion in the operations, which have already been increased to 20 times the normal peacetime demands experienced by the company in 1938. A sit-down, slow-up strike threatened company operations in Cleveland for a short time in April 1941. The Dow Chemical Co. also expanded fabricating facilities in 1940; it completed a $500,000 sheet-rolling mill at Midland, Mich., and early in 1941 began to construct a $1,000,000 addition to the new castings foundry at Bay City, Mich. In the spring of 1941 the Ford Motor Co. completed a new sand-casting foundry of 110,000 pounds monthly capacity to manufacture parts for Pratt & Whitney aircraft engines.[6] The use of magnesium in Ford automobiles and tractors was discontinued for the duration of the magnesium shortage. Other established companies that greatly extended their magnesium-fabricating facilities include the Wright Aeronautical Corporation, Fairlawn, N. J.; Eclipse Aviation Division of the Bendix Aviation Corporation,[7] Bendix, N. J.; Bohn Aluminum & Brass Corporation, Detroit, Mich., and its subsidiary, Magnesium Fabricators, Adrian, Mich.; Wellman Bronze & Aluminum Co., Cleveland, Ohio; Springfield Bronze & Aluminum Co., Springfield, Mass.; Harvill Aircraft Die-Casting Corporation, Los Angeles, Calif.; and Doehler Die Casting Co., Batavia, N. Y.

Aircraft manufacturers took 75 percent of the magnesium-alloy products made in the United States during 1940. Producers of air-

[6] Iron Age, Ford Describes New Magnesium Foundry: Vol. 147, No. 2, January 9, 1941, p. 75.
[7] Ward, Robert E., Manufacturing Nonferrous Sand Castings for Aircraft: Foundry, Vol. 69, No. 5, May 1941, pp. 81–83, 175–176.

plane engines (and propellers) purchased 64 percent of the products made for this industry, airplane-wheel manufacturers 19 percent, and airframe makers 17 percent. Magnesium alloys crowded aluminum alloys to a small extent in the structural aircraft field because of their excellent strength-weight ratio, easy machinability, and welding properties. The wider use of magnesium-alloy castings in engines and of various structural products in secondary airframe structures gradually was extended to more important parts of the landing-gear and control systems.[8] The service record and weight saving of magnesium-alloy wheels of large land planes have been so satisfactory that over 75 percent of the commercial and military planes now under construction are so equipped. The very low weight of American aircraft engines per horsepower is attributed to the use of magnesium-alloy products. Work is proceeding on a fuselage using plastics molded over magnesium-alloy reinforcements, and full-size wing panels of the metal are being tested. It is evident that the demand for magnesium not only has been spurred onward by the 518-percent increase in military-airplane output (from a monthly average of 178 in 1939 to about 1,100 in March 1941) but also by the greater quantity of magnesium-alloy products used per plane.

The automotive industry was the second largest consumer of magnesium-alloy products in 1940, taking 10 percent of the total sales. Products sold or used in the portable machine, equipment, and tool industries comprised 6 percent, textile industry 3 percent, foundry equipment industry 2 percent, stationary machinery industry 1 percent, and all other industries 3 percent.

Stocks of the cruder forms of magnesium on hand at producers' and consumers' plants on December 31, 1940, totaled 620,242 pounds of pure magnesium (ingot, stick, powder, etc.) and 1,746,011 pounds of original and secondary magnesium alloy (ingot and scrap), with a total magnesium content of 2,209,100 pounds, compared with 924,791 pounds of pure magnesium and 1,334,170 pounds of alloy, with a total magnesium content of 2,138,900 pounds, on December 31, 1939. The increase in structural magnesium alloy product fabricating capacity and the subsequent enlargement of working stocks is attributable to the 31-percent advance in stocks of magnesium alloy.

NATIONAL DEFENSE AND PRIORITIES

Magnesium, formerly listed as a critical material by the Army and Navy Munitions Board, was the second metal upon which formal mandatory priorities were invoked. Although there are abundant domestic supplies of magnesium-bearing raw materials, extraction of the metal therefrom is difficult and involves intricate processes. Before the present emergency, Army and Navy authorities considered magnesium important from a military standpoint chiefly in its pyrotechnic application in tracer bullets, flares, star shells, etc. Today, however, the metal has assumed unprecedented importance in the national defense program because of its use in airplanes and engines and for incendiary bombs.

In the summer of 1940 there was a slight shortage in the supply of magnesium; but during the fall months, as aircraft-production in-

[8] Mathes, John C., Magnesium Alloys in the Aircraft Industry: Jour. Soc. Automotive Eng. (Trans.), vol. 48, No. 2, February 1941, pp. 76-80.
Woldman, Norman E., Magnesium in Aircraft: Metals and Alloys, vol. 12, No. 4, October 1940, pp. 430-435.

creased and more metal was specified per plane, the shortage became more critical. Although a number of domestic concerns became interested in production of the metal late in 1940 the only assured expansion is that of the Dow Chemical Co. and the Todd-California Shipbuilding Corporation, previously mentioned.

On February 12, 1941, E. R. Stettinius, Jr., Director of the Priorities Division of the Office of Production Management, requested producers of magnesium and magnesium products to allocate all metal to defense needs. The Dow Chemical Co. then asked that orders for metal be accompanied by a certification that the material was to be used to meet current defense requirements. On March 3, 1941, the Priorities Division removed magnesium from a preferential allocation status and placed it under mandatory priorities, subject to the controls imposed February 24, 1941, on producers of aluminum and machine tools. Magnesium producers and fabricators subsequently were required to submit monthly a complete booking of orders for the ensuing month. The Division obtains from the Scheduling Unit, Wright Field, Dayton, Ohio, monthly data on the requirements of the military aircraft program and then allots the Unit the larger portion of the metal output for distribution to manufacturers of airplane parts. The Division allocates the remaining magnesium to other uses—for pyrotechnics in ordnance, as an alloying constituent in aluminum and zinc, for British export, and for important civilian requirements. On March 26, 1941, the Priorities Division made available 200 short tons of magnesium for export to Great Britain and stipulated that British defense orders receive the same priority treatment as United States defense orders.

It appears that unless domestic production of magnesium is sharply increased, virtually all of the metal will continue to be consumed by defense industries whose 1941 requirements are expected to be much greater than the supply.

PRICES

The nominal New York price for 99.8-percent ingot magnesium, carlots, remained unchanged at 27 cents a pound throughout 1940. Quotations for less than carlots, 100 pounds or more, were 29 cents a pound. Extruded sticks, carlots, were quoted at 34 cents a pound; for less than carlots of 100 pounds or more, 36 cents a pound. Alloy ingot normally is quoted at 3 cents a pound more than pure magnesium ingot. London magnesium ingot quotations remained at 1s. 6d. to 1s. 7d. a pound during the year.

FOREIGN TRADE

Official export statistics on magnesium were not separately reported prior to September 1939. It is estimated, however, that exports totaled approximately 4,200,000 pounds in 1939 and 2,100,000 pounds in 1938. Export data compiled by the Bureau of Foreign and Domestic Commerce show that during the period from September to December 1939, inclusive, the United States shipped 979,936 pounds of magnesium valued at $274,382, of which 642,431 pounds were sent to France and 147,605 to the United Kingdom. In 1940 exports totaled 1,718,444 pounds valued at $582,961, of which 546,437 pounds were shipped to the United Kingdom, 478,472 to France, 244,772 to Mexico, 213,195 to Sweden, 147,062 to Canada, and 49,846 to Italy. During the first quarter of 1941 the United States shipped 299,785 pounds of metal valued at $112,110, of which 180,870 pounds were sent to the United Kingdom, 95,897 to Canada, and 20,000 to Mexico. On July 5, 1940, magnesium was placed under export control. No magnesium has been imported since 1939, when 66 pounds of metal and scrap valued at $24 and 10 pounds of alloy valued at $25 were received from Germany.

TECHNOLOGIC DEVELOPMENTS

Numerous United States patents were granted in 1940 on the production of magnesium, and other new and undisclosed production methods were under investigation by various organizations. Of the two basic processes, the electrolytic chloride continues to be the method most widely used in the production of metal, although direct electrothermic oxide reduction is receiving increasing attention.

According to Pidgeon and Phillips, anhydrous magnesium chloride can be satisfactorily produced by passing chlorine through a porous, granular mixture of MgO and C at temperatures between 800° and 1,000° C.[9] Reducing agents recommended in the thermal processes include calcium carbide, aluminum, carbon, and ferrosilicon. The Blackwell-Turner (British) direct thermal recovery process employs a high-frequency induction furnace with a ferrosilicon or calcium carbide reducing agent, wherein the resultant magnesium vapor is condensed on a cooling dome that covers the furnace.[10]

The Metallurgical Division of the Bureau of Mines completed its laboratory-size magnesium pilot plant at Pullman, Wash., in March 1941. Magnesia is to be reduced here with carbon by the direct electrothermal process and a spray of oil employed to shock-cool the resultant metal vapor.[11]

Technologic improvements were made in 1940 on the fabrication of magnesium-alloy products;[12] on new alloy compositions, especially those of high strength and improved chemical stability; on surface treatments;[13] on basic design factors relative to structural airplane subassemblies; in the art of permanent molding; and in the technique of spot and arc welding,[14] riveting, and general assembly practices.[15] The Guerin stamping process, using rubber as the forming medium and heated steel dies, is employed to fabricate airplane parts from sheet made of magnesium alloyed with 1.2 percent manganese. Tests indicate that substantial savings in weight and costs are effected by using magnesium-alloy sheet in monocoque airplane construction.[16]

[9] Pidgeon, L. M., and Phillips, N. W. F., The Production of Anhydrous Magnesium Chloride: Trans. Electrochem. Soc., vol. 78, 1940, pp. 91-115.

[10] Pannell, Ernest V., Work cited in footnote 2.

[11] Dean, R. S., Progress Reports—Metallurgical Division, 42. Annual Report of the Metallurgical Division, Fiscal Year 1940: Bureau of Mines Rept. of Investigations 3547, 1941, pp. 65-68.

[12] Ward, Robert E., Manufacturing Nonferrous Sand Castings for Aircraft: Foundry, vol. 69, No. 5, May 1941, pp. 80-83, 175-176.

Brooks, M. E., and Winston, A. W., Magnesium Foundry Practice: Ann. Convention, American Foundrymen's Assoc., May 1941, 24 pp.

Chase, Herbert, Cold Chamber Die Casting: Iron Age, vol. 146, No. 22, November 28, 1940, pp. 31-34; Die Castings in Magnesium Alloy: Metals and Alloys, February 1941, vol. 13, No. 2, pp. 145-150.

Mathes, John C., Recent Developments in Magnesium Alloys: Jour. Aeronautical Sci., vol. 8, No. 1, November 1940, pp. 24-31.

[13] Schmidt, H. W., Gross, W. H., and De Long, H. K., The Surface Treatment of Magnesium Alloys: 22d Ann. Convention, Am. Soc. Metals, Cleveland, October 1940, 29 pp.

[14] Iron Age, Welding Magnesium Alloy Sheets: Vol. 145, No. 3, January 18, 1940, pp. 48-49.

[15] Beck, Adolf, The Technology of Magnesium and Its Alloy (trans. in English from the German): London, 1940, 512 pp.

American Machinist, The Working of Magnesium Alloys: Vol. 85, No. 9, May 1, 1940, pp. 291-302.

[16] Conlon, E. W., Magnesium for Aircraft Construction: Jour. Aeronautical Soc., vol. 7, No. 6, April 1940, pp. 252-255; Conlon, E. W., and Meeker, D. P., Magnesium Alloy Research: Air Corps Technical Report 4530, May 1940, 39 pp.

The incendiary bombs used in the European War weigh about 2 pounds and consist of a case or shell of magnesium alloy filled with a thermite mixture of granulated aluminum, iron oxide, and sometimes a little magnesium powder. The impact detonator ignites the thermite, which burns at 3,000° C. and in turn ignites the magnesium shell casing, which burns at 1,300° C.;[17] both flames are practically impossible to extinguish, yet they burn so quietly that a serious fire may be started before measures are taken to control it. A large bomber can carry 1,000 to 2,000 of these light bombs.

WORLD PRODUCTION

Although official data are lacking, there is no doubt that world production and consumption of magnesium metal rose to new high points in 1940. The meager information available indicates the following general trend in world production of magnesium in recent years.

Estimated world production of magnesium, 1937–40, by countries, in metric tons

Country	1937	1938	1939	1940
France	1,500	1,800	2,500	2,000
Germany	12,080	14,100	16,500	19,000
Italy	66	102	300	500
Japan	1,200	1,500	2,000	4,000
Switzerland	230	300	700	700
U. S. S. R.	700	1,000	1,000	1,500
United Kingdom	2,000	3,000	5,000	6,500
United States	[1] 2,059	2,918	3,039	5,680
Total	19,800	24,700	31,000	39,900

[1] Sales.

Canada.—Experiments by the National Research Laboratories indicate that brucite granules are the most suitable domestic raw material for the production of magnesium by the electrolysis of fused chloride but that dolomite probably is better when a ferrosilicon reducing agent is used in a distillation method.[18]

Germany.—In spite of stocks being accumulated in 1938 and 1939, German production of magnesium is estimated to have increased to a total between 16,000 and 19,000 metric tons in 1940. A decree dated December 9, 1940, prolonged State control on the establishment and expansion of magnesium plants until the end of 1945. The pilot plant at Radenthein, Kaernten, Austria, which used the Hansgirg direct electrothermal reduction process and magnesite as raw material, had a hydrogen explosion in August 1939, and the works were abandoned temporarily for lack of construction steel.

Italy.—Early in 1940 the Società Anonima Italiana per il Magnesio e le Leghe di Magnesio started producing magnesium at Bolzano, and by early fall output reached 1 ton of metal daily.

United Kingdom.—Magnesium Elektron, Ltd., and Magnesium Metal & Alloys, Ltd., produce most of the British output of metal. Domestic dolomite and sea water have replaced imported magnesite as the chief raw materials. Distribution and fabrication of magnesium are controlled by the Minister of Aircraft Production.

[17] British Library of Information, Incendiary Bombs and Fire Precautions: Air Raid Precautions Handbook 9, London, 1940, 60 pp.; Tiffany, J. E., Extinguishing Fires Set by Incendiary Bombs: Paper presented at Annual Meeting of New York Association of Fire Chiefs, Utica, N. Y., May 1941, 31 pp.

[18] Goudge, M. F., Magnesia from Canadian Brucite: Canadian Min. and Met. Bull. 341, September 1940, pp. 481–505.

ANTIMONY AND CADMIUM

By T. H. Miller and T. P. Wootton [1]

SUMMARY OUTLINE

ANTIMONY

The antimony industry was unusually stable from late in 1939 throughout 1940, in spite of numerous events of importance to world trade in the metal. The German conquest of western Europe in the early months of the year further dislocated international trade; Japanese occupation of eastern China prevented shipments via normal trade routes, and for the fifth consecutive year Chinese exports declined. The curtailment of Chinese shipments was largely offset by marked increases in production from Bolivia and Mexico. World production is estimated to have been 10 to 12 percent above that of 1939. or about 35,000 metric tons.

The New York price for American brands was maintained at 14.00 cents a pound compared with an average price of 12.36 cents in 1939 and 12.35 cents in 1938. The price for Chinese metal was stable at 16.50 cents, duty paid, compared with 14.44 cents in 1939 and 14.59 cents in 1938.

Domestic production of ore and concentrate declined sharply, but metal contained rose about one-fourth. The antimony content of antimonial lead produced from all classes of domestic ores increased 106 percent over the 1939 figure and was the largest recorded since 1929. The total production from all raw materials—scrap and domestic and foreign ores—increased nearly 45 percent and was the largest since 1930. Primary metal available for consumption increased 55 percent but did not quite equal the record set in 1937. Stocks of metallic antimony, as reported to the Bureau of Mines by six producers, increased from 734 tons at the end of 1939 to 1,024 on December 31, 1940.

The Laredo and Los Angeles smelters again reported substantial increases in production; and, for the first time, the new Kellogg plant

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

of Bunker Hill & Sullivan Mining & Concentrating Co. reported production and the Texas smelter reported metal recovered from domestic ores. The new Bunker Hill plant operates on tetrahedrite from silver ore of the Coeur d'Alene district, Idaho. Antimony and bismuth are recovered as byproducts.

A new book [2] gives a brief résumé of the metallurgy of 24 metals, including antimony and cadmium.

Figure 1 shows trends in world production from 1910 to 1938 and United States imports and prices from 1910 to 1940.

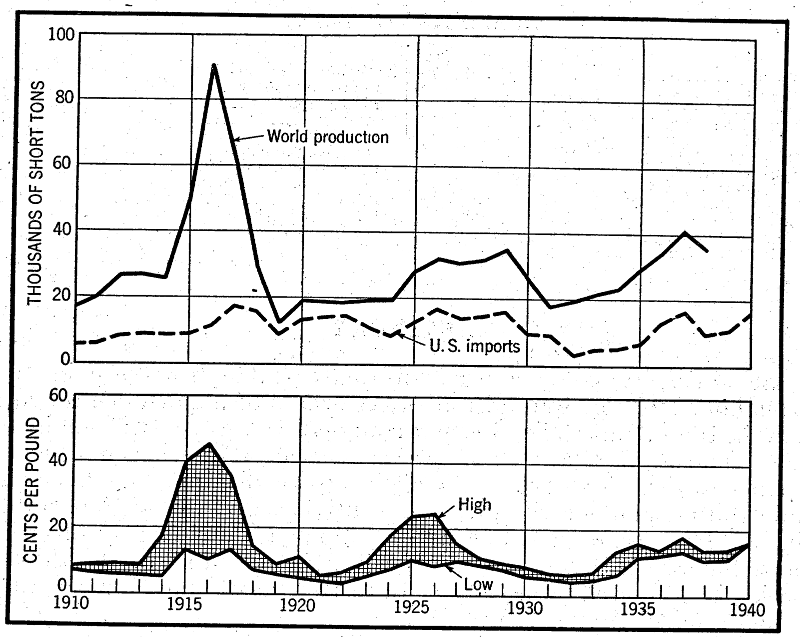

FIGURE 1.—Trends in world production, 1910–38, and United States imports and New York price of antimony, 1910–40.

Salient statistics for antimony in the United States, 1936–40

	1936	1937	1938	1939	1940
Production of antimony ore and concentrates......short tons..	3,867	4,250	2,730	3,174	1,124
Antimony contained........do....	755	1,266	650	393	494
Antimony content of antimonial lead produced from domestic and foreign ores........short tons..	1,471	1,726	2,080	1,108	2,077
Secondary antimony produced........do....	9,900	12,340	8,500	9,810	11,421
Imports for consumption:					
Antimony in ore........do....	10,545	13,818	8,322	9,448	15,733
Needle or liquated antimony........do....	1,185	772	90	228	113
Metal........do....	1,171	1,043	821	1,045	209
Oxide........do....	1,201	1,118	414	167	....
Exports of foreign antimony........do....	392	437	711	58	276
Primary antimony available for consumption........do....	15,040	18,132	11,557	11,609	17,955
Stocks of antimony in bonded warehouse at end of year short tons..	443	656	345	685	3,417
Average price of antimony at New York: [1]					
Chinese........cents per pound..	12.97	15.30	14.59	14.44	16.50
American........do....	12.25	15.35	12.35	12.36	14.00
World production........short tons..	38,900	42,100	35,600	(2)	(2)

[1] According to American Metal Market.
[2] Figures not yet available.

[2] Bray, John L., Nonferrous Production Metallurgy: John Wiley & Sons, New York, 1941, 430 pp.

National defense.—The general national defense aspects of antimony were discussed in detail in Minerals Yearbook, 1939. The metal is still classified as a strategic raw material by the Army and Navy Munitions Board. The United States Department of the Interior continued its investigation of deposits and issued reports on antimony ore in Inyo County, Calif., and Valley County, Idaho.

Presidential Proclamation No. 2413 of July 2, 1940, effective July 5, 1940, listed various articles and materials to be exported only when authorized by license provisions contained in the proclamation. Mineral commodities covered by the proclamation included antimony ores, concentrates, metal, alloys in crude and semifabricated form, and antimony compounds.

The Strategic Materials Act (Public, No. 117—76th Congress, 1939) and a subsequent act (Public, No. 664—76th Congress, June 25, 1940) authorized the Reconstruction Finance Corporation to acquire stocks of strategic and critical materials for use in the national defense program. On June 28, 1940, the Metals Reserve Co. was created for this purpose. Purchases of metallic antimony were included in the program, and at the end of April 1941 the company had received 6,796 tons of Chinese and 250 tons of domestic antimony. There remained on order 2,750 tons of domestic metal and an undisclosed amount of Chinese material, included, with wolframite and tin, in the recent $90,000,000 loan to China. Domestic antimony was purchased from the Texas Mining & Smelting Co., produced at Laredo, Tex., from ore mined in Mexico. Deliveries are to be made at the rate of 250 tons a month until the 3,000-ton contract is completed.

DOMESTIC PRODUCTION

MINE OUTPUT

Antimony produced in the United States from domestic ores is derived from antimony, lead, and gold mines. Byproduct antimonial drosses obtained in lead refining are used in the manufacture of antimonial lead, other alloys, and chemical compounds, such as oxides and sulfides. The 1940 production of antimonial lead at primary lead refineries from domestic ores contained 1,915 tons of antimony—an increase from 929 tons in 1939.

Domestic ores and concentrates produced in 1940 contained 494 tons of recoverable antimony (25 percent greater than in 1939), although the output of ore and concentrates declined from 3,174 to 1,124 tons. Thirty-nine producers shipped ore containing 1 ton or more of antimony from 5 States and Alaska as follows: 2 each in Arizona and Montana, 11 in California, 3 in Idaho, 20 in Nevada, and 1 in Alaska, where Morris P. Kirk & Son, Inc., continued to be the only producer. The Yellow Pine district, Valley County, Idaho, and the Kantishna district, Alaska, were the outstanding producing areas.

Alaska.—The Stampede mine in the Kantishna district, owned by Morris P. Kirk & Son, Inc., ran at full capacity throughout the summer months and produced about 40 percent more ore than in 1939. The ore was treated in a small mill erected in 1939, and the concentrates were shipped to the company plant in Los Angeles, Calif. The ore and concentrates are hauled by tractor-drawn sleds during the winter months to the railroad at Lignite, from where it is reshipped to the States by rail and water. Antimony minerals have long been known to occur on Stampede Creek, but no systematic attempt at commercial exploitation was made until 1936, when Kirk began operations. The ore occurs as a lode in schist and is found principally in a large lens of nearly pure stibnite containing only minor amounts of gold or silver. The mine is developed by a vertical shaft, an adit, and surface trenches. Ore formerly was beneficiated by hand-sorting until it contained 50 to 55 percent antimony.

Arizona.—A small amount of ore containing about 23 percent antimony was produced from the Tip-Top and Walker districts, Yavapai County. The Tip-Top deposit was discovered during the year, and the ore is reported to contain some gold and silver.

California.—Most of California's production came from Kern County, but two small shipments were also made from Inyo and San Bernardino Counties. The Inyo County deposits were described in a report [3] issued in connection with the strategic minerals investigations being conducted jointly by the Bureau of Mines and the Geological Survey, United States Department of the Interior. The author's abstract is quoted in full:

> The antimony deposits of the Wildrose Canyon area, Inyo County, Calif., are in chlorite schist and amphibolite of probable pre-Cambrian age. All but two of the large deposits lie within a small area of close folds, striking about north-northeast, near Antimony Ridge on the south side of the canyon and were deposited in zones of fracture and shearing along the limbs and crests of the anticlines. Fracturing favorable to the reception of the ores is commonest in the amphibolite—a tough rock competent to hold open spaces.
>
> The antimony minerals of the deposits are stibnite and several oxides. The chief gangue mineral is quartz, which encloses fragments of country rock; gypsum is rather common, and fluorite is rather abundant in one deposit. It is believed that the stibnite and associated primary minerals were deposited at low temperature and shallow depth in Tertiary or Quaternary time. They are probably not directly related in origin to the dikes of aplite and pegmatite, the only igneous rocks exposed in the region, though like these dikes, they may have come from a magmatic source.
>
> The reserves are estimated to be about 50,000 tons of ore, containing 1½ to 5 percent of antimony. They may be somewhat greater, but they can hardly be much greater unless the ore goes deeper than now appears probable. A price for antimony of 20 to 30 cents a pound would be required to assure a profit on the mining of most of this ore.

Idaho.—As in the past, most of Idaho's production came from the Yellow Pine district, Valley County. Production of the Bradley Mining Co. was negligible, but the United Mercury Mines Co. produced ore containing more than 100 tons of metallic antimony. The Bureau of Mines and the Geological Survey continued their investigations under the Strategic Materials Act, and a formal report [4] was issued late in the year. White's abstract is quoted herewith:

> The area described in this report lies in the northeastern part of the Yellow Pine district, Valley County, in central Idaho. It has produced much gold and little else in the past, but it has a special interest at present because it contains what is probably the largest reserve of antimony in the United States.
>
> The ores, as ores of antimony, are in general of low grade. Stibnite, the only antimony mineral present, occurs partly in veins and veinlets and partly disseminated throughout wide shear zones in quartz-monzonite of the Idaho batholith. The main shear zone, which strikes northeastward, may be an offshoot of

[3] White, Donald E., Antimony Deposits of the Wildrose Canyon Area, Inyo County, Calif.: Geol. Survey Bull. 922-K, 1940, pp. 307-325.

[4] White, Donald E., Antimony Deposits of a Part of the Yellow Pine District, Valley County, Idaho: Geol. Survey Bull. 922-I, 1940, pp. 247-279.

the north-striking Monday fault. Both the shear zone and the fault are in quartz-monzonite and are probably related to the nearby contact of the monzonite with a huge roof pendant of metamorphosed sedimentary rocks.

Two periods of mineralization are represented in the area, the first by pyrite, arsenopyrite, and gold; the second by antimony and silver. The two periods are believed to have been genetically related and to have occurred in Tertiary time. Mineralization in even the earlier period is thought to have taken place at relatively shallow depth. The temperature was high during the early stages but decreased considerably while the ore minerals were being introduced.

The principal mine of the area is the Yellow Pine mine. The Meadow Creek mine also contains possible reserves. The main workings of the Yellow Pine mine are two quarries, one on each side of the East Fork of the South Fork of the Salmon River. The ore in the eastern quarry will be referred to as the East ore body, that in the western quarry as the West ore body, though the two may be continuous under the stream. The mine is owned by the Bradley Mining Co. That company is mining at present only in the East ore body, which is rich enough in gold to be profitably worked but contains only a negligible amount of antimony. The West ore body contains a much higher proportion of antimony, as well as some gold and silver, but it was not being mined in late 1939 because the net value of the ore at the current price of antimony was considerably less than that of the ore in the East body.

Some mining may soon be done in the West body because of a temporary emergency. The recovery of gold from ore of the East body is unsatisfactory, and to increase the percentage of recovery a cyanide plant will probably be built. It may then be deemed expedient to suspend mining in the East body until the cyanide plant is put in operation and to keep the miners busy meanwhile in the West quarry. But long-continued mining of the West ore body will not be worth the owners' while unless the ore can be made to yield at least as high a profit as that of the East ore body.

This condition might be brought about through a rise in the contract price paid by the smelter for antimony; the price of 3.75 cents a pound paid in 1939 for the antimony contained in the concentrates would have to be raised to about 7 cents. The West ore body might also be made profitable by building a plant for electrolytic separation of antimony. Such a project is not likely to be attempted unless an open-market price of 12 cents a pound could be assured for several years. Under either of the two conditions stated the largest possible production would probably be between 1,200 and 1,600 tons of antimony. Greater production might follow a price high enough to warrant expansion of the plants at mine and mill. It is not easy to predict how high a price would be necessary to encourage greater production, but it might be about 10 cents a pound for antimony containedi n concentrates, or the equivalent price of 15 cents a pound for metallic antimony. Assured stability of price, however, be it said again, would be essential.

The easily minable reserves in the West ore body are estimated to be at least 193,000 tons of ore, containing 7,620 tons of recoverable antimony. About 2,625,000 tons more, estimated to contain 18,350 tons of recoverable antimony, may lie between the creek level and a depth 200 feet lower; but this estimate is more doubtful than the preceding, especially with respect to grade. It appears likely that a large additional tonnage may lie in ground either outside or beneath that now known to be productive that could be explored at low cost. The amount of antimony ultimately mined must of course depend on the prices obtainable for it.

Montana.—Two operators shipped ore containing an estimated total of 23 tons of antimony from the Burns district, Sanders County. This is the first recorded production of antimony from Montana deposits since the last war, when several carloads were shipped from this same area.

Nevada.—Several shipments of ore containing a total of 157 tons of metal were reported from Elko, Lander, Nye, Pershing, and White Pine Counties in 1940. Extensive prospecting and sampling were carried on in several other districts and in some old mines.

Oregon.—Some prospecting was done on deposits in Baker and Jackson Counties, but no production was recorded.

SMELTER OUTPUT

In 1940, primary antimony for shipment to others was produced from foreign and domestic ores at three plants in the United States: Bunker Hill & Sullivan Mining & Concentrating Co., Kellogg, Idaho; Menardi Metals Co., El Segundo, near Los Angeles, Calif.; and Texas Mining & Smelting Co., Laredo, Tex. In addition, metallic antimony was produced by the American Smelting & Refining Co. but was converted into other products such as antimonial lead and was not sold as metallic antimony.

A new unit costing approximately one-half million dollars was added to the Bunker Hill smelter at Kellogg to produce metallic antimony by the Lee-Muir process from the tetrahedrite ores of the Coeur d'Alene district. A test run was made at the plant March 1, 1940, and operations were begun soon thereafter.

At the Menardi plant,[5] the concentrates are slowly calcined at a closely regulated temperature with a limited amount of air. The mercury passes out of the furnace with the gases, and the antimony remains behind in the sinter; 1,000 pounds of sinter are mixed with 200 pounds of cast-iron borings, 175 pounds of silica, 100 pounds of mill scale, and 150 pounds of soda ash and charged to a 5- by 16-foot reverberatory furnace. Metal, matte, and slag are drawn together into 400-pound pots and allowed to cool. The resulting button of metal is easily separated from the matte and slag. About 1.5 percent of the antimony is lost in the slag and about 3.5 percent in the matte. Iron and arsenic are removed from the crude metal as it goes through a sweating furnace, four small reverberatories, and a tilting starring furnace. Oxides recovered from the flues, baghouse, and spray tower are reduced with charcoal and crude oil and the resulting pigs refined in the furnaces mentioned above. Pigs average 42 to 43 pounds each and are sold in three grades: C Brand, 99.0 percent antimony; M Brand, 99.5 percent; and M Special, 99.8 percent. All grades have the "stars" characteristic of the trade.

Imports of antimony ore in 1940 amounted to 37,966 tons containing 15,733 tons of antimony. Of this total, 9 smelters received 32,354 tons of ore containing 13,071 tons of antimony or 83 percent of the total antimony. Receipts exceeded consumption at these plants, and stocks of antimony ore increased 30 percent. In addition, 9 firms that treat chiefly scrap lead reported imports of 2,176 tons of antimony ore containing 1,055 tons of antimony. Data for the 18 firms are summarized in the table below.

Consumption and stocks of foreign antimony ore by 18 companies during 1940, in short tons

	Foreign antimony ore			Foreign antimony ore	
	Gross weight	Antimony content		Gross weight	Antimony content
Stocks on Dec. 31, 1939	7,775	3,388	Consumed during 1940	31,982	13,421
Received during 1940	34,530	14,126	Stocks on Dec. 31, 1940	10,323	4,093

[5] Menardi, H. B., Reduction of Livingstonite Concentrate: Am. Inst. Min. and Met. Eng. Tech. Pub. 1042, February 1939, 8 pp.

Production of antimonial lead at primary lead refineries is shown in the accompanying table. The figures cover only part of the total antimonial lead production, as large quantities are produced at plants that operate exclusively on scrap, and some hard lead is made by mixing antimony and soft lead.

Antimonial lead produced at primary lead refineries, 1936–40, in short tons

Year	Production	Antimony content				
		From domestic ores	From foreign ores [1]	From scrap	Total	
					Quantity	Percent
1936	23, 230	1, 434	37	691	2, 162	9. 3
1937	27, 524	1, 636	90	853	2, 579	9. 4
1938	24, 123	1, 871	209	729	2, 809	11. 6
1939	21, 995	929	179	923	2, 031	9. 2
1940	29, 762	1, 915	162	867	2, 944	9. 9

[1] Includes lead ores, antimony ores, and metallic antimony.

SECONDARY PRODUCTION

A large part of the total antimony available for consumption each year in the United States is recovered in the treatment of secondary nonferrous metals. The production of antimony from secondary metals in 1940 totaled 11,421 tons—a 16-percent increase from the 9,810 tons produced in 1939. Primary antimony available for consumption in the United States in 1940 totaled 17,955 tons. Total antimony available was thus 29,376 tons, including 61 percent primary and 39 percent secondary; similar percentages for 1939 were 54 and 46, respectively.

Most of the secondary antimony is recovered from old scrap returning from worn-out and obsolescent equipment. In 1940, old scrap yielded 11,176 tons of antimony and new scrap 245 tons. Lead-base alloys, chiefly antimonial lead, supplied 97 percent of the total secondary antimony recovered in 1940; most of the remainder came from tin-base scrap. Discarded storage batteries are the largest single source of secondary antimony. In 1940, plants treating secondary metals reported the consumption at 165,387 tons of battery lead plates yielding 5,954 tons of recoverable antimony or 52 percent of the total secondary antimony produced. Babbitt of all types, including Mixed Common, No. 1, and Genuine, yielded 2,387 tons of antimony, and 1,968 tons came from type metals and drosses. The remainder of the secondary antimony in 1940 came from hard lead (yielding 837 tons of antimony), cable lead (241 tons), No. 1 pewter (19 tons), and lead sludge (15 tons).

Most of the plants treating scrap metals containing antimony also consume other antimony materials, such as antimony ore or metallic antimony. These materials are used to adjust or "sweeten" the antimony content of the products. Refined metallic antimony is rarely produced from scrap metals, as most of the output is in the form of lead-base and tin-base alloys. Much of the production is in the form of antimonial lead returned directly to the storage-battery trade. Antimony oxide, sodium antimonate, and other compounds are also produced from scrap metals.

DOMESTIC CONSUMPTION

Precise data on the consumption of primary antimony in the United States are not available owing to lack of information on dealer and consumer stocks and on the quantity of domestic antimony recovered in alloys other than antimonial lead and in compounds; however, an approximate idea of the trend of consumption can be obtained from the following table, which shows the annual supply available for consumption.

Primary antimony available for consumption in the United States, 1936–40, in short tons [1]

	1936	1937	1938	1939	1940
Domestic antimony recovered in antimonial lead	1,434	1,636	1,871	929	1,915
Imports for consumption (antimony content):					
Antimony ore	10,545	13,818	8,322	9,448	15,733
Needle or liquated [2]	830	540	63	160	79
Compounds [3]	975	909	336	138	4
Type metal, etc	309	410	355	121	191
Regulus	1,171	1,043	821	1,045	209
Total available	15,264	18,356	11,768	11,841	18,131
Exports under draw-back	224	224	211	232	176
Available for consumption	15,040	18,132	11,557	11,609	17,955

[1] Excludes domestic antimony recovered as miscellaneous alloys, oxides, and other compounds.
[2] Content estimated at 70 percent.
[3] Content estimated at 80 percent.

Primary antimony available for consumption in 1940 increased 55 percent over the figure for 1939, both imports of ore and domestic production having increased markedly. According to the American Bureau of Metal Statistics, 115,600 tons of antimonial lead were used in manufacturing storage batteries during the year compared with 106,500 tons in 1939 and 92,000 in 1938. This battery metal contains 4 to 12 percent antimony, largely from scrap, although a substantial quantity of new metal is added to "sweeten" the alloy.

An important use of antimony is in white-base antifriction bearing metals. Shipments of this material produced for sale and for plant consumption in 1940, according to the Bureau of the Census, totaled 12,822 tons compared with 11,785 tons in 1939 and 8,259 in 1938. These figures are taken from reports submitted by 39 manufacturers in 1938 and 1939 and 38 manufacturers in 1940, who represent approximately 84 percent of the total industry.

The use of antimony in making chemicals continued to grow in 1940, as the production of oxides and other compounds increased 33 percent to 10,211 short tons containing approximately 8,223 tons of metal. Figures on the production of compounds in the 4 preceding years, with the estimated antimony content in parentheses, are as follows: 1939, 7,668 tons (6,188); 1938, 4,393 tons (3,539); 1937, 6,992 tons (5,667); and 1936, 4,852 tons (3,940). Nearly all of this material was made from foreign ores. Oxide is the most important compound. It is used extensively in paints and sanitary enamelware. Hansen [6] has commented interestingly on the substitution of zircon for antimony in certain enamels:

[6] Hansen, J. E., New Porcelain Enamels Use No Antimony, Have High Quality: Steel, vol. 108, No. 1, January 6, 1941, p. 249.

* * * New zircon-type enamels containing no antimony develop high reflectance values and assure us of high-quality white enamels in the event that supplies of antimony compounds are restricted. Such restrictions might possibly be invoked since antimony is listed as a strategic material by the War Department. These new zircon-type enamels are being used by a large number of enameling plants.

The following companies reported production of oxide and other salts in 1940:

American Smelting & Refining Co	120 Broadway, New York, N. Y.
Harshaw Chemical Co	Elyria, Ohio.
John D. Lewis, Inc	Mansfield, Mass.
McGean Chemical Co	Cleveland, Ohio.
Menardi Metals Co	Los Angeles, Calif.
Metal & Thermit Corporation	120 Broadway, New York, N. Y.
Texas Mining & Smelting Co	Laredo, Tex.

In a recent paper,[7] Bissell stated that plated stamped-steel or antimonial lead die castings containing 8 to 13 percent antimony will appear on practically all 1942 model automobiles. He stated further:

Antimonial lead die castings cost about 25 percent more per part than zinc-alloy die castings. The former costs about 25 percent less per pound but has a specific weight more than 50 percent higher. Although its tensile strength is only about one-third that of zinc alloy, engineers who plan to use it as a substitute material contend that its strength is adequate for the unstressed decorative parts for which it is to be used. An important advantage of their use is that the antimonial lead die castings can be made from the same dies used previously for zinc. On the other hand, antimonial lead die castings must be made with care in buildings which are separated from plants in which zinc alloys are being cast; otherwise the lead may get into the zinc and spoil it. Antimonial lead also is difficult to polish. Radiator ornaments, trim strips on fenders, lamp bodies, and other ornamental strips are also slated to be made of antimonial lead die castings on some cars when zinc is not longer obtainable. Furthermore, antimonial lead die castings can be made with steel reinforcements in them in parts where additional strength is required.

According to Bissell, in case of a shortage of antimony for these antimonial lead die castings, they can be replaced by parts of plated stamped steel or by plastics. He also points out that before such substitutions become necessary the zinc situation may be relieved to such an extent that the zinc-alloy die castings as originally designed can be used.

The substitution of calcium for antimony in certain products has been proposed.[8] Metallurgists claim that an alloy containing 0.1 percent calcium can be substituted satisfactorily for the storage-battery grids now made of an alloy containing 10 percent antimony. The Bell Telephone Co.'s technical staff states that an alloy containing 0.04 percent calcium is more satisfactory for cable sheathing than the present material, which contains about 1 percent antimony.

FOREIGN TRADE

The following tables show imports and exports of antimony and antimony products.

[7] Bissell, Thomas A., Designing for Alternate Materials: Soc. Automotive Eng. Preprint (mimeographed), June 1941, 20 pp.
[8] Mining and Contracting Review, vol. 42, No. 7, April 15, 1940, p. 11.
Society of Automotive Engineers Journal, vol. 48, No. 6, June 1941, p. 208.

Antimony imported for consumption in the United States, 1936–40

Year	Antimony ore			Needle or liquated antimony		Antimony metal		Antimony oxides and other compounds	
	Short tons	Antimony content		Short tons	Value	Short tons	Value	Short tons	Value
		Short tons	Value						
1936	30,486	10,545	$1,200,132	1,185	$139,784	1,171	$243,474	1,219	$217,505
1937	42,453	13,818	1,775,011	772	101,963	1,043	228,485	1,136	249,152
1938	19,811	8,322	1,095,497	90	12,016	821	155,420	420	94,400
1939	21,000	9,448	1,132,359	228	30,102	1,045	196,812	173	29,786
1940	37,966	15,733	2,027,612	113	19,464	209	50,048	5	1,851

Antimony imported for consumption in the United States, 1939–40, by countries

Country	Antimony ore			Antimony metal	
	Gross weight (short tons)	Antimony content		Short tons	Value
		Short tons	Value		
1939					
Argentina[1]	332	218	$21,700		
Belgium				191	$35,954
Bolivia[1]	3,926	2,454	371,099		
China				661	117,072
France				56	10,566
Mexico	16,036	6,346	676,471	125	29,915
Peru	706	430	63,089		
United Kingdom				12	3,305
	21,000	9,448	1,132,359	1,045	196,812
1940					
Argentina[1]	56	31	5,876		
Belgium				7	2,276
Bolivia[1]	9,250	5,547	860,813		
China				194	45,126
Colombia	13	7	615		
Honduras	10	5	1,671		
Mexico	27,525	9,545	1,065,296		
Peru	1,112	598	93,341	2	488
United Kingdom				6	2,158
	37,966	15,733	2,027,612	209	50,048

[1] Imports credited to Argentina originate largely in Bolivia.

Estimated antimony content in type metal, antimonial lead, and other alloys imported for consumption in the United States, 1936–40, in short tons[1]

Year	Type metal and antimonial lead	Other alloys[2]	Total	Year	Type metal and antimonial lead	Other alloys[2]	Total
1936	[3] 56	253	309	1939	59	62	121
1937	[3] 17	393	410	1940	191		191
1938	[3] 59	296	355				

[1] For details of gross weight and values, see imports shown in Lead chapter of this volume.
[2] Chiefly in special antimony-lead alloys containing high percentage of antimony.
[3] Type metal only.

Foreign antimony (regulus or metal) exported from the United States, 1936–40

Year	Short tons	Value	Year	Short tons	Value
1936	392	$56,308	1939	58	$16,736
1937	437	86,991	1940	276	75,440
1938	711	96,836			

As in other recent years, imports of antimony ore in 1940 came principally from Mexico and Bolivia. Imports from Bolivia more than doubled in 1940, and receipts from Mexico were the highest on record, except for 1937, when 34,736 short tons were imported.

In addition to the exports of foreign metal reported in the last table above, 176 tons were exported in finished products under the draw-back provisions of the tariff law; draw-back exports were 232 tons in 1939 and 211 in 1938. Stocks of antimony in bonded warehouses on December 31, 1940, totaled 3,417 tons compared with 685 at the end of 1939—an increase of 400 percent. This increase is due largely to stocks being acquired by the Metals Reserve Co.

PRICES

On September 25, 1939, domestic brands of metallic antimony were quoted at 14.00 cents a pound in New York. This price remained unchanged during the remainder of 1939 and throughout all of 1940 and was still quoted in June 1941. Similarly, the price of Chinese metal, duty paid, at New York was quoted at 16.50 cents a pound on October 27, 1939, and this price also had not been changed by June 1941. These prices compare with an average of 12.36 cents for American brands and 14.44 cents for Chinese brands in 1939. Very little Chinese metal was available in 1940.

Average monthly quoted prices of antimony, prompt delivery at New York, 1936–40, in cents per pound

Month	Chinese brands (duty paid)[1]					American brands[2]			
	1936	1937	1938	1939	1940	1937	1938	1939	1940
January	12.96	14.14	15.56	14.00	16.50	14.14	13.75	11.68	14.00
February	13.05	14.69	15.74	14.00	16.50	14.55	13.75	11.25	14.00
March	13.42	16.92	15.75	14.00	16.50	16.37	13.75	11.27	14.00
April	13.50	16.79	15.65	14.00	16.50	16.02	13.65	11.50	14.00
May	13.50	14.79	14.46	14.00	16.50	14.79	12.46	11.70	14.00
June	13.20	14.70	13.94	14.00	16.50	14.70	11.73	12.00	14.00
July	13.00	14.79	14.00	14.00	16.50	14.81	11.02	12.00	14.00
August	12.57	15.53	14.00	14.00	16.50	15.34	10.88	12.00	14.00
September	12.50	(3)	14.00	14.00	16.50	16.59	11.32	12.87	14.00
October	12.50	(3)	14.00	14.24	16.50	16.92	12.06	14.00	14.00
November	12.50	15.91	14.00	16.50	16.50	15.87	12.25	14.00	14.00
December	12.93	14.69	14.00	16.50	16.50	14.12	11.56	14.00	14.00
Average	12.97	15.30	14.59	14.44	16.50	15.35	12.35	12.36	14.00

[1] Metal Statistics, 1940, p. 529, except for 1940, which was taken from daily issues of American Metal Market.
[2] Metal Statistics, 1941, p. 537.
[3] No average, owing to lack of offerings during greater part of month.

The price of English regulus (minimum of 99 percent antimony) was £87½ a long ton from November 1, 1939, through January 1940. On February 1 the price rose to £92½, and on May 1 it reached £98. There was a slight increase to £98–99 during July and August, but on September 1 it was reduced to £90, where it remained the balance of the year. On December 31, the quotation was further reduced to £85. Foreign regulus (spot deliveries from warehouse, duty paid) was quoted at £87½ during January but rose to £95 February 1. A further increase to £98 was effective May 1, and it fluctuated near that figure throughout August. On September 1 the price dropped to £91, thence to £90, where it remained the remainder of the year.

Quotations for antimony ore on January 4, 1940, according to Engineering and Mining Journal Metal and Mineral Markets, were as follows: "Per (short-ton) unit of antimony contained, 50 to 55 percent, $1.50 @ $1.60; 58 to 60 percent, $1.60 @ $1.70; 60 to 65 percent, $1.80 @ $1.90. London, 60 to 65 percent, 10s. 6d. per long-ton unit." By mid-March, quotations had risen to $1.70 @ $1.75 for the lower-grade ore, $1.75 @ $1.85 for intermediate-grade, and $2.00 @ $2.20 for higher-grade at New York and 12s. 6d. for higher-grade in London. During the remainder of the year, prices generally declined, and on December 12 quotations were $1.25 @ $1.35 for 50- to 55-percent ore, $1.40 @ $1.50 for 58- to 60-percent, and $1.50 @ $1.60 for 60- to 65-percent in New York and 9s. 3d. for the higher-grade ore in London.

WORLD PRODUCTION

Data on world production in 1939 and 1940 are very incomplete, since the nations at war will not release their figures. However, data from countries that supplied 89 percent of the total recorded world production in 1938 indicate a decline of about 1 percent in 1939. Similarly, statistics from countries that produced 77 percent of the total in 1938 indicate a 12-percent increase over that year in total world production during 1940. Production from Bolivia and Mexico increased and again exceeded that of China. Bolivia produced (exported) approximately 30 percent, China 15 percent, and Mexico 31 percent of the world total during 1940. The United States produced about 1 percent.

World production of antimony, 1936–40, by countries, in metric tons [1]

[Compiled by L. P. Lounsbery]

Country	1936	1937	1938	1939	1940
North America:					
Canada		[2] 18	34	[3] 550	(4)
Honduras	1				(4)
Mexico [5]	6,719	9,788	7,391	7,243	11,286
United States	630	1,056	542	328	412
South America:					
Argentina		31	174	97	(4)
Bolivia [6]	6,040	6,556	8,682	9,255	10,813
Peru	696	848	963	775	835
Europe:					
Czechoslovakia	829	997	[3] 800	(4)	(4)
Germany (Austria)	100	200	145	(4)	(4)
Greece	159			1	(4)
Italy	402	414	740	(4)	(4)
Portugal	20	49	131	(4)	(4)
Yugoslavia	1,301	1,447	2,739	3,337	(4)
Asia:					
Borneo, British	30	4		14	(4)
Burma	82	28	84	(4)	(4)
China [7]	16,348	14,702	7,797	6,497	5,493
Chosen	14	8	(4)	(4)	(4)
India, British			11	(4)	(4)
Indochina	38	5	83	19	9
Japan	110	(4)	(4)	(4)	(4)
Turkey (Asia Minor)	457	536	398	460	(4)
Africa:					
Algeria	983	778	744	(4)	(4)
Morocco:					
French	88	20	125	(4)	(4)
Spanish	12	158	93	(4)	(4)
Southern Rhodesia	68	64	63	50	(4)
Union of South Africa	15		10	6	22
Oceania:					
Australia:					
New South Wales	45	70	70	(4)	(4)
Queensland	4	(8)	7		(4)
Victoria	94	145	195	100	(4)
Western Australia		[3] 245	196	124	(4)
New Zealand			1		(4)
	35,300	38,200	32,200	(4)	(4)

[1] Approximate recoverable metal content of ore produced exclusive of antimonial lead ores. 80 percent of reported gross content is used as a basis of calculations for all countries except Bolivia, Mexico, Peru, and the United States, where 92 percent is used.
[2] Recoverable metal content of concentrates exported. [3] Estimated.
[4] Data not available.
[5] Includes antimony content of antimonial lead.
[6] Exports.
[7] Figures represent antimony content of regulus, crude antimony, and oxide exported.
[8] 442 kilos.

REVIEW BY COUNTRIES

Argentina.—The most recent available information on the antimony industry in Argentina appears in the July 1940 issue of Foreign Minerals Quarterly, published by the Bureau of Mines. The section on antimony is quoted in full:

The output of antimony ore in 1937 was 18 tons, in 1938, 383 tons, and in 1939, 210 tons. Most of this production comes from the Pabellon mine at 14,500 feet altitude in the Cerro Granadas, in the Department of Rinconada, Province of Jujuy.

The deposit at Pabellon is a vein crosscutting the schist country rock and developed by adits over a length of 300 feet, with an easterly strike and 25° dip to the north. Both stibnite and antimonite occur irregularly scattered in this argillaceous quartz vein, and the ore reserves are said to be small. Only the richer portions of the vein are mined, and the ore is hand-sorted, crushed, and concentrated by primitive methods to a 68-percent sulfide product and a 54-percent oxide product.

Another antimony mine in this Province is the Cerro Lina, which is just south of the 23° parallel at 12,500 feet altitude in the Department of Susques. The deposit is a north-south vertical vein from a few inches to several feet in width, containing auriferous stibnite in a gangue of quartz, limonite, and some pyrite and oxidized copper ore. In 1939, 40 tons of product with 48 percent antimony and 13 grams gold were made.

In the Province of La Rioja is a small antimony mine, the Santa Isbel, situated in the valley of Cebila 20 miles from the town of Chumbicha. Here four parallel veins from 5 to 15 inches wide, with vertical dips, traverse the metamorphic schists and have been prospected by adits and open cuts over a length of 1,200 feet. Both sulfide and oxide of antimony occur with some pyrite in irregular concentrations along these veins. The output in 1938 was 43 tons and in 1939, 4 tons.

The National Lead Co. produces a small tonnage of byproduct antimony from the imported Bolivian lead ores at its smelter at Puerto Vilelas. It also imports about 100 tons of antimony ore from Bolivia for the manufacture of antimonial lead.

Bolivia.—A comprehensive review of the Bolivian antimony industry was reprinted in Minerals Yearbook, 1940, from Foreign Minerals Quarterly (vol. 2, No. 4, October 1939, pp. 39–45). Two additional timely papers [9] appeared during the year.

Canada.—The electrolytic antimony plant of the Consolidated Mining & Smelting Co., Ltd., ran throughout the year at a daily rate of about 5 tons of metal. Costs are reported to have been reduced appreciably, and continued successful operation is expected. The metal is extracted from flue dusts recovered at the company refinery at Trail, British Columbia. According to press reports, a car of antimony ore was shipped to Montreal from the Stuart Lake property of Pioneer Gold Mines of B. C., Ltd.

In June 1940 a crew was employed by Reed Realities, Ltd., to sample an old antimony mine at South Ham, Wolfe County, Quebec. This deposit was discovered in 1863. The ore consists of stibnite, kermesite, valentinite, and native antimony in a series of slates and schists. The antimony content is said to average about 5 percent.

China.—The Chinese apparently still control their main producing areas, but Japanese control of normal trade routes continues to interrupt the flow of metal to consumer countries.

Germany.—No figures are available on German trade in antimony, but it is presumed that the Reich is amply supplied from Czechoslovak and Yugoslav production and possibly from Belgian stocks.

Indochina.—Only 9 metric tons were reported produced in 1940. The Cao-Bang area, however, is said to have deposits containing 250,000 tons of marketable ore.

Italy.—An antimony smelter at Su Suergiu near Villasalto, Cagliari, Sardinia, has produced as much as 900 tons of metal annually in recent years. According to press reports, Italian imports of metal declined sharply in 1939. No figures for 1940 are available.

Mexico.—Mexican antimony is derived from three sources: Antimony ores from several localities, as metal and as alloys from lead ores smelted at Monterrey, and from the mercury-antimony ores of the Huitzuco district, Guerrero. Most of the straight ores are exported to the Texas Mining & Smelting Co. plant at Laredo, Tex., and concentrates from the Huitzuco district are shipped to the Menardi plant near Los Angeles, Calif., where both mercury and antimony are recovered.

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[9] Reagan, P. H., Bolivia for Strategic Minerals: Eng. and Min. Jour., vol. 141, No. 10, October 1940, pp. 57–58. Wright, Charles Will, South America as a Source of Strategic Minerals: Min. and Met., vol. 21, June 1940, pp. 283–287.

The Huitzuco deposits have been described by Vaupell, from whose paper [10] the following notes have been abstracted. The deposits are in north-central Guerrero, a State on the Pacific Ocean southwest of the Federal District of Mexico. Discovery was recorded in 1873, and for many years mercury was the only metal sought. At the surface the ore occupies extinct mud geysers, but in depth it is found in breccia, veins, and as replacements in limestone. The deposits have been developed to a total vertical depth of about 850 feet. The antimony occurs as the sulfide, stibnite, and in the rare mercury-antimony mineral, livingstonite. The stibnite increases in depth. The ore is treated in a 175-ton flotation plant, and the concentrates are shipped by rail to the United States. A recent shipment of concentrates contained 7.73 percent mercury, 26.40 percent antimony, and 29.68 percent sulfur. Mining and milling operations are carried on by Explotadora de Mercurio de Huitzuco, S. A.

According to a press report, late in 1940 an antimony sulfide deposit was being developed in the vicinity of Nogales, Sonora. Another report, earlier in the year, was to the effect that a 15,000-ton body of sulfide ore, containing appreciable quantities of antimony and arsenic had been discovered at a property near Guadalcazar, San Luis Potosi.

Peru.—Production increased 8 percent over that in 1939. In January the Bureau of Mines issued a report[11]—Mineral Resources, Production and Trade of Peru—from which the following notes on antimony have been extracted.

Antimony is produced at a large number of small mines in the Departments of Puno, Huanuco, and Lima. The deposits consist of ore shoots, or concentrations of stibnite, in quartz viens traversing belts of slate and schist, but usually of no great tonnage. In general, the mines are worked by primitive methods and without mechanical equipment. Because of the spotty nature of the occurrences, the annual output varies considerably.

For 20 years (from 1915 to 1935) production varied from none to 500 tons, averaging 100 tons. This production increased to 1,907 tons in 1936 and to 2,560 tons in 1937 but dropped to 1,445 tons in 1938. In 1939 the estimated output is about the same as in 1938.

Besides the stibnite concentrate, since 1935 from 10 to 20 tons of antimony bars, with 78 percent antimony and 15 percent lead, and several hundred tons of antimonial lead with 5 to 6 percent antimony have been produced each year at the La Oroya smelter.

Among the outstanding prospects in the Department of Puno is that of La Suerte, 60 miles north of Juliaca. Here ore pockets containing from 100 to 200 tons of stibnite occur in a quartz vein and from these a monthly output of about 30 tons of concentrate is made. About 3 miles east of La Suerte another antimony prospect is now being developed.

In the Department of Huanuco near the town of Obas three quartz veins from 1 to 3 feet wide, with ore shoots of stibnite, occur in a phyllite and greenstone schist. These have been developed by several adits, and the present monthly output is about 15 tons. As the only means of transport to this property is by mule, transport costs are naturally high.

In the Department of Lima, Province of Canta, and 3 miles from the town of Carac, is the Santa Rosa antimony mine at 14,000 feet altitude. Here a quartz vein a foot wide has been developed by three adits 100 to 150 feet long. The ore mined averages 4 percent, and present production is about 10 tons a month. A large reserve of ore averaging 1.5 to 2 percent is said to occur in other quartz veins at this mine, but mining costs are too high at present to permit exploitation.

[10] Vaupell, C. W., Mercury Deposits of Huitzuco, Guerrero, Mexico: Am. Inst. Min. and Met. Eng. Tech. Pub. 842, September 1937, 14 pp.
[11] Bureau of Mines, Foreign Minerals Quarterly: vol. 3, No. 1, January 1940, pp. 39–40.

BIBLIOGRAPHY

In addition to the papers cited in footnotes to the text, the following selected list of references is presented for the information of those interested.

AREND, A. G. Reclaiming Antimony from Waste; an Economic Use for Speiss. Chem. Age—Met. Section, vol. 44, No. 1127, February 1, 1941, pp. 77–78.

Speiss is obtained in the smelting of nickel, copper, and tin ores and residues. The antimony content of a typical speiss ranges between 10 and 15 percent. This can be recovered by fusing with pyrite, crushing to 16-mesh, fusing with sodium sulfate and coal, dissolving in boiling water, and depositing the metal electrolytically, using lead anodes and sheet-iron cathodes in iron tanks.

CAPPS, STEPHEN R. Geology of the Alaska Railroad Region. Geol. Survey Bull. 907, 1940, 201 pp.

The region described extends from Seward on the Gulf of Alaska 450 miles north to Fairbanks and the Yukon Basin and covers a strip approximately 70 miles wide on each side of the Government owned and operated Alaska Railroad. Important mineral deposits, particularly gold and coal, occur in the region, and reserves are known to be large. Mineral production during the last 40 years has amounted to about $150,000,000. During this same period, the Geological Survey and the technical press have issued more than 100 written reports and maps on the region, and Bulletin 907 was issued to bring that information together under one cover and in condensed form. Three geologic maps on a scale of approximately 4 miles to the inch accompany the report.

ERICKSON, STEPHEN E., AND ANDERSON, ARVID E. Recovery of Antimony and Tin Compounds from their Ores. U. S. Patent 2,230,972, February 4, 1941.

This invention relates to a process for recovering compounds of antimony and tin from their ores, and more particularly from refractory ores that are not amenable to the ordinary metallurgical methods. Oxide ores containing a metal included in the group consisting of antimony and tin are mixed with soda ash and sulfur and subjected to an anhydrous reducing roast at a high temperature, the soluble polysulfides are leached out with water, and the metal values are recovered by precipitation.

McKEOWN, M. R. Gold-antimony Deposits of Nullagine. Chem. Eng. and Min. Rev., vol. 32, No. 376, January 10, 1940, pp. 143–144.

These lodes, in the Pilbarra district, Western Australia, have been worked desultorily since about 1905. Stibnite and gold occur in a gangue of quartz and partly decomposed country rock. The ore is reported to be very uniform throughout the district. Tests indicate that 85 percent of the antimony and 95 percent of the gold is recoverable by flotation of the stibnite, followed by cyanidation. Some cervantite is present in the oxidized zone.

SEGURA, DAVID. Metallurgy of the Huitzuco Mercury Ores. Am. Inst. Min. and Met. Eng. Tech. Pub. 896, February 1938, 7 pp.

This paper presents the findings of the preliminary tests, which resulted in the construction of a flotation plant at the mine and a reduction plant for the recovery of antimony and mercury at Los Angeles, Calif.

SCHIRRMEISTER, KURT. Manufacture of Antimony Trioxide Pigments. U. S. Patent 2,200,478, May 14, 1940.

This patent covers the preparation of antimony trioxide by the reaction of antimony trifluoride with alkaline reacting compounds instead of by the usual sublimation of the metal or its compounds. The product is claimed to be at least equal to the sublimed oxide, especially with reference to its covering power, whiteness, and the ease with which it is ground with oil.

SOUTH AFRICAN MINING AND ENGINEERING JOURNAL. Antimony Mining in South Africa, vol. 51, No. 2457, pt. 1, March 2, 1940, pp. 9 and 11.

A résumé of the history of antimony mining on the Murchison range from the first World War to the present. Production figures are given, and the prospects for revival of the industry are discussed.

CADMIUM

In 1940, the cadmium industry established new records for the production of both metallic cadmium and cadmium compounds.

Domestic production of the metal increased more than 34 percent, and the production of cadmium compounds increased 24 percent over 1939. Apparent consumption was 23 percent greater than in 1939, in spite of the fact that producers' exports exceeded imports by 100,285 pounds in 1940. Sales of metallic cadmium increased 20 percent and exceeded production by nearly 5 percent. Stocks of metallic cadmium at producers' plants decreased from an estimated 656,000 pounds at the end of 1939 to 330,000 pounds on December 31, 1940. Further declines in producers' stocks were reported early in 1941, and stocks of metallic cadmium held by producers on June 1 were estimated at 200,000 pounds. Data on stocks at consumers' plants are not available, but surveys developing this information are being made.

Demand for cadmium for electroplating increased markedly in 1940 despite rising metal prices, and producers could not meet requirements completely. Much of the demand for cadmium-plated goods was indirectly the result of the national defense program, and considerable cadmium is used directly in filling military orders. These requirements are expected to increase during 1941. Cadmium for military requirements includes cadmium-plated bolts and nuts for aircraft assembly, cadmium-plated wire cloth, and cadmium-plated shoe nails. Increased demand also was reported for cadmium bearings and other alloys and for pigments.

World production data for 1939 are incomplete, and censorship restrictions applied in 1940 prohibited publication of such fragmentary data as were available.

Imports of cadmium dust from Mexico increased slightly in 1940, but imports of metallic cadmium dropped to only 27,491 pounds, all of which came from Belgium before the German invasion. Exports of metallic cadmium by producers totaled 127,776 pounds in 1940; in addition, considerable metallic cadmium was exported by jobbers and brokers. Cadmium was placed on the list of materials under export-license control by Proclamation No. 2463 of March 4, 1941.

Except for the first few days of January 1940, the price of metallic cadmium in commercial sticks, f. o. b. New York, was 80 cents a pound the entire year. Patented shapes continued to hold a premium of 5 cents a pound. During the last few months of the year, however, these quotations were considered nominal, as sales were reported at much higher prices.

Cadmium produced, sold by producers, imported, and consumed in the United States, 1936–40, in pounds

Year	Produced			Metallic cadmium sold by producers	Metallic cadmium imported	Apparent consumption
	Metallic cadmium	Cadmium compounds (estimated Cd content)	Total cadmium			
1936	3,633,495	626,800	4,260,000	3,626,669	576,139	4,836,000
1937	[1] 4,265,973	828,000	[1] 5,094,000	[1] 4,059,764	828,535	[1] 5,923,000
1938	[1] 4,077,961	431,000	[1] 4,509,000	[1 2] 2,525,666	22,582	[1] 4,073,000
1939	[1] 4,411,530	679,000	[1] 5,091,000	[1] 5,190,273	309,874	[1] 5,401,000
1940	5,921,488	845,000	6,766,000	[3] 6,206,627	27,491	6,666,000

[1] Revised figures.
[2] Of this quantity, 458,283 pounds were exported.
[3] Of this quantity, 127,776 pounds were exported.

DOMESTIC PRODUCTION

Cadmium derived from both domestic and foreign raw materials is included in the data in the foregoing table. Figures on the production from each source are not available. Cadmium flue dust imported from Mexico in 1940 yielded 945 tons of metallic cadmium compared with 852 tons in 1939 and 838 in 1938.

In the United States, cadmium is derived chiefly from zinc ores, and normally its production is therefore directly related to the production of zinc. Zinc smelters operated substantially at capacity during 1940, and consequently the output of cadmium increased to a new record. Large quantities of foreign zinc concentrates are now being treated at domestic smelters, however, which may materially change the cadmium production. The Herculaneum (Mo.) plant of the St. Joseph Lead Co. again entered the list of producers of metallic cadmium, and the Sherwin-Williams Co. began producing the metal at its plant at Coffeyville, Kans.

Two domestic cadmium plants are briefly described in Bray's[12] new book on nonferrous metallurgy, and the following notes have been taken from his work.

The Midvale (Utah) plant of the United States Smelting, Refining & Mining Co. treats dust from the lead smelter containing about 22 percent cadmium, 11 percent lead, and 48 percent arsenic. The material is roasted, mixed with sulfuric acid and water, and heated in a reverberatory furnace to convert all of the base metals to sulfates and remove most of the arsenic. The sulfates are then leached about 20 minutes in an agitator, and the zinc, iron, lead, and copper are precipitated by neutralization with lime and filtered out of the solution. The filtrate contains about 12 percent cadmium and is electrolyzed in small tanks between aluminum cathodes and Duriron anodes with a current density of 5 to 8 amperes per square foot at 3 volts. The metal is melted in iron pots under caustic soda cover and cast into the required shapes for the market.

The plant of the American Zinc, Lead, & Smelting Co. at East St. Louis, Ill., is designed to treat 200 tons a day of zinc concentrates, containing approximately 0.4 percent cadmium. The flow sheet accompanying Bray's article shows the flow of materials through the zinc-cadmium distillation plant, from the raw concentrate to the finished zinc, cadmium, and sulfuric acid. The feed is treated in gas fired roasters, and the cadmium is caught in the Cottrell and flue dusts, which are then mixed with the calcines, residues, zinc chloride liquor, and fuel and sent to Dwight-Lloyd sintering machines. The fume from these machines, containing the cadmium, is recovered in another Cottrell precipitator. This dust is leached with sulfuric acid and sodium chlorate; the zinc and cadmium go into solution as the lead is precipitated as the sulfate. The solution is then transferred to another tank, and 90 to 95 percent of the cadmium is precipitated as a sponge by the slow addition of zinc dust. The sponge is then filtered, washed, and dried, mixed with lime and a reducing agent, and distilled in a horizontal batch retort. The retorts yield metallic cadmium, blue powder, and a residue containing 1.5 to 6.0 percent cadmium, 7.0 to 30.0 percent zinc, and 1.5 to 8.0 percent lead. This residue and the zinc chloride-sulfite liquor are returned to the circuit to form part of the Dwight-Lloyd sintering-machine charge.

[12] Bray, John L., Nonferrous Production Metallurgy: John Wiley & Sons, New York, 1941, 430 pp.

The following companies produced cadmium or cadmium compounds in 1940:

	Location of plan
American Smelting & Refining Co	Denver, Colo.
American Steel & Wire Co	Donora, Pa.
American Zinc Co. of Illinois	Fairmont City, Ill.
Anaconda Copper Mining Co	Great Falls, Mont.
Chemical & Pigment Co., Inc	Baltimore, Md.
E. I. du Pont de Nemours & Co	Cleveland, Ohio.
Eagle-Picher Mining & Smelting Co	Henryetta, Okla.
Harshaw Chemical Co	Elyria, Ohio.
New Jersey Zinc Co	Palmerton, Pa.
St. Joseph Lead Co	Josephtown, Pa., and Herculaneum, Mo.
Sherwin-Williams Co	Chicago, Ill., and Coffeyville, Kans.
Sullivan Mining Co	Kellogg, Idaho.
U. S. Smelting, Refining & Mining Co	Midvale, Utah.

DOMESTIC CONSUMPTION

Exact data regarding the consumption of metallic cadmium by uses are not available, but estimates based upon information furnished by producers indicate that the 6,206,627 pounds of metallic cadmium shipped to consumers in 1940 were divided about as follows: 3,736,000 pounds for electroplating, 1,145,000 pounds for cadmium bearings, 272,000 pounds for alloys other than bearings, 705,000 pounds for pigments and chemicals, and the remainder (348,627 pounds) for other purposes and export. Similar estimates for 1939 and earlier years are not available. The demand for cadmium as a corrosion-resisting plating on iron has increased rapidly in recent years and is strong even in years of high cadmium prices. The consumption of cadmium in automobile bearings has varied widely from year to year. Cadmium is also used as an alloy in copper wire; in rolled plates for locomotive fire boxes, castings in electrical apparatus, fusible alloys in fire-extinguishing devices, pigments, solders, stereotype plates, accumulator cells, and glass manufacture; as a deoxidizer in alloys of aluminum, silver, and nickel; and in domestic silverware.

Russell [13] has described the effects of cadmium salts on the body as follows:

> The salts of cadmium, particularly the sulfate, carbonate, and oxide, may cause irritation of the respiratory tract, and gastrointestinal disturbances. Fatal cases of poisoning by cadmium fumes have been reported. The symptoms of cadmium poisoning include weakness, shortness of breath, vomiting, headache, dryness of the throat, and bronchitis. It has been found that the safe limit of cadmium vapors in the air is 0.1 milligram per cubic meter. Electroplating tanks in which cadmium is used should be equipped with efficient local exhaust ventilation to prevent the escape of cadmium fumes.
>
> The use of chemically impure electrodes, or other materials in electroplating, may cause poisoning by the impurities present, such as arsenic, lead and mercury.

A brief discussion of cadmium recently appeared.[14] Markwith lists the industries and occupations wherein cadmium poisoning may be contracted, with particular reference to Ohio.

An interesting paper on the occurrence of cadmium and certain other minor elements in sphalerite recently appeared.[15] The author states, "The data used consist of new spectrographic analyses of minor

[13] Russell, J. P., Health Hazards in Electroplating: Metal Finishing, vol. 38, No. 6, June 1940, p. 324.
[14] Markwith, R. H., Cadmium and Its Compounds: Ohio Dept. of Health, 1940, 7 pp.; mimeographed; contains bibliography.
[15] Stoiber, Richard E., Minor Elements in Sphalerite: Econ. Geology, vol. 35, No. 4, June–July 1940 pp. 501–519.

elements in 75 sphalerite samples from many varied localities." Fifty-three of the specimens analyzed originated in the United States. According to a table accompanying the article, cadmium was found in all the specimens, consituted 0.1 percent or more in 73, and exceeded 1 percent in 9.

According to Johnston,[16] the length of runs between grinds on multislide presses can be increased as much as 300 percent by cadmium-plating the material being formed. The plating apparently acts as a lubricant.

Recent patents on cadmium include the following:

Blackwell, H. A., and Turner, W. L., Process for the Reduction of Zinc, Cadmium, and Mercury: U. S. Patent 2,229,716, January 28, 1941.

Groombridge, W. H., and Dee, T. P., Process of Preparing a Cadmium Metaphosphate Catalyst: U. S. Patent 2,206,226, July 2, 1940.

O'Brien, James J., Production of Cadmium Colors: U. S. Patent 2,220,116, November 5, 1940. Method of Making Cadmium Sulfide Pigments: U. S. Patent 2,220,117, November 5, 1940. Process of making Cadmium Red Pigments: U. S. Patent 2,226,573, December 31, 1940. Preparation of Cadmium Pigments: U. S. Patent 2,237,311, April 8, 1941.

FOREIGN TRADE

In normal years, considerable metallic cadmium is imported from Canada and various European countries, including Belgium, Netherlands, Italy, Norway, Poland, and Germany. Imports from European countries were disrupted in 1940, and only 27,491 pounds were received, all of which came from Belgium before the German invasion. Imports in 1939 were 309,874 pounds, of which 197,454 pounds came from Belgium. Exports of cadmium as metal vary between wide limits. Producers of metallic cadmium reported direct exports of 458,283 pounds of metal in 1938, none in 1939, and 127,776 pounds in 1940. In addition, considerable cadmium is exported by jobbers, dealers, and brokers who purchase metal from domestic producers. These exports are not reported to the Bureau of Mines. There is a limited import and export trade in cadmium compounds, but the quantities involved are believed to be relatively unimportant. Exports of cadmium with benefit of draw-back totaled 13,996 pounds in 1940 compared with 52,149 pounds in 1939 and 36,081 in 1938; most of this metal was in bearings. The United States also imports crude materials containing cadmium for refining. Cadmium recovered from flue dust imported from Mexico in 1940 totaled 1,890,000 pounds compared with 1,704,000 pounds in 1939. Production of cadmium from imported flue dust and other residues will increase sharply in 1941 owing to receipts of material from Africa that formerly went to Belgium and Germany.

PRICES

The average of producers' and platers' quotations in 1940, as reported by Engineering and Mining Journal Metal and Mineral Markets, was 82.3 cents a pound compared with 64.1 cents in 1939, 98.0 cents in 1938, $1.223 in 1937, 97.8 cents in 1936, 70.5 cents in 1935, and 55 cents in 1933 and 1934. The average price, based solely upon quotations by producers for ordinary commercial shapes, quan-

[16] Johnston, J. G., Stamp-forming Runs Increased 300 Percent by Cadmium-plating the Material: Steel, vol. 108, No. 1, January 6, 1941, p. 243.

tity business, in 1940 was 79.9 cents a pound compared with 59.2 cents in 1939, when Metal and Mineral Markets established this basis. The average value, based upon sales as reported to the Bureau of Mines by producers, was 70 cents in 1940 compared with 54 cents in 1939, 75 cents in 1938, $1.14 in 1937, 80 cents in 1936, and 50 cents in 1935.

At the beginning of 1940, patented shapes were quoted at 85 cents a pound to platers, and the quotation for commercial sticks in wholesale quantities was 75 cents; but, effective January 8, the price of sticks was raised to 80 cents. There were no further changes in the quotations of either commodity during the year, but sales were reported at prices far above the published quotation during the last quarter.

The London market opened at 5s. 6d. a pound and remained there until early May, when quotations dropped to 5s. on Empire metal and 4s. 10d. on outside offerings. Quotations were within 2d. of this last figure the balance of the year.

WORLD PRODUCTION

Data on the world output of cadmium are very incomplete because the belligerent nations have restricted the publication of production figures. The following table gives the salient statistics on world production, insofar as they are available.

World production of cadmium, 1936–40, by countries, in kilograms

[Compiled by L. P. Lounsbery]

Country	1936	1937	1938	1939	1940
Australia (Tasmania)	251,826	210,608	199,326	175,150	(1)
Belgium	203,997	271,000	182,000	[2] 530,800	(1)
Canada	356,484	338,018	317,122	426,234	(1)
France	84,000	99,000	116,000	(1)	(1)
Germany	302,000	355,000	432,000	(1)	(1)
Italy	54,630	90,850	69,000	(1)	(1)
Japan	23,563	(1)	(1)	(1)	(1)
Mexico	(3)	(3)	(3)	(3)	(3)
Norway	101,876	154,192	207,667	(1)	(1)
Poland	140,900	124,461	244,000	(1)	(1)
South-West Africa	[4] 98,900	[4] 138,300	116,000	197,000	(1)
U. S. S. R.	50,000	50,000	50,000	(1)	(1)
United Kingdom	22,160	124,142	124,898	(1)	(1)
United States:					
Cadmium compounds [5]	284,310	375,573	195,497	307,988	383,284
Metallic cadmium	1,648,117	1,935,603	1,849,722	2,001,026	2,685,928
	3,600,000	4,300,000	4,100,000	(1)	(1)

[1] Data not available.
[2] Exports.
[3] Mexican Government reports total cadmium content of material produced in Mexico as follows: 1936, 535,017 kilos; 1937, 619,792 kilos; 1938, 762,398 kilos; 1939, 816,584 kilos; 1940, 815,734 kilos. This material is exported for treatment elsewhere; therefore, to avoid duplication of figures, the data are not included in this table.
[4] Cadmium content of quantity exported. Represents in part shipments from stocks on hand.
[5] Estimated cadmium content.

REVIEW BY COUNTRIES

Canada.—Most of the cadmium produced in Canada comes from the plants of the Consolidated Mining & Smelting Co. at Trail, British Columbia, and the Hudson Bay Mining Co., at Flin Flon, Manitoba. These plants have an annual capacity of 500 and 180 tons, respectively. No figures on 1940 production have been released, but the plants operated continuously throughout the year, undoubtedly at a greatly increased rate.

Germany.—Certain restrictions were placed on the use of cadmium in 1939, but after the plants in Upper Silesia and Norway were acquired the situation was eased somewhat. The metal has largely replaced nickel as a rust-preventing plating metal. The price for rods (sticks) and anodes (shapes) remained about the same, that is, 4.50 and 5.0 reichsmarks per kilo, respectively.

Mexico.—No metallic cadmium is produced in Mexico, but a large part of the United States supply comes from Mexican ores. Most of it is recovered in flue dust at smelters in Monterrey and Rosita. The material is shipped to the Globe plant of the American Smelting & Refining Co., Denver, Colo., for treatment. During the period 1936–40, domestic metal produced from dust imported from Mexico averaged 1,530,000 pounds a year or nearly 30 percent of the average apparent domestic consumption in those years.

South-West Africa.—Otavi Minen und Eisenbahn Gesellschaft is the sole producer of cadmium in the territory. The metal is contained in flue dust, which is a byproduct from the smelting of the copper-lead-zinc ores of the Tsumeb mine and contains approximately 38 percent cadmium. Before the European conflict, the flue dust was shipped to Belgium and Germany, but no exports were made to these countries in 1940.

PLATINUM AND ALLIED METALS

By H. W. DAVIS

SUMMARY OUTLINE

There was an active demand for platinum metals in the United States during 1940. Stimulated by defense activities, there were noteworthy increases in sales to the electrical and chemical industries. Although sales to the jewelry trade were considerably higher than in 1939, they represented a smaller proportion of the total. Recoveries of new and secondary platinum metals in the United States gained 14 and 5 percent, respectively, in 1940. Production of placer platinum metals increased 12 percent. Imports of platinum metals declined 36 percent from 1939, which, however, was a record year. On the other hand, exports of unmanufactured platinum metals were 19 percent greater than in 1939. Despite the increased demand for platinum metals in 1940, prices remained relatively stable for all metals except iridium, which toward the year end sold at more than $275 an ounce. The greatly increased price of iridium was attributed to cessation of supplies from the U. S. S. R., accelerated consumption, and speculation.

Salient statistics of platinum and allied metals in the United States, 1939–40, in troy ounces

	1939	1940		1939	1940
Production:			Stocks in hands of refiners, Dec. 31: [3]		
Crude platinum from placers	32,460	[1] 36,500	Platinum	71,393	[3] 144,302
			Palladium	29,273	[3] 93,244
New metals:			Other	16,884	[3] 32,368
Platinum	[2] 36,033	[2] 38,951			
Palladium	3,491	4,564		117,550	[3] 269,914
Other	1,917	3,824			
			Imports for consumption:		
	41,441	47,339	Platinum	190,226	126,696
			Palladium	96,829	60,204
Secondary metals:			Other	19,572	8,745
Platinum	45,432	47,657			
Palladium	13,039	14,773		306,627	195,645
Other	4,972	4,000			
			Exports:		
	63,443	66,430	Unmanufactured	46,329	55,027
			Manufactures (except jewelry)	4,041	1,800

[1] Subject to revision.
[2] In 1940 includes 8,427 ounces (8,205 in 1939) of new platinum from domestic sources, comprising 3,957 ounces (2,919 in 1939) derived from crude placer platinum, none (16 ounces in 1939) from ore, and 4,470 ounces (5,270 in 1939) obtained from domestic gold and copper ores as a byproduct of refining.
[3] Beginning with 1940, figures include stocks held in the United States by importers of platinum-group metals from the United Kingdom.

Although the United States leads the world by a wide margin in consumption of platinum metals, before 1935 it had supplied but a very small proportion of the world output. During the 10 years 1925–34, annual production averaged only 8,300 ounces—1,000 ounces of placer platinum, 600 ounces from palladium-bearing copper ore, and 6,700 ounces as byproduct of gold and other metals. Since 1935, however, largely in consequence of large-scale mining in Alaska, the production of platinum metals in the United States has increased phenomenally, attaining a maximum of 48,269 ounces in 1938—40,932 ounces of placer platinum, 7,247 ounces recovered from gold and copper refining, and 90 ounces obtained from platinum-bearing ore. During the 5 years 1935–39 it averaged 28,300 ounces—20,600 ounces of placer platinum, 7,600 ounces recovered from gold and copper refining, and 100 ounces obtained from platinum-bearing ore. In 1940 production was about 44,300 ounces. Thus, the United States has attained the rank of fourth largest producer of platinum metals.

In addition, the United States is an important refining center and occupies a prominent position in the international platinum trade. During 1940, for example, 47,339 ounces of new platinum metals and 66,430 ounces of secondary platinum metals were recovered by domestic refiners, 195,645 ounces of unmanufactured platinum metals were imported for consumption, and 55,027 ounces of platinum and allied metals (ingots, sheets, wire, alloys, and scrap) and a considerable quantity of placer platinum were exported.

Despite the much larger output of domestic placer platinum, most of the new platinum metals recovered by refiners in the United States in 1940, as in previous years, were derived from crude platinum from foreign sources, notably Colombia, as most of the Alaska platinum was refined abroad. The major part of the refined new platinum metals now consumed in the United States emanates from the United Kingdom; the metals are recovered there chiefly as byproducts in refining nickel-copper matte from the Sudbury district of Ontario and, to a smaller extent, from matte from the Rustenburg district of the Union of South Africa and from placer platinum originating in the Goodnews district (Alaska).

CRUDE PLATINUM

Production.—Mine returns for 1940 indicate a production of 35,000 ounces of crude platinum (containing 28,860 ounces of platinum-group metals valued at $1,092,000) in Alaska,[1] 1,400 ounces in California, 31 ounces in Montana, and 69 ounces in Oregon—a total of 36,500 ounces. Comparable figures for 1939 are 31,300 ounces of crude platinum (containing 27,230 ounces of platinum-group metals valued at $997,000) in Alaska, 1,140 ounces in California, and 20 ounces in Oregon—a total of 32,460 ounces. Production in Alaska came mainly from placer deposits in the Goodnews district of southwestern Alaska; most of it was mined by a large modern dredge and by well-mechanized draglines. In California most of the output of platinum was a byproduct of dredges working the gold placers in Amador, Merced, Placer, Sacramento, Shasta, Siskiyou, Stanislaus, Tehama, and Trinity Counties. The production in Montana was a byproduct of a dredge working the gold placer in Lewis and Clark County. The principal production in Oregon came from the ocean beach near Cape Blanco, Curry County.

Many gold and copper ores in the United States contain small quantities of platinum metals. In 1940, 7,774 ounces of platinum metals were recovered as a byproduct of refining gold and copper ores compared with 8,634 ounces in 1939.

[1] Figures and other information for Alaska from Federal Geological Survey.

The Goodnews (Alaska) platinum deposits have been described recently by Mertie.[2] The report describes the geography, general geology, and economic geology of the platinum deposits and is illustrated with topographic and geologic maps. It includes 28 commercial analyses of platinum metals of Fox Gulch and Platinum Creek, 8 of Squirrel Creek, 47 of Lower Platinum Creek and Salmon River, and 1 of Clara Creek. The average commercial analysis of platinum metals of the streams follows:

Average commercial analysis of platinum metals of the Goodnews district, Alaska, in percent

	Fox Gulch and Platinum Creek	Squirrel Creek	Lower Platinum Creek and Salmon River	Clara Creek
Platinum	62.10	68.69	73.48	73.29
Iridium	20.34	13.19	9.77	5.90
Osmium	3.93	3.25	1.93	.69
Ruthenium	.33	.25	.15	.13
Rhodium	1.49	1.38	1.05	.42
Palladium	.23	.27	.31	.56
Gold	.32	.41	2.10	1.01
Impurities	11.26	12.56	11.21	18.00

Purchases.—Platinum refiners in the United States reported purchases of domestic crude platinum from the following sources in 1940: Alaska, 4,293 ounces; California, 1,563 ounces; Montana, 31 ounces; and Oregon, 119 ounces—a total of 6,006 ounces (4,479 ounces in 1939). Domestic refiners also reported purchases of 34,374 ounces (35,135 ounces in 1939) of foreign crude platinum or osmiridium in 1940—2 ounces from Canada, 33,320 ounces from Colombia, and 1,052 ounces from the Union of South Africa.

Prices.—Buyers reported purchases at $21.92 to $37.67 an ounce for domestic crude platinum and $26.92 to $51.03 an ounce for foreign crude platinum or osmiridium in 1940.

REFINED PLATINUM METALS

New metals recovered.—Reports from refiners of crude platinum, gold bullion, nickel, and copper indicate that 47,339 ounces of platinum metals were recovered in the United States from these sources in 1940, a 14-percent increase over 1939. It is estimated that 12,704 ounces of the total output in 1940 were derived from domestic sources.

New platinum metals recovered by refiners in the United States in 1940, by sources, in troy ounces

	Platinum	Palladium	Iridium	Osmiridium	Others	Total
Domestic from—						
Crude platinum	3,957	21	589	309	54	4,930
Gold and copper refining	4,470	3,183	87		34	7,774
	8,427	3,204	676	309	88	12,704
Foreign from— Crude platinum; Nickel and copper refining	30,524	1,360	841	335	1,575	34,635
Total recovery: 1940	38,951	4,564	1,517	644	1,663	47,339
1939	36,033	3,491	1,051	727	139	41,441

[2] Mertie, J. B., Jr., The Goodnews Platinum Deposits, Alaska: Geol. Survey Bull. 918, 1940, 97 pp.

New platinum metals recovered by refiners in the United States, 1936–40, in troy ounces

Year	Platinum	Palladium	Iridium	Osmiridium	Others	Total
1936	39,728	4,682	1,678	541	317	46,946
1937	36,174	5,945	1,998	640	501	45,258
1938	30,444	3,653	1,247	384	485	36,213
1939	36,033	3,491	1,051	727	139	41,441
1940	38,951	4,564	1,517	644	1,663	47,339

Secondary metals recovered.—In 1940, 66,430 ounces of secondary platinum metals were recovered from the treatment of scrap metal, sweeps, and other waste products of manufacture that contain platinum, a 5-percent increase over 1939.

Secondary platinum metals recovered in the United States, 1936–40, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1936	55,959	6,786	[1] 1,922	[1] 1,499	66,166
1937	55,926	12,680	[1] 2,076	[1] 1,524	72,206
1938	44,654	13,489	[1] 1,253	[1] 4,895	64,291
1939	45,432	13,039	[1] 2,767	[1] 2,205	63,443
1940	47,657	14,773	1,365	2,635	66,430

[1] Revised figures.

Prices.—Except for iridium, there were no appreciable changes in the quoted prices [3] of platinum metals in 1940. Platinum opened the year at $40 an ounce but declined to $38 on April 15 and to $36 on September 5. Palladium remained steady at $24 an ounce, as did rhodium at $125 and ruthenium at $35 to $40. Iridium, however, opened the year at $125 an ounce and advanced on January 11 to $175, but on April 25 it declined to $150 and on September 12 to $125, where it remained until October 27. Effective October 28, the quoted price was raised to $140, and increases on November 11, 26, and 29 and December 11 brought it to $275. Some sellers were reported to have asked higher prices. The advance in price was attributed to heavier demand from the aircraft industry, greatly reduced imports, and speculative influences. Because of the advance in the price of iridium a study of military requirements and available supplies was conducted by the Office of Production Management, which found according to a press notice of January 15, 1941, "There is no justification whatever for the great advance in the price of iridium, culminating in a jump during November and December from $148 to $300 or more per ounce" and "* * * that contrary to prevalent rumor there is no real shortage of iridium." On February 6, 1941, the quoted price was lowered to $175 an ounce.

Consumption and uses.—Platinum and its allied metals (palladium, iridium, rhodium, ruthenium, and osmium) are characterized by high melting point, whiteness, and resistance to oxidation at high temperatures and to attack by destructive chemical compounds. As pure metals, combined, clad, or alloyed with other metals, the platinum metals are employed in jewelry and dentistry, in the chemical and electrical industries, and for numerous miscellaneous purposes.

A material gain in world output of platinum metals, owing chiefly to improvements in metallurgical processes for refining copper-nickel ores, has made available large quantities of platinum, palladium,

[3] Engineering and Mining Journal, Metal and Mineral Markets: Vol. 11, 1940.

iridium, rhodium, ruthenium, and osmium. In 1938—the latest year for which fairly complete figures are available—world production of platinum metals was about 540,000 ounces, of which about 57 percent was recovered as byproducts in the refining of nickel, copper, and gold ores, whereas in 1929 world production was about 231,000 ounces, of which about 17 percent was so obtained. With increased supplies, relative stability in the price of platinum and palladium has been reached at levels that permit their use for plant equipment and other industrial purposes. Despite the rapid advance in output of the platinum metals during the past decade, research has found new uses for them, and developmental activities are opening up larger and more diversified markets in which they are becoming accepted.

The most widely used metal of the group is platinum, which constituted 122,978 ounces (59.4 percent) of the total platinum metals reported sold to consumers in the United States in 1940. The largest single buyer of platinum is the jewelry industry, where, alloyed with iridium or ruthenium, it is employed as a setting for diamonds and other precious stones in rings and other forms of jewelry. About 42 percent (51,296 ounces) of the total sales of platinum went to the jewelry trade in 1940.

Second in magnitude as a consumer of platinum in 1940 was the chemical industry, which took 25 percent (31,174 ounces) of the total domestic sales. Platinum is used in this industry as a catalyst to produce sulfuric acid and for ammonia oxidation to produce nitric acid and nitric oxide, lining processing and reaction vessels, hydrogenation of organic compounds, rayon spinnerets, nozzles for the production of glass fiber, glass insulators for the bases of electric-light bulbs, tubing, valves, siphons, and safety disks for handling corrosive liquids and gases, anodes for the production of "per" salts, gas-analysis cells, crucibles, and laboratory equipment.

The electrical industry, which usually ranks fourth as a consumer of platinum, advanced to third place in 1940, taking 14 percent (17,548 ounces). Platinum is used in this industry for thermocouples, temperature measuring and recording instruments, precision resistance thermometers, high-temperature furnace windings, spark-plug electrodes, magneto contacts, electrical contacts, relays, thermostats, automobile voltage regulators and direction indicators, and switches for potentiometric recorders.

The dental industry dropped from third to fourth position as a consumer of platinum in 1940, taking 8 percent (9,859 ounces). Platinum, either pure or alloyed, is used in tooth pins, bridges, and bracings for artificial teeth, as matrices on porcelain inlays, and in orthodontic appliances.

Next to platinum, palladium is the most extensively used metal of the platinum group; it is about half as common as platinum but less costly. It comprised 69,319 ounces (33.5 percent) of the total platinum metals sold to domestic consumers in 1940. Palladium, pure or alloyed, is adapted to many of the uses of platinum and during the past 2 decades has been employed in increasing quantities by the dental, electrical, and jewelry industries. The conservation of gold by many countries has stimulated the demand for the platinum metals, particularly palladium, and the substitution of palladium for gold alloys for dental restoration, pen points, and articles of jewelry has made substantial progress. Palladium in telephone relays and other types of electrical contacts found an improved market in the electrical field; in consequence, the electrical industry was the chief consumer in 1940, taking 47 percent (32,528 ounces). There was an increased demand for palladium in dentistry, which took 38 percent (26,346 ounces) of the total. The jewelry industry is the next largest consumer of palladium, and small quantities are used in the manufacture of chemical ware.

The consumption of the other platinum metals—iridium, rhodium, osmium, and ruthenium—is comparatively small and comprised only 7.1 percent of the total for the group in 1940. Iridium is used chiefly as a hardening addition to platinum, rendering it suitable for laboratory vessels, surgical tools, hypodermic needles, thermoelements, and jewelry. Its compounds are employed as fixing agents, porcelain pigment, and (in the form of black) as a catalyst. There was a noteworthy increase in the demand for iridium in magneto contacts for airplanes in 1940. Rhodium is alloyed with platinum for high-melting-point thermocouple wire, furnace windings, and laboratory ware for certain special applications, and for use as a catalyst to produce sulfuric acid and for ammonia oxidation to produce nitric acid and nitric oxide. Rhodium plating is employed as a finish for glassware and silverware and in surfacing reflectors for searchlights and projectors. Platinum-rhodium spinnerets continue to replace the older platinum-gold spinnerets in the production of rayon, because of their superior resistance to the various corrosive agents used. Osmium, in association with other metals, provides pen points that will resist wear and corrosion by ink. These alloys also replace jewels as bearings in fine instruments. The oxide is used as a biological stain for fats and for fingerprint work. Ruthenium also is utilized as a hardener for platinum metals, and one of its salts serves as a biological stain. Because of the increased demand for iridium in the aircraft industry, ruthenium was effectively employed as a hardener of platinum in jewelry.

The following table shows reported sales of platinum metals to consumers in the United States in 1940; such sales totaled 206,890 ounces. The figures include sales of platinum metals recovered from crude platinum, gold bullion, copper and nickel bullion and matte, electrolytic muds, and scrap materials and sweeps; sales of imported platinum metals handled by domestic refiners; and sales in the United States by importers of platinum-group metals from the United Kingdom. Before 1940 the figures excluded sales in the United States by importers of platinum-group metals from the United Kingdom; therefore, the statistics for 1940 are not comparable with those for earlier years.

Platinum metals sold in the United States in 1940, by domestic consuming industries, in troy ounces [1]

Industry	Platinum	Palladium	Iridium, osmium, rhodium, and ruthenium	Total
Chemical	31,174	1,624		
Electrical	17,548	32,528		
Dental	9,859	26,346	14,593	206,890
Jewelry	51,296	7,624		
Miscellaneous and undistributed	13,101	1,197		
	122,978	69,319	14,593	206,890

[1] Figures include sales in the United States by importers of platinum-group metals from the United Kingdom.

Stocks.—On December 31, 1940, 269,914 ounces of platinum metals were in the hands of refiners and importers of platinum-group metals from the United Kingdom. Before 1940, the stocks of platinum metals held in the United States by importers of platinum-group metals from the United Kingdom were not included in the statistics; therefore, the figures for 1940 are not comparable with those for earlier years.

Stocks of platinum metals held by refiners in the United States, December 31, 1936–40, in troy ounces [1]

Year	Platinum	Palladium	Iridium	Osmium, rhodium, and ruthenium	Total
1936	56,886	29,853	[2] 8,198	[2] 8,980	103,917
1937	60,236	21,942	[2] 8,846	[2] 8,475	99,499
1938	71,058	30,071	[2] 7,151	[2] 9,631	117,911
1939	71,393	29,273	[2] 7,000	[2] 9,884	117,550
1940 [1]	144,302	93,244	32,368		269,914

[1] Beginning with 1940, figures include stocks held in the United States by importers of platinum-group metals from the United Kingdom.
[2] Revised figures.

FOREIGN TRADE [4]

Imports.—Imports of platinum metals into the United States during 1940 dropped to 195,645 ounces from 306,627 in 1939; the latter figure, however, was an all-time high. Although the imports of all metals of the platinum group except osmium declined, the most noteworthy decrease was that of iridium; receipts amounted to only 237 ounces (all from the United Kingdom) compared with 6,363 ounces in 1939, of which 4,284 ounces came from the U. S. S. R., 1,665 ounces from the United Kingdom, 318 ounces from Norway, and 96 ounces from France. During the 5 years 1935–39, imports averaged 4,354 ounces, of which 45.6 percent came from the United Kingdom, 43.0 percent from the U. S. S. R., 10.9 percent from Norway, and 0.5 percent from other sources. Imports of osmiridium dropped to 1,857 ounces in 1940 from 2,204 ounces in 1939 and from an average of 3,380 ounces during the 5 years 1935–39. Imports of refined platinum decreased substantially in 1940 compared with 1939, but those of unrefined platinum increased considerably, chiefly because of the receipt of concentrates from Canada.

The principal sources of imported platinum metals in 1940 were the United Kingdom (122,957 ounces), Canada (35,659 ounces), and Colombia (34,011 ounces).

Platinum metals imported for consumption in the United States, 1936–40

Year	Troy ounces	Value	Year	Troy ounces	Value
1936	210,440	$5,996,034	1939	306,627	$9,881,531
1937	206,937	7,418,364	1940	195,645	5,748,005
1938	161,189	4,366,912			

[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.

Platinum metals imported for consumption in the United States, 1939–40, by metals

Metal	1939		1940	
	Troy ounces	Value	Troy ounces	Value
Platinum:				
Ores of platinum metals (platinum content)	5,943	$137,500	13,653	$314,400
Grain and nuggets	32,266	905,315	44,667	1,215,683
Sponge and scrap	83,995	2,910,159	32,734	1,250,016
Ingots, bars, sheets, or plates not less than ⅛-inch thick	68,022	2,173,260	35,642	1,175,827
	190,226	6,126,234	126,696	3,955,926
Manufactures of, not jewelry	(1)	8		
Iridium	6,363	686,560	237	38,774
Osmiridium	2,204	51,162	1,857	64,851
Osmium	623	22,229	1,617	57,064
Palladium	96,829	2,099,104	60,204	1,256,696
Rhodium	5,352	643,703	3,586	333,217
Ruthenium	5,030	252,531	1,448	41,477
	306,627	9,881,531	195,645	5,748,005

1 Less than 1 troy ounce.

Platinum metals (unmanufactured) imported for consumption in the United States in 1940, by countries, in troy ounces

Country	Platinum				Iridium	Osmium and osmiridium	Palladium	Rhodium and ruthenium	Total
	Ores of platinum metals (platinum content)	Grain and nuggets	Sponge and scrap	Ingots, bars, sheets, or plates not less than ⅛-inch thick					
Argentina		284	128				5		417
Australia			558			45			603
Brazil		11	7						18
Canada	12,177	10,168	880				10,168	2,266	35,659
China		294							294
Colombia	1,004	28,266	4,741						34,011
Cuba				108					108
El Salvador				10					10
France				146					146
Japan			142					9	151
Norway	311	342					443		1,096
Panama, Republic of	155								155
Switzerland			20						20
United Kingdom	6	5,302	26,258	35,378	237	3,429	49,588	2,759	122,957
	13,653	44,667	32,734	35,642	237	3,474	60,204	5,034	195,645

Exports.—Exports of unmanufactured platinum metals increased to 55,027 ounces in 1940 from 46,329 ounces in 1939. Noteworthy were the exports to the United Kingdom, which advanced to 22,622 ounces (2,859 in 1939). There were also conspicuous increases in the exports to Argentina, Brazil, and Japan. On the other hand, exports to Germany ceased (11,401 ounces in 1939), and those to France declined to 3,877 ounces (13,709 in 1939).

Platinum and allied metals exported from the United States, 1936–40

Year	Unmanufactured		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value
1936	55,454	$2,069,205	2,590	$123,891
1937	59,567	2,908,552	2,874	100,944
1938	33,635	1,156,644	796	31,111
1939	46,329	1,528,563	4,041	213,445
1940	55,027	2,280,339	1,800	96,703

Platinum and allied metals exported from the United States in 1940, by countries

Country	Unmanufactured (ingots, sheets, wire, alloys, and scrap)		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value
Argentina	6,047	$207,771	----	----
Brazil	5,385	207,712	40	$1,893
Canada	2,148	91,064	697	39,893
Chile	261	9,230	4	298
China	457	12,646	5	227
Colombia	235	11,437	3	222
Cuba	282	9,130	1	39
France	3,877	137,753	----	----
India, British	----	----	66	6,422
Iraq	130	6,384	----	----
Japan	10,417	330,779	524	27,792
Kwantung	76	4,800	----	----
Netherlands	1,189	75,620	----	----
Palestine	----	----	304	10,468
Philippine Islands	111	3,712	4	350
Switzerland	1,394	47,506	----	----
Turkey	120	3,800	----	----
United Kingdom	22,622	1,102,193	40	2,263
Other countries	276	18,802	112	6,836
	55,027	2,280,339	1,800	96,703

WORLD PRODUCTION

Figures on world production of platinum metals by countries are fairly complete for 1936, 1937, and 1938, and data are available for most of the chief producing countries for 1939; however, because of government restrictions on the publication of statistics for many countries, few figures for 1940 are available.

World production of platinum and allied metals, 1936–40, in troy ounces

[Compiled by L. P. Lounsbery]

Country and product	1936	1937	1938	1939	1940
Australia:					
New South Wales: Placer platinum	47	46	8	(1)	(1)
Tasmania: Placer osmiridium	281	586	191	283	(1)
Belgian Congo: From refineries:					
Palladium	12,571	12,507	1,575	(1)	(1)
Platinum	3,183	2,122	225	(1)	(1)
Canada:					
Placer platinum	20	22	16	25	(1)
From refineries: [2]					
Platinum	131,551	139,355	161,310	148,877	(1)
Other platinum metals	103,671	119,829	130,893	135,402	(1)
Colombia: Placer platinum (exports)	38,333	29,315	34,549	39,070	(1)
Ethiopia: Placer platinum	8,038	(1)	(1)	(1)	(1)
Italy: From refineries: Platinum	836	1,286	1,029	(1)	(1)
Japan: Placer platinum	34	(1)	(1)	(1)	(1)
Netherlands Indies (probably placer platinum)	----	----	21	28	(1)
New Zealand: Placer platinum	29	55	1	13	(1)
Panama: Placer platinum	19	267	----	----	----
Papua: [3]					
Placer platinum	21	20	41	2	(1)
Placer osmiridium	17	8	4	4	(1)
Sierra Leone: Placer platinum	484	308	180	83	(1)
Union of South Africa:					
Platinum (content of platinum metals) [4]	19,751	17,776	18,256	18,068	(1)
Concentrates (content of platinum metals) [4]	13,163	21,849	35,124	41,243	(1)
Osmiridium [5]	5,431	5,790	5,354	7,031	(1)
U. S. S. R.: Placer platinum [6]	100,000	100,000	100,000	100,000	100,000
United States:					
Placer platinum	9,785	10,803	40,932	32,460	[7] 36,500
Ore (content of platinum metals)	110	124	90	66	----
From refineries: [8]					
Platinum	4,443	4,761	3,761	5,270	4,470
Other platinum metals	4,541	5,817	3,486	3,364	3,304
	456,000	[9] 473,000	[9] 537,000	[10] 531,000	(1)

[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] Estimated production. [7] Subject to revision.
[8] New platinum metals recovered in gold and copper refining of domestic materials.
[9] Exclusive of Ethiopia and Japan.
[10] Exclusive of New South Wales, Belgian Congo, Ethiopia, Italy, and Japan.

Canada.—Figures on recovery of platinum metals from the nickel-copper ores of the Sudbury district, Ontario, in 1940 are not available, but in 1939, 148,877 ounces of platinum and 135,402 ounces of other platinum-group metals were recovered. Concentrates assaying 50 to 60 percent platinum metals from the Port Colborne refinery, those assaying 80 to 90 percent platinum metals from the Copper Cliff refinery, and residues averaging about 4 percent platinum metals from the Clydach (South Wales) refinery are normally shipped to the International Nickel Co. precious metals refinery at Acton, England, for the recovery of platinum, palladium, iridium, rhodium, and ruthenium. In 1940, however, some concentrates were refined in the United States. Platinum and palladium are recovered in the form of sponge of an average purity of 99.93 and 99.94 percent, respectively, and rhodium, ruthenium, and iridium in the form of meal of an average purity of 99.7 percent each. The platinum metals contained in the ore of the Falconbridge Nickel Mines, Ltd., were, before the German occupation of Norway on April 9, 1940, recovered at the precious metals separating plant at Kristiansand. Osmium is not present in the Sudbury nickel ore in sufficient quantity to make its recovery commercially important.

Colombia.—The South American Gold & Platinum Co. produced 24,294 ounces of crude platinum metals in 1940 (27,975 in 1939) and 58,462 ounces of gold (59,416 in 1939). The figures of other operators are not available.

Union of South Africa.—According to the Department of Mines and Industries, the estimated content of platinum metals produced in the Union of South Africa was about 43,600 ounces during the 7 months January–July 1940. Figures for the entire year are not available. In the year 1939 production was 66,342 ounces.

Sales of platinum metals from South Africa were 28,483 ounces valued at £228,504 (£8.02 an ounce) during the first 7 months of 1940 compared with 47,912 ounces valued at £302,370 (£6.31 an ounce) in the entire year 1939. The average composition of the product sold in 1939 was platinum 66.27 percent, palladium 25.71 percent, iridium 0.42 percent, osmium and osmiridium 0.22 percent, rhodium 0.64 percent, ruthenium 2.20 percent, and gold 4.54 percent.

Sales of osmiridium were 3,369 ounces valued at £40,779 (£12.10 an ounce) during the first 7 months of 1940 compared with 6,076 ounces valued at £36,456 (£6 an ounce) in the entire year 1939. The average composition of the product sold in 1939 was osmium 28.64 percent, iridium 25.72 percent, ruthenium 13.52 percent, platinum 10.37 percent, gold 3.88 percent, rhodium 0.40 percent, and undetermined 17.47 percent.

The platinum deposits of the Union of South Africa have been described briefly in a recent report of the Department of Mines.[5]

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[5] Department of Mines, Union of South Africa, The Mineral Resources of the Union of South Africa: Pretoria, 1940, 544 pp. (Platinum Metals, pp. 186–193).

MINOR METALS

By Paul M. Tyler

SUMMARY OUTLINE

Although none of the various minor metals regularly reviewed in this chapter was included in the Army and Navy strategic- or critical-materials lists, many of them were carefully studied by various Government agencies. Several items normally are imported; nevertheless, it has been possible to undertake domestic production of virtually all those that hitherto came from continental Europe. Owing to the small tonnages involved, shipping space was available for necessary imports of ores from South America; in fact, the only real problem was the bidding for bottoms by importers of Indian ilmenite, which tended to aggravate the difficulty and cost of getting cargo space for manganese ore and certain other needed imports from British India and other Far Eastern sources. Virtually the only other item in this group that involves movement of more than a few hundred tons of material overseas is mixed zircon-rutile concentrate, which comes from Australia.

By virtue of the military order of July 2, 1940, the export from the United States of various materials was permitted only under license, and other items were added from time to time. Effective April 15, 1941, or earlier, the minor metals and their (specified) ores, salts, and compounds subject to export control (Schedule 1) included beryllium, radium, titanium, and uranium. Ferrocolumbium was also included.

The story of the year, as regards wide popular appeal, was the premature announcement that atomic energy had been harnessed so that it could be employed for performing useful work. According to one rumor, Hitler had set 200 scientists to working out practical details, so that this new power could be employed to speed up airplanes and other instruments of the blitzkrieg. The real achievement in this field was isolation of the isotope of uranium, U235, whose fission does afford the hope of commercially tapping this boundless new reservoir of potential energy. On the other hand, it was found that less than 1 percent of this isotope is present in ordinary uranium and that methods of separating it are highly inefficient. Through the shroud of mystery that hides from the layman the advances on this uttermost frontier of modern science, nothing definite has yet penetrated that justifies definite prediction as to commercial implications.

Exploring the same general sector of atomic research, Dr. Pecher, at the University of California, produced radioactive yttrium by transmutation of strontium under bombardment of 16-million-volt deuterons from a cylotron. According to Jeffries:[1]

> * * * The yttrium produced by transmutation of strontium is strongly radioactive, with a life of about 100 days. This life is long compared with, say, radioactive sodium but it is short compared with radium. Radioactive yttrium may be used to radiograph steel and metal parts. The amount so far produced experimentally is equivalent to about 25 milligrams of radium. At present, however, production of yttrium by this process is more expensive than radium for similar doses of gamma radiation. It seems probable that the ultimate cost of producing gamma radiation from yttrium may be much lower than from radium. What these experiments suggest, however, is that other radioactive materials may come from the cylotron and other atom-smashing hoppers.

IMPORTS

Imports of specified rare metals and alloys during the last 3 years are summarized in the accompanying table.

Imports of minor metals for consumption in the United States, 1938–40 [1]

Commodity	1938		1939		1940	
	Quantity	Value	Quantity	Value	Quantity	Value
Barium, boron, columbium or niobium, strontium, tantalum, thorium, titanium, uranium, vanadium, and zirconium:						
Metals........pounds..	610	$1,553	----------	----------	----------	----------
Alloys of the foregoing with one another........pounds..	4,056	2,434	2,291	$1,610	----------	----------
Alloys of the foregoing with aluminum, chromium, cobalt, copper, manganese, nickel, or silicon........pounds..	79,357	5,113	715,881	39,264	698,665	$47,771
Beryllium, caesium, lithium, and potassium metal........pounds..	1,475	2,383	198	454	16	290
Beryl or beryllium ore........do....	291,415	5,990	917,447	14,574	1,609,976	23,865
Boron carbide........do....	2,165	3,243	5,064	5,849	7,408	8,525
Calcium:						
Calcium metal........do....	41,299	16,144	41,718	17,758	11,900	6,518
Calcium silicide........do....	1,402,314	77,003	3,972,571	225,312	2,131,758	154,424
Cerium:						
Cerium metal........do....	(2)	12	----------	----------	----------	----------
Ferrocerium and other cerium alloys........pounds..	468	1,255	585	1,184	462	1,611
Cerite or cerium ore........do....	----------	----------	----------	----------	----------	----------
Cerium compounds........do....	----------	----------	----------	----------	----------	----------
Columbium and tantalum:						
Ductile columbium, tantalum, and alloys........pounds..	49	357	----------	----------	----------	----------
Columbium ore........do....	645,141	228,078	109,132	37,062	595,220	210,526
Tantalum ore........do....	41,706	80,092	56,561	82,990	490,460	258,514
Ferroboron........do....	----------	----------	----------	----------	----------	----------
Ferrouranium........do....	----------	----------	----------	----------	----------	----------
Radium salts........grams..	38.75	787,025	78.631	1,953,820	30.311	748,097
Radioactive substitutes........	----------	5,746	----------	966	----------	5,650
Selenium and salts........pounds..	101,034	163,598	124,830	193,168	134,429	198,163
Sodium metal........do....	----------	----------	----------	----------	----------	----------
Thorium nitrate........do....	----------	----------	----------	----------	----------	----------
Titanium:						
Ilmenite........do....	451,462,220	1,018,430	573,152,770	1,126,200	443,282,470	750,590
Rutile........do....	460,446	26,533	883,674	23,170	312,065	14,849
Ferrotitanium........do....	----------	----------	350	77	----------	----------
Uranium ore........do....	----------	----------	5	10	2,400,198	2,110,927
Uranium oxide and salts of..pounds..	376,708	520,540	1,439,324	1,197,786	240,199	388,355
Zirconium:						
Zirconium ore........do....	4,183,506	62,111	6,865,026	49,919	33,690,506	252,749
Ferrozirconium, zirconium ferrosilicon........pounds..	244,126	13,520	799,269	50,169	533,055	37,126
Zirconium silicon........do....	----------	----------	----------	----------	----------	----------
Other alloys, used in the manufacture of steel or iron, not elsewhere specified........pounds..	22	152	500	400	627,347	8,667
Ores, metallic, not elsewhere specified........pounds..	----------	----------	----------	----------	45,660	13,003

[1] Compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.
[2] Less than 1 pound.

[1] Jeffries, Zay, Rare Metals and Minerals: Min. and Met., vol. 22, No. 410, February 1941, p. 85.

BARIUM

Barium metal is now made in the United States, chiefly to supply the small requirements for radio, vacuum, and thermionic tubes where it is used as "getter," along with lithium, potassium, and calcium. In common with other rare metals, it is now supplied by Kemet Laboratories (Cleveland, Ohio) clad in iron or other common metal. An interesting use of Kemet Iron Clad barium wire is to form a high-temperature lubricating film on special steel balls for rotating anodes in highly evacuated small X-ray tubes.[2] At high temperatures the barium diffuses through the iron, volatilizes, and condenses, in part, on the surfaces of the balls. Oil could not be used for this work, both because of the high temperature and because of its volatility, and the reduction in friction and improved life of rotating parts resulting from the barium coating are quite remarkable.

BERYLLIUM

Beryllium production is still an infant industry, but in 1940 it grew lustily. Most of the metal is now produced as a 4-percent master alloy with copper, in which form it is sold at $15 per pound of contained beryllium, whereas beryllium metal of domestic manufacture costs approximately $45 a pound compared with $100 formerly charged for German-produced metal of less purity. Wrought beryllium alloys—which are made by remelting the master alloy and which are ready for fabrication—now range from 0.1 to 2.25 percent in beryllium content. Best-known and longest on the market is a binary alloy containing 2 to 2.25 percent beryllium. The base price for strip and other merchant forms of this alloy is 96 cents per pound when copper is 10 cents (98 cents at 12-cent copper). By adding a little cobalt (0.25 percent, for example), which seems to stabilize the properties and improve uniformity as well as to facilitate precipitation hardening, the Be content can be reduced to 1.8 percent without loss of properties obtainable by heat treatment.[3] Another alloy on the market contains approximately 0.5 percent beryllium and 2.6 percent cobalt, and there is also one with only about 0.1 percent beryllium and 0.3 percent chromium, the remainder being copper in both instances. These two alloys are primarily electrical alloys (conductivity, approximately 50 and 70 percent that of copper, respectively) with excellent strength and hardness. The 2.6-percent cobalt alloy, however, is reported also to have an unusually high endurance limit at temperatures around 500° F.

In its annealed, soft condition, the 2-percent beryllium-copper alloy shows a tensile strength of about 66,000 pounds per square inch, with 50-percent elongation in 2 inches. According to the leading producer, cold-rolled and heat-treated strip will show over 190,000 pounds per square inch tensile strength with about 3 percent elongation. The heat-treatable nature of beryllium alloys results from precipitation hardening. When a beryllium-copper alloy is cooled (quenched) rapidly from 800° C., the copper becomes supersaturated with beryllium and is in a soft, unstable state. During aging or reheating in the range 250° to 300° C., a stable condition is reached

[2] Jeffries, Zay, Work cited in footnote 1, p. 82.
[3] Stott, L. L., Beryllium and Beryllium Copper: Metal Progress, vol. 38, No. 4, October 1940, pp. 539–540.

through precipitation of the excess in the form of a submicroscopic dispersion of the gamma phase. Extended reheating in the precipitation range of temperature will cause apparent coalescence and growth in size of grain, with consequent resoftening.

A fair amount of beryllium oxide is sold—chiefly as a superrefractory but also for other purposes—but beryllium is used mainly in alloys, almost entirely in beryllium copper. Beryllium nickel, however, also has possibilities, aluminum alloys with beryllium additions are being investigated, and the metal itself has recently been made experimentally in the United States. Sawyer and Kjellgren[4] have reported tests on 99.5-percent pure beryllium metal with impurities divided between aluminum, iron, magnesium, carbon, and silicon. The high velocity of sound in beryllium was remarkable, as it conducted sound waves 2-1/2 times as rapidly as steel. The polished metal also exhibited fairly good reflectivity for white light (52 to 55 percent); although this was not as good as that of polished aluminum (80 percent), the surface seemed to be permanent, and this factor, combined with its low density of 1.84, its high elastic modulus, and fair electrical (and thermal) conductivity, suggests its use for instrument mirrors, both oscillating and stationary. A chill-cast bar was rather weak, very brittle (ultimate tensile strength, 20,990 pounds per square inch without any measurable elongation), and hard (114 Brinell at 1,500-kg. load).

Beralite, a beryllium-aluminum alloy sponsored by E. B. Wilford and H. S. Cooper, was being investigated in 1940 for possible use in aircraft construction. It is claimed that this alloy is lighter than aluminum, as strong as good steel, and comparatively noncorrosive.

Great strength combined with good electrical heat conductivity and resistance to wear had led to the use of beryllium copper in many industries, but the property now being emphasized as outstanding is the stability of the spring properties of alloys under steady loads. When properly heat-treated, beryllium copper exhibits a remarkably small amount of elastic drift or hysteresis compared to steel or other bronzes, according to the manufacturer. This characteristic is bringing increased use of the material for calibrated springs in instruments of all kinds where accuracy of spring properties is vital, as well as in the electrical field wherever maintenance of constant contact pressures is desired.

The following comments on uses are abstracted from Mineral Trade Notes:[5]

> At the moment the rapidly expanding demand for beryllium comes from a diversity of minor uses—in little gadgets of various kinds. By far the largest outlet is for springs and similar small parts in business machines. Next in importance is the construction of control instruments, but the new aircraft program promises to make this the most important field, even though no additional uses are found for these alloys.
>
> Characteristic of certain valuable properties of beryllium alloys is their use in Bourdon springs in pressure gages, notably those for oxygen, which have to resist corrosion as well as retain indefinitely their resistance to fatigue. Most metals—and, more particularly, heat-treated alloys—after long repeated stress tend to "creep" or lengthen, just as a rubber band when overstretched does not quite return to its original length. Part of the reputedly phenomenal fatigue resistance of beryllium alloys is due to their high tensile strength and elastic limit, but their

[4] Sawyer, C. B., and Kjellgren, B., Beryllium and Some of Its Aluminum Alloys: Metals and Alloys, vol. 11, No. 6, June 1940, pp. 163–167.
[5] Tyler, Paul M., Beryllium: Bureau of Mines Mineral Trade Notes, vol. 11, No. 5, November 20, 1940, pp. 5–8.

stability of spring performance seems to be due in part also to a peculiar inherent property of the alloys after precipitation hardening. It has been suggested that the very low "elastic drift" or hysteresis results from the circumstance that stresses are relieved by heating to about the same temperature as that required for precipitation hardening. They are also claimed to exhibit remarkable resistance to wear and change in volume when subjected to rubbing loads under heavy pressure. Beryllium-copper alloys have been used for nonmagnetic ball bearings under certain circumstances, for fuse springs in shells, and in the automobile industry for solderless connectors and spring terminals, with a resultant speeding up of the assembly of distributors and sundry electrical equipment.

A specialized outlet for beryllium copper is in low-sparking or "safety" tools. Various nonferrous alloys have been used for hammers and cold chisels where a spark from a steel tool might cause serious explosion, as in repairing a gas tank. But most of these alloys lacked the hardness, strength, and toughness of beryllium copper, which, therefore, has been adopted by several leading chemical and oil companies. The range of safety tools for use where dangerous gases or liquids are present extends from wire brushes to axes, pitchforks, pliers, wrenches, and wrecking bars, in addition to the better-known hammers and chisels. No type of tool will eliminate spark hazard but beryllium-copper tools greatly reduce it.

Beryllium has recently been proposed in England as an ingredient of a new textile fiber of the rayon family. The other principal raw material is seaweed. The spinning solution for the new filaments, as reported in The Chemical Age (January 11, 1941, p. 39), is sodium alginate, which can be spun by the usual rayon machinery, comprising a gear pump, a "candle" filter, a multiple-orifice jet, and a final silk-fabric filter. The sodium alginate solution is readily obtained from seaweed, of which very large quantities are available. The quality of the yarn, however, is determined by the composition of the coagulating bath. A simple calcium chloride solution, preferably slightly acidified, can be employed, but a calcium alginate yarn dissolves in warm soap and soda solutions, such as might be used for laundering fabrics. A certain amount of washability may be obtained by treating such yarns with aluminum or chromium acetate, but the yarn with best all-round characteristics so far made from seaweed is hardened in a coagulating bath of beryllium acetate. Upon the basis of present prices for beryllium ore the manufacture of beryllium-alginate rayon appears commercially feasible, according to the report in The Chemical Age.

The present high cost of beryllium is not due to the cost of raw materials or to lack of efficient processes for recovering the metal from beryl, which is apparently the only commercial ore. Even under present conditions, the metal probably could be sold with good profit at $5 a pound, provided the volume of sales was large enough to carry the heavy expense of laboratory and market research and general overhead. Such items can bog down any infant enterprise, and they have proved to be extraordinarily serious in the beryllium industry. Undoubtedly the demand for beryllium would increase even more rapidly if the price could be reduced still further, particularly the price to the ultimate consumer. Even now the instrument maker or fabricator must pay almost as much for his beryllium alloys as he did 5 years ago, when the beryllium content of the master alloy cost exactly twice as much as it does today.

Apart from price, another deterrent to more rapid expansion in the utilization of beryllium has been doubt among consumers as to the adequacy of beryllium-ore supplies. Actually, the offerings of beryl have greatly exceeded demand, and now both leading American beryllium companies are confident that as the industry grows ore supplies will grow proportionately. Although several substantial deposits have been reported that are alleged to contain enough beryl to permit being worked for beryl alone without depending on joint products (feldspar, gem materials, or other minerals) to carry the expense of mining, it is generally conceded that supplies must be drawn from various States and perhaps from South America and other foreign countries as well. Statistics of domestic production or consumption of beryllium cannot be published, but information available to the Bureau bof mines indicates that domestic production of beryl has ranged in recent years from less than 100 to a maximum of not more than 200 tons a year, whereas imports have been increasing. From 50 to 100 tons annually of beryl are ground and used in certain kinds of pottery or ceramic wares. As a good deal of the apparent supply has gone to build up socks, domestic consumption in making beryllium oxide and alloys has never exceeded about 300 tons. With beryl worth only $30 to $50 a ton, the total apparent consumption is obviously a small item in our national economy; yet it should be noted that a single ton of beryl worth, say, $50 delivered at the furnace will yield enough beryllium to make at least 3,000 pounds of beryllium alloy, and the present trend may increase this to an average of 5,000 or even 8,000 pounds, thus multiplying the value of the mine product at least 100-fold.

Imports of beryl in 1940 rose to a new record—805 short tons valued at $23,865—of which 422 tons were from Argentina, 377 from Brazil, and 6 from Union of South Africa.

CALCIUM

Metallic calcium, produced before the European War almost exclusively abroad, chiefly in France, is now made in the United States, the leading consumer. It is employed more and more for grain-refining alloy steels and in small amounts in some magnesium products. Various uses, as summarized by Mantell,[6] include: (a) Deoxidizer and alloy agent for copper, lead, and other nonferrous metals; (b) preparation of high-temperature, high-resistance nickel-chrome and nickel-chrome-iron alloys; and (c) as a reducing agent, in form of hydride, in the manufacture of rare metals, such as titanium, uranium, vanadium, and zirconium.

COLUMBIUM AND TANTALUM

Both columbium and tantalum are used indirectly in the manufacture of munitions and to a minor extent directly. Total imports of tantalum ores in 1940 jumped to 490,460 pounds compared with only 56,561 in 1939, the previous high record. Owing to collapse of markets in Europe, tantalum ores from Belgian Congo and other African sources, as well as from Brazil, came to the United States during the latter part of 1940. Such ores substantially augmented available supplies of tantalum, but the fact that they contained more columbium than those from Australia is indicated by a decline in the average value of the imports to less than 53 cents a pound from $1.47 in the preceding year. Imports of columbium ore, including rather small quantities from other countries than Nigeria, which hitherto has furnished virtually all the imports into the United States, advanced

[6] Mantell, C. L., New Uses of the Minor Metals: Metal Progress, vol. 38, No. 4, October 1940, pp. 527–528.

to 595,220 pounds, more than five times the quantity imported in 1939 but substantially less than the annual imports during the preceding 4 years. Early in 1941, the Fansteel Metallurgical Corporation, pioneer domestic producer of tantalum metal, was expanding its North Chicago (Ill.) plant at an estimated cost of $150,000. Vascoloy-Ramet Corporation, Jersey City, N. J., a subsidiary, was also expanding manufacturing facilities, according to press reports.

Small additions of ferrocolumbium make stainless steel more weldable, inhibiting intergranular corrosion ("weld decay"). A new development in the General Electric Co. laboratories in 1940, possibly highly significant, involves preparation of a new precipitation hardening alloy containing 3 percent columbium (balance iron). This alloy—which is not a steel, as it contains no carbon but contains the intermetallic compound, Fe_3Cb_2—reveals exceptionally good rupture strength at 1,100° F. As it exhibits remarkably low creep at high temperatures, it may be possible with this alloy to boost the temperatures at which steel turbines are operated without recourse to the expensive steels hitherto considered necessary.[7] Possible applications of tantalum are indicated in connection with nitriding steels,[8] but additions of tantalum tend to render steel unfit for use in guns or even in structural work. Although the demand for ferrotantalum has declined, owing to substitution of much cheaper ferrocolumbium, certain tantalum alloys are not unimportant—notably tantalum-tungsten and tantalum-nickel, which are employed in fountain pens and radio tubes, respectively. Ultrahard cemented carbides of tantalum are being used increasingly—alone or in combination with carbides of tungsten or titanium—in wire-drawing dies, steel cutting tools, and wear-resistant parts of machines. The metal has a variety of commercial applications, of which perhaps the most important with regard to quantity requirements is in the manufacture of corrosion-resistant apparatus and equipment in chemical plants and laboratories. Newly developed is a bayonet-type heater comprising 19 tantalum-protected steel tubes, which can be filled with live steam and plunged into hydrochloric acid. Tantalum is also used in various types of heat interchangers, pump and valve parts, nozzles, and spinnerets for rayon and other synthetic fibers and threads, temperature-control apparatus, and sundry vessels and parts exposed to chlorine and other corrosive agents. Copper or steel pipes can be lined or covered with a thin layer of tantalum. Tantalum is still used in certain types of current rectifiers, although demand from this source has declined. Another use, associated more directly with the national defense program, is for portable radio transmitters; owing to its remarkable gas-absorptive properties, it is one of the best metals for radio-transmitting tubes or valves.

Sintered tantalum for electrolytic condensers can now be made with a coarse, porous structure, whose many microscopic surfaces are covered with films of tantalum oxide, which gives the material its condenser qualities and which is re-formed by reaction with the electrolyte if ruptured by electric overload. An important use of such

[7] Parker, E. R., The Development of Alloys for Use at Temperatures Above One Thousand Degrees Fahr.: Am. Soc. Metals (paper presented at 22d annual convention, Cleveland, Ohio, October 21-25, 1940).
[8] Genders, R., and Harrison, R., Tantalum-Iron Alloys and Tantalum Steels: Jour. Iron and Steel Inst., 1936, No. II, p. 173P.

condensers is for lightning and surge arresters in railway-signal circuits, especially for the protection of signal lamps. Several thousand are in use; so far, not one has been reported damaged by lightning.[9]

Really high-grade tantalite was in good demand and was quoted in Engineering and Mining Journal Metal and Mineral Markets during 1940 up to $2.50 a pound of contained Ta_2O_5, basis 60-percent concentrate. Domestic ores, however, are mixtures of columbite and tantalite—as are almost all ores except the tantalite produced near Wodgina, Australia, and the columbite produced in Nigeria—and the following remarks by Groves [10] deserve careful attention by all prospective miners and mineral merchants:

> * * * The materials most sought after are columbite with a small content of tantalum and tantalite with a small columbium content. Whereas the former fetches prices in the neighborhood of £70 a ton, the latter runs up to about £600 a ton. It is, however, a great mistake to suppose that ore with roughly equal amounts of columbic and tantalic oxides should be worth something approximately midway between the two prices. The fact is that, although prior to the outbreak of hostilities Germany bought considerable quantities of such ore, at the present time there is little or no market for it. What the prospector really wants to find then is tantalite with not more than a few percent of columbic oxide, similar to the best Australian tantalite which carries 70 percent or more of Ta_2O_5 and only a few percent of Cb_2O_5. If he finds such ore, the next step is to ascertain whether it is free from cassiterite or wolframite; if it is, then he is lucky and a representative sample should be sent for assay. Until the results of the assay are available, however, it is impossible to assess the value of the material with any certainty. If cassiterite or wolframite occur mixed with the tantalite, provided the tantalum content of the tantalite is high, it should be possible to arrange for a mineral separation or to sell at a penalized price.

Tantalum metal was quoted in the United States throughout the year at $160.60 (base) a kilogram for C. P. rod and $143 for sheet, subject to discounts on volume business. Corresponding figures for columbium metal were $560 a kilogram for rod and $500 for sheet. Ferrocolumbium, 50 to 55 percent, was quoted at $2.25 to $2.35 a pound of columbium contained (f. o. b. producer's plant). Groves (work cited) describes British Empire conditions as follows:

> Tantalum metal, now quoted as nominal, was sold for some time before the war at £18 per pound (as compared with platinum at £10 an ounce). The average value of the Australian production of tantalite in 1936 was £A.630 and in 1937 £A.886. The total Australian output in these 2 years was 31,000 and 36,800 pounds respectively. Tantalite from elsewhere, i. e., tantalite containing an appreciable amount of columbium, is generally quoted at 55s. to 60s. a unit, i. e., in the neighborhood of £150 a ton. The best columbite fetches only about half this price.

Small amounts of tantalum scrap occasionally reach the market, chiefly in the form of discarded rayon spinnerets. The scrap recovery value of tantalum used in chemical equipment is relatively low, and it costs over 100 times as much as stainless steel, yet it has proved the most economical construction material to transfer heat efficiently in various processing operations where corrosion conditions are severe. No production of tantalum-bearing ores was reported for the United States in 1940.

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[9] Jeffries, Zay, Work cited in footnote 1, p. 84.

[10] Groves, A. W., Tantalum—The Position, Past and Present, of Ore and Metal: The Mining Jour. (London), vol. 209, No. 5463, May 4, 1940, pp. 281–282.

INDIUM

Reduction in price of electrolytic indium (99.99+ percent) from $30 to $15 and later to $12.50 a troy ounce tended in 1940 to increase demand for the metal in platings and diffused platings on cadmium and other alloy bearings for airplane and other high-duty internal-combustion engines. Indium is also used in small quantities as an alloy constituent of jewelry and dental alloys, to improve the tarnish resistance of silverware, as a glass colorant, in the electrical contact field, and in low-melting alloys.

In dental castings 0.5 percent indium is said to improve corrosion resistance, melting range, hardness, and strength. A large optical company has used it for small pins in hinges of spectacle frames to resist corrosion.

In wearing parts of engines and machines, indium affords desired corrosion resistance without impairing fatigue resistance and other good properties of cadmium alloy bearings. For such service, the procedure (patented) is to plate indium onto the base metal and then to cause it to diffuse or alloy in the surface by means of a low-temperature treatment which (on steel-backed pieces) takes 2 hours at 340° F. Modern engines need bearings having great strength and wear resistance—such as cadmium alloys, lead alloys, copper-lead, and copper-nickel alloys—all of which corrode more easily than certain older mixtures in the presence of lubricants containing organic acids from animal- or vegetable-oil additions or oxidation of petroleum oils.

Indium is a very soft, heavy (specific gravity, 7.28), silvery, easily melted (melting point, 155° C.) metal that boils at red heat. According to Dyer,[11] as recently as 1924 it took several months to round up a total of 1 gram of the metal at a cost considerably higher than that of platinum—$10 a gram. A little research showed that it was a stabilizer for certain nonferrous metals, and when sizable quantities of indium-bearing ores were found in Mohave County, Ariz., the deposit was explored by shaft and drifts. This property, which is owned by the Indium Corporation of America (Home Office: 805 Watson Place, Utica, N. Y.), is reported to be able to supply large quantities of the metal. However, the potentially large production of indium from metallurgical residues more than suffices for current needs.

RADIUM AND URANIUM

The agreement between the Union Minière du Haut Katanga of Belgium and Eldorado Gold Mines, Ltd., of Canada, dividing world markets for radium in a 60:40 ratio, is said to have remained in force during 1940. World events, however, virtually eliminated the continent of Europe as a market for radium, and stocks sent to the United States for safekeeping are reported to be more than adequate to meet any anticipated requirements during the next several years. Normal sales for medical purposes in the United States are estimated at less than 25 grams a year. Luminous paints, which are used on instrument dials for airplane and other military equipment, do not require very large quantities, because a little radium goes a long way. One gram, for example, will furnish all the luminous paint needed for several thousand planes. Metal radiography seems to be growing more important and may be used extensively for the examination of castings,

[11] Dyer, J. R., Jr., Indium—Properties and Uses: Iron Age, vol. 146, No. 25, December 19, 1940, p. 35.

forgings, and other metal parts for munitions, but inasmuch as the radium for these purposes can be used repeatedly and can be transported readily from place to place, 5-or 10-gram lots at a few strategic locations could take care of national defense requirements.

Owing to a sharp decline in world demand for radium and uranium the Canadian producer stopped all operations at Great Bear Lake in June 1940. Early reports implied that the shut-down might be brief—only long enough for refinery and sales development to catch up with recent increases in ore output—but later advices indicated that the mine might remain closed at least 2 or 3 years. It is stated that the mine is in excellent condition and that ore reserves are ample to keep the concentrator (100-ton daily capacity) in operation for a long time. During the winter of 1939–40 flotation equipment for cleaning pitchblende was flown in by plane, and other additions and changes were made to increase the efficiency of the mill. Refining capacity at Port Hope, Ontario, was expanded before the end of 1939 to 8 grams of radium and 40 tons of uranium compounds a month. It was rumored that stocks of ore and material in process at Port Hope were ample to keep the refinery busy for 3 years or more. Moreover, it was announced [12] that uranium concentrates from the United States had been received for treatment upon a custom basis.

Although the radium refinery at Oolen, near Antwerp, fell into German hands upon the surrender of Belgium the mines in Belgian Congo did not come under Hitler's control, and the colonial government decided to permit shipments of copper and other metals and mineral products to Great Britain and the United States. Imports into the United States of uranium compounds dropped to 240,199 pounds valued at $388,355 in 1940 compared with a maximum of 1,439,324 pounds with a value of $1,197,786 in 1939, whereas imports of "uranium ore," normally negligible (5 pounds valued at $10 in 1939) jumped to 2,400,198 pounds valued at $2,110,927 in 1940; all came from Belgian Congo.

The price of radium advanced slightly to $30 a milligram early in 1940, then remained unchanged throughout the remainder of the year. Imports aggregated only 30.311 grams valued at $24,700 a gram in 1940 compared with 78.631 grams valued at $24,800 in 1939 and 38.75 grams valued at $20,300 in 1938.

About 85 percent of the world radium output is employed for medical purposes, 10 percent in luminous material, and 5 percent for miscellaneous uses, including the inspection of metal castings and forgings for inner flaws.

Polonium and ionium.—These materials may be extracted from Canadian radium ores. Ionium, which is about 40 times as abundant in these ores as radium, has long been used meagerly in scientific work, notably at meteorological stations, and may have possibilities in luminous paints, although it is not recovered by the Port Hope refinery process. Recently polonium has found actual commercial employment in a spark-plug alloy. Said to be worth $2,000,000 an ounce, minute traces are nevertheless used by Firestone Tire & Rubber Co. in spark-plug electrodes to ionize the air gap and speed the passage of a hot spark under all temperature conditions.

[12] Mining Journal (London), vol. 210, No. 5482, September 14, 1940, p. 566.

Uranium.—When uranium 235 is hit by a neutron that enters into its nucleus the atomic weight becomes 236, which is an exploding atom that splits easily. Merely by adding water, energy can be released, and when all this water is converted into steam the process stops unless more water is supplied, making the energy-liberating process automatic and self-regulating. Uranium 238 seemingly disintegrates only according to the well-known, leisurely schedule that ends up with lead after intermediate transformations into radium or actinium. When hit by a neutron that enters its nucleus its atomic weight may be increased to 239, but this is a relatively stable, nonexploding atom. Only about 0.1 percent of ordinary uranium is U–235, and production of this isotope on a commercial scale is problematical. However, fully a half-dozen laboratories are working on uranium as a source of power.

As a corollary to this research, there has been some quiet inquiry into sources of uranium. Assuming that 1 pound does yield as much power as 5 million pounds of coal or 3 million gallons of gasoline, we do not need very much uranium to supply even the enormous power requirements of the United States where 400,000,000 to 500,000,000 tons of coal burned annually furnish only 47 percent of the total energy consumed, the remainder being generated by oil (32 percent), natural gas (11 percent), and water power (10 percent).

The leading domestic producer of uranium ores today is the United States Vanadium Corporation at Uravan, Colo., where a new plant costing about $100,000 was built in 1940 to recover uranium from tailings from the vanadium plant. The total capacity is 50 tons a day, but details of anticipated uranium recoveries have not been published. Some of the concentrates, however, have been shipped to Port Hope, Ontario, as well as to Pittsburgh, Pa., for refining.

It is interesting now to revive the theory that because naturally disintegrating uranium and its derivatives constantly emit heat and are so universally distributed in the earth's crust, they must have profoundly modified the earth's rate of cooling in the past and must still play an important part in maintaining terrestrial heat. Almost all rocks, especially acid igneous rocks, are radioactive and so are the waters of the ocean and inland seas. Water from deep-seated springs and wells usually has marked radioactivity, so much so that the curative properties of waters at certain spas were attributed to this cause. Even the atmosphere is charged with radioactive substances that are carried down by rain or snow. In compact and unweathered rocks there is a nearly constant ratio of radium to uranium, provided they are old enough for equilibrium to have been reached. This ratio is 3.3×10^{-7}:1, which is another way of saying that very old rocks are likely to contain 3,300,000 times as much uranium as radium. The uranium content of younger granites actually may be more than their radioactivity would indicate. On the other hand, it does not follow that uranium is distributed as widely in nature as are radioactive substances because such materials may include fugitive emanations, mesothorium, and other products that may not even be in the uranium family.

Although at least 100 minerals contain uranium, the only important uranium ores have been uraninite or pitchblende and carnotite. Pitchblende occurs massive in metalliferous veins, notably at Joachimsthal, Bohemia, and also at Johanngeorgenstadt, Saxony; more recently, it has been found in Belgian Congo and Canada. Carnotite has been noted chiefly as a canary-yellow impregnation in sandstone in western Colorado and eastern Utah. Many pegmatites contain crystals of uraninite or pitchblende and occasionally other uranium-bearing minerals, usually in such small proportions as to preclude their commercial consideration, except perhaps as a minor byproduct of feldspar or mica mining. Apart from pegmatite specimens (from North Carolina, Connecticut, the Black Hills of South Dakota, and the even more diversified mineral galaxy at Barringer Hill, Tex.—mostly sold to mineral collectors) and carnotite, virtually the only domestic production of uranium mineral has been in Colorado, mainly in Gilpin County, where pitchblende has been found associated with pyrite and zinc and lead sulfides. Autunite, which has been reported in South Dakota and Utah and recently in the Ruby Mountains, Nev., may have somewhat more commercial significance as a source of uranium than of radium, as its radium content is less than the usual ratio for uranium minerals.

According to Clarke,[13] Maj. C. E. Dutton has suggested that radio-activity in limited tracts 1 to 3 and not over 4 miles below the surface of the earth may develop enough heat to fuse the rocks and cause periodic eruptions; at least one investigator who agrees with this theory has reported an astonishingly high figure for the radium content of fresh lavas from Vesuvius.

All but the most basic rocks contain at least 1 part of radium per trillion, and acid rocks contain more than 3 parts per trillion. This may indicate as much as 1 part in 100,000 or 0.001 percent of uranium in the average rock.

SELENIUM AND TELLURIUM

Consumption of selenium in glassmaking, by far the leading use, increased in 1940, and several of the numerous minor applications expanded.

Both selenium and tellurium are employed to improve the machinability of copper and copper alloys and to a very small extent as modifying agents in corrosion-resistant steels. Additions of selenium have been made successfully to 18/8 steels whose work-hardening properties tend to develop extreme surface hardness as soon as they are cast or otherwise worked, the improvement being similar to that obtained by additions of sulfur and without the deleterious effect of sulfur on corrosion resistance and mechanical strength. Fansteel Metallurgical Corporation (North Chicago, Ill.) has announced a new line of industrial rectifiers employing selenium plates. Suggested applications include supply of current for magnetic clutches, solenoid valves, alarm signal and communication systems, and isolated direct-current motors. The International Telephone Development Co. (New York, N. Y.) is also reported to be using selenium rectifiers.

Small but steadily growing quantities of tellurium are used to toughen rubber and lead. Tellurium lead has been in service long enough now to confirm by practical tests the claims as to its extraordinary resistance to corrosion, wear, and mechanical break-down, which are all the more remarkable in view of the fact that it differs in composition from ordinary good chemical lead only by an addition

[13] Clarke, F. W., The Data of Geochemistry, 4th ed.: Geol. Survey Bull. 695, 1920, p. 310.

of less than 0.1 percent tellurium. Small additions of tellurium, in this instance about 0.5 percent, are employed in two new free-machining forgeable alloys of copper recently developed and patented by the Chase Brass & Copper Co. Another new development [14] is to improve the quality and lengthen the useful life of chilled-iron car wheels; this is accomplished by introducing very small quantities of graphite and tellurium in correct proportion and balance into each ladle as the metal is poured. A newly patented "daylight lamp" employs tellurium vapor in a tube to fill in certain wave lengths to produce a continuous spectrum.

Prices of selenium (black, powdered, 99.5 percent) and of tellurium remained at $1.75. Barium selenite ($BaSeO_3$) was quoted in Glass Industry at $1.40 to $1.60 a pound with "commercial (25 percent Se)" at $0.85 a pound, and sodium selenite (Na_2SeO_3) at $1.50 to $1.65 a pound.

Production, sales, and imports of selenium and production and sales of tellurium in the United States, 1936–40

Year	Selenium				Tellurium	
	Production (pounds)	Sales [1] (pounds)	Imports		Production (pounds)	Sales [1] (pounds)
			Pounds	Value		
1936	352,480	226,402	122,806	$215,835	57,956	25,453
1937	435,821	282,598	92,523	161,382	51,409	23,365
1938	225,674	166,494	101,034	163,598	11,076	26,944
1939	227,131	345,726	124,830	193,168	25,234	63,431
1940	328,731	368,709	134,429	198,163	85,622	88,996

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

TITANIUM

The feature of the titanium industry in 1940 was the phenomenal rise in ocean freight on imported ilmenite. The bulk of the ilmenite consumed in the United States for making pigments and much of that for alloys and miscellaneous uses is imported from British India. A much larger proportion of the domestic consumption of rutile—chiefly for welding-rod coatings and ceramics—is produced in the United States, and substantial quantities of processed rutile of domestic as well as of foreign origin are exported from this country.

Although the price of ilmenite f. o. b. Travancore actually declined further during 1940 (average invoice value of imports a long ton: $3.75 in 1940, $4.40 in 1939, and $5.05 in 1938), quotations delivered c. i. f. U. S. Atlantic ports advanced during the summer to $18 to $20 a gross ton. Owing to the higher ocean freight and marine insurance, this quotation continued nominal throughout the remainder of the year; it compares with $10 to $12 during 1939 and earlier years. Actually, the freight rates, which normally average around $4 a long ton, had advanced by the end of the year to more than $20 a ton; and in March 1941, owing to the competitive bidding of imports of manganese, cargo rates as high as $28 a long ton were bid for shipments of ilmenite to the United States Atlantic seaboard.

[14] Drake, C. C., The Importance of Tellurium in Manufacturing: Mines Mag., vol. 30, No. 9, October 1940, pp. 498–500, 516.

After a study of the geological origin of the nelsonite dikes of Amherst County, Va., which have furnished most of the domestic output of both rutile and ilmenite to date, Moore [15] concluded that thorough exploration should reveal large domestic reserves heretofore little suspected. Higher prices for ilmenite naturally stimulated interest in domestic sources, and it was rumored that certain large consumers examined various properties and even did some active prospecting in the Carolinas, California, and elsewhere; but no definite information as to new mining developments has been furnished the Bureau of Mines, except regarding New York, where the National Lead Co. was reported [16] to be negotiating to acquire the old MacIntyre iron mine, Tahawus, N. Y. The ore body is a titanium-bearing magnetite, and the property has been inoperative for about 30 years.

Imports of ilmenite declined late in the year, whereas consumption probably increased, as it was encouraged not only by the acceleration of general industrial activity but also by the necessity for conserving zinc and perhaps lead, thus speeding further substitution of titanium pigments for competitive materials. Consideration has been given to the wider use of ferrotitanium in steelmaking as a means of conserving ferromanganese. Mention may be made also of Grainal alloys—complex deoxidizers that contain aluminum, titanium, and a hardening agent such as vanadium, the titanium functioning to protect and intensify the hardening effect of the vanadium so that less of this more expensive element can be used. As the aluminum and titanium develop fine-grained metal by deoxidization, metal so treated develops a desirable combination of strength and ductility, as well as strength and hardness when quenched and drawn. This treatment is applied chiefly to forging steels containing about 0.4 percent carbon and 1.8 percent manganese.

Malaya, which produced virtually no ilmenite until 1935, has since furnished 5,000 to 10,000 long tons a year, the output rising to 11,098 tons in 1939. This material is derived by magnetic separation from "amang", the refuse from washing crude tin concentrates. Stocks of amang in heaps, surveyed before September 1939, aggregated 358,700 tons; but it is not known how many years' accumulation this stock represents or how much ilmenite could be recovered annually from current tin-mining operations.[17] In accordance with the tin restriction agreement, no export is permitted if the amang contains as much as 0.5 percent tinstone.

Ferrocarbon-titanium continued to sell at $142.50 a short ton f. o. b. producer's plant. Notwithstanding the rapid advances in delivered cost of ilmenite raw material, titanium pigments remained virtually stationary in price. Titanium dioxide (carloads) dropped from 13¼ to 13 cents a pound but on December 31, 1940, was advanced to 13½ cents. Calcium-base pigment was quoted through much of the year at 5 to 6½ cents a pound, according to quality, and barium- or magnesium-base pigment at 5¼ to 6¼ cents, but the minimum prices on these items were advanced fractionally at the end of the year to 5¼ and 5½ cents, respectively. In 1921, titanium dioxide sold for 40 cents a pound and the composite barium-base product for 12 cents.

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[15] Moore, C. H., Jr., Origin of the Nelsonite Dikes of Amherst County, Va.: Econ. Geol., vol. 35, No. 5, August 1940, pp. 629–645.

[16] Engineering and Mining Journal, Metal and Mineral Markets. Vol. 12, No. 9, February 27, 1941, p. 3.

[17] Imperial Institute, The Mineral Resources of Malaya: Bull., vol. 38, No. 1, January–March 1940, pp. 76–77, 82.

Domestic production of rutile in Virginia and Arkansas undoubtedly attained an all-time record in 1940, although figures cannot be published. As reported in the official statistics, imports of rutile declined from 442 short tons valued at $23,170 in 1939 to only 156 tons valued at $14,849 in 1940, but probably several times this quantity of rutile is imported from Australia in the form of mixed concentrates classified as "zirconium ores," and doubtless the total supply of rutile from foreign sources increased over 1939.

Engineering and Mining Journal quotations for rutile remained unchanged throughout the year at 10 cents a pound (nominal) for 94-percent concentrate, and advanced from $60 to $75 a short ton for 88- to 90-percent concentrates, c.i.f. New York, reflecting increased freight rates as well as confirming a substantial increase in the foreign market values as indicated by the import statistics.

Production of metallic titanium involves special precautions owing to its avidity for both oxygen and nitrogen. The process of W. Kroll (Niagara Falls, N. Y.) described at the Electrochemical Society meeting at Ottawa, Ontario, October 2 to 5, 1940,[18] begins with $TiCl_4$, which is reduced with pure magnesium in a molybdenum-lined crucible in the presence of pure argon at about 1,000° C. The powdered metal, which does not alloy with magnesium, is separated from the magnesium salts by leaching and acid treatment. It is compressed into bars and melted in a special vacuum apparatus. The absence of all gases that might react with the metal is of especial importance. After melting, the titanium is easily rolled hot. A strip 1 mm. thick can be bent cold without fracture.

The high opacity and hiding power of titanium pigments are utilized not alone in paint and decorative coatings but to an increasing extent in paper, rubber, cosmetics, rayon, and other products. In papermaking they can be dispersed in starch, glue, and casein size, and their ready retention in paper pulps permits their addition as beater fillers—improving opacity, color, and brightness with a minimum of loading.[19]

For compounding white and colored rubber the dioxide and calcium-base pigments can be employed because of their fine particle size, high opacity, and chemical inertness. Titanium-barium pigments are used for similar reasons in leather manufacture, for drumming wet skins for white or light-color leathers.

By dispersing some of the titanium pigment in the viscous solution before spinning and thus incorporating it into rayon filaments, the luster of the rayon can be readily controlled without clogging spinnerets or weakening the material.

As it causes no irritation and is nontoxic, titanium dioxide finds increasing use in the cosmetic field, as whitener in face powders, skin lotions, etc. Additions of 1 percent TiO_2 notably improve the appearance of white soap.

In respect to uses, Wartman [20] says:

> By far the greater proportion of titanium consumed is in the form of purified titanium dioxide or mixtures thereof with other substances, such as zinc oxide, barium or calcium sulfate, etc., for use as white or yellow pigments in paints, enamels, rubber, plastics and like materials. On a basis of area covered per dollar of cost titanium dioxide is one of the cheapest white pigments. It possesses

[18] Canadian Chemical and Process Industries, vol. 24, No. 10, October 1940, p. 496.
[19] Canadian Chemical and Process Industries, Work cited in footnote 18, p. 508.
[20] Wartman, F. S., Titanium: Paper presented at dedication of Bureau of Mines Experiment Station, Salt Lake City, Utah, 1940.

also the advantages of being nontoxic and immune to discoloration by exposure to sulfur-bearing gases.

Ilmenite is the raw material from which white pigment is usually made. One process involves digestion of the concentrate with fuming sulfuric acid, filtration and clarification of the solution of iron and titanium sulfates, reduction of iron to the ferrous condition, and precipitation of titanic dioxide by hydrolysis.

Rutile as such is used to the extent of two or three thousand tons per year for coating welding rods for the electric arc. The fluxing power of titanium oxide gives a slag of the right viscosity and its electrical properties aid in producing a steady arc. Titanium compounds are also used in minor amounts as mordants in dyeing, as catalysts in various chemical reactions, for coloring and increasing the acid resistance of ceramic glazes, and for smoke screens in warfare.

The amount of titanium used pure or in metallic alloys is estimated to represent only a few percent of the total amount consumed. Most of the titanium used in the metallic state is in the form of alloys such as ferrotitanium, ferrocarbontitanium, cuprotitanium, etc. These alloys are added to molten metal as scavengers just before casting. . . .

Ferrocarbontitanium is the cheapest of the ferro-alloys and the one most used as a deoxidizer in steel and grey cast iron. In amounts up to a few pounds per ton, it is added just before casting. . . .

For carbon control purposes, the more expensive ferrotitanium is used.

There are at least three commercial processes for the production of this material. One is a modification of the thermite process. The thermite process cannot be used to produce pure titanium because the heat of reaction is not great enough, but it can be used to reduce a mixture of one part TiO_2 with several parts Fe_2O_3 to give ferrotitanium which may contain 22-42 percent Ti, and 3-8 percent Al with very little carbon. The reduction may also be carried out by dropping the oxides to be reduced onto a bath of molten aluminum. The third method depends on the fact that at the high temperature of the electric furnace, and in the presence of molten iron, an excess of silicon will reduce titanium dioxide to metal, although at lower temperatures metallic titanium will decompose silica. By this process a low-carbon, aluminum-free alloy for use in grey cast iron is obtained. . . .

The use of titanium in sintered hard alloys for machine tools is a recent development. The carbide, nitride, and silicide may be so used. The latter two are among the hardest synthetic compounds known to man. . . .

Titanium carbide is reported to be harder than tungsten carbide but not so good a conductor of heat. For this reason the use of titanium carbide in the tool is desirable if maximum hardness is essential, but otherwise is detrimental since the lower heat conductivity adversely affects the life of the tool.

It will have been noted that thus far no mention has been made of uses for pure titanium and alloys of which titanium forms a major part. The reason is simply that there is no real field of application for either type of material at present. Titanium in alloying with other metals, tends to form compounds insoluble in the solid state or if it forms solutions, the tendency is toward those which are stable only in the liquid state. Such conditions favor the formation of brittle alloys of little structural use. Pure titanium is so difficult to prepare at present that it is of no commercial use, although with physical properties similar to those of wrought iron and only sixty percent as heavy per unit volume, it would be an interesting structural material if it could be prepared cheaply. . . .

ZIRCONIUM

Improved demand for zircon was reported by Zircon Rutile, Ltd., which recently completed plant extensions increasing capacity about 70 percent for treating beach sands near Byron Bay on the north coast of New South Wales, Australia. Imports into the United States of "zirconium ore" jumped in 1940 to 16,845 short tons, about one-half of which was mixed zircon-rutile concentrate from Australia.

Zircon is used to a steadily growing extent in refractories, specialized porcelains, and heat-resisting glass. It is also the usual raw material for the manufacture of zirconium compounds, of which opacifiers are probably most important, supplanting antimony and to some extent tin oxide in vitreous enamels and ceramic glazes. The use of zircon enamels is growing; they are nonpoisonous and the same opacity is obtained with 2 percent zirconium as with 6 percent antimony oxide, it is claimed.

Metallic zirconium is employed as powder or ductile metal in photoflash bulbs, radio-transmitter tubes, ammunition primers, spot welding electrodes, and a variety of other applications. According to information furnished by the Foote Mineral Co. (1609 Summer St., Philadelphia, Pa.), this metal has a unique combination of high corrosion resistance and ability to absorb large volumes of certain gases. Below 100° C., the metal is immune to attack by some of the most corrosive agents known. At 500° to 860° C. it can absorb great quantities of hydrogen and at higher temperatures oxygen, nitrogen, carbon monoxide, carbon dioxide, and other gases. Zirconium, accordingly, is particularly well suited as a "getter" in vacuum tubes and chemical processes to improve and maintain high vacuum. In steelmaking, zirconium acts as a scavenger and deoxidizer, removing nitrogen and oxygen as well as nonmetallic inclusions. In the range 0.08 to 0.10 percent zirconium the improvement in grain is marked, and above 0.15 percent the zirconium combines with sulfur to produce a better surface on high-sulfur steels. Cast nickel-silicon bronze and other nonferrous alloys may benefit by additions of zirconium.

An interesting property of zirconium and of titanium metal is that, when drawn across glass or a glazed ceramic surface, they leave a brilliant, silvery, adherent streak. This affords a means of decorating high-grade glassware and pottery without the present necessity of using platinum compounds, followed by a special firing operation.

Engineering and Mining Journal quotations at the end of 1940 were: Zircon ore, 55 percent ZrO_2, f. o. b. Atlantic seaboard, carloads, $70 a short ton. Zirconium metal, commercially pure, powdered, $7 a pound. Zirconium alloys, 12 to 15 percent Zr, 39 to 43 percent Si, $102.50 to $107.50 a gross ton; 35 to 40 percent Zr, 42 to 52 percent Si, 14 and 16 cents a pound. These quotations are the same as those in 1939 except for zircon ore and the lower-grade alloy (ferrosilicon zirconium). The former remained at $55 a ton until the fourth quarter of the year, when it began to advance by $5 steps to $70 a ton in early December. The alloy was advanced from $97.50 to $102.50, where it had remained for a long time, to $102.50 to $107.50 in July.

PART III. NONMETALS

BITUMINOUS COAL[1]

SUMMARY OUTLINE

The bituminous-coal industry in 1940 responded to the increased industrial activity growing out of the defense program; production was much greater than in 1939 and reasonably steady throughout the year.

An outstanding event of the year was the establishment of minimum prices for bituminous coal, f. o. b. mine, effective October 1, 1940, by the Bituminous Coal Division, United States Department of the Interior, operating under the Bituminous Coal Act of 1937. The Coal Act, due to expire April 26, 1941, was granted a 2-year extension by the Congress.

Production.—The output of soft coal in 1940 was 453,245,000 net tons—a 15-percent increase over 1939 (see tables 2 and 3). The coal industry made substantial gains, in common with general business activity throughout the year, and the total output for the year was 46 percent above the record low of 1932, although 15 percent below the 534,989,000 tons of 1929 (see figs. 1, 2, 4, and 5).

Imports and exports.—Exports of bituminous coal rose from 11,590,478 net tons in 1939 to 16,465,928 in 1940—a 42-percent increase. At the same time imports, which are relatively insignificant, rose only 5 percent from 355,115 tons in 1939 to 371,571 in 1940. As in the past, virtually all these imports and more than 80 percent of the exports represented trade with Canada (see fig. 10).

Consumption.—After allowances have been made for foreign trade and changes in consumers' stocks, the total consumption of bituminous coal in 1940 totaled 430,723,643 tons—an increase of 52,745,006 net tons over 1939. Each of the more important classes of consumers shared the increase, which ranged from 109 percent for

[1] The collection of statistics on the bituminous-coal industry which previously was conducted by the Bureau of Mines is now performed by the Bituminous Coal Division, U. S. Department of the Interior, H. A. Gray Director.

Material in this chapter was prepared in the Division's Economics Branch under the supervision of G. A. Lamb, chief. They were completed under the immediate direction of W. H. Young, in collaboration with R. L. Anderson and M. E. McMillan.

Final figures for 1939 are being compiled under a joint agreement between the Bureau of the Census and the Bituminous Coal Division, and these figures will be released later. Final figures for 1940 are being compiled by the Bituminous Coal Division. and these figures will be released later. Data for 1938 are final.

beehive coke ovens to 7 percent for railroads. Bunker consumption declined slightly (see fig. 3 and table 4).

Changes in stocks.—The reserve supply of coal in the hands of industrial consumers and retail coal yards rose from a total of 44,571,000 net tons at the beginning of the year to 50,998,000 tons at the close. Between the same periods stocks on the upper Lake docks declined 591,996 tons, and unbilled coal in cars at the mines or classification yards fell 234,800 tons (see fig. 1 and tables 1 and 5).

Distribution.—Shipments of bituminous coal during 1940 rose substantially above the 1939 level in each of the primary channels of distribution. Table 6 shows trends in distribution of bituminous coal for 1923, 1929, and 1936–40. Changes in the monthly volume of the more important movements are shown in figure 4.

Freight rates.—The average revenue per ton of bituminous coal

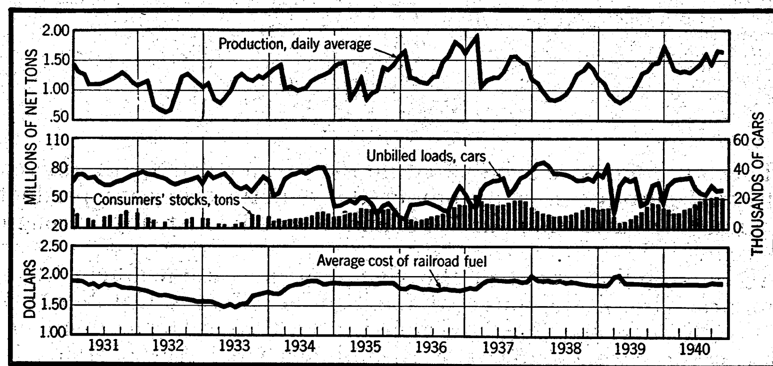

FIGURE 1.—Trends of production, stocks, and prices of bituminous coal, 1931–40.

originated, often called the average railroad freight charge, was $2.23 in 1939 compared with $2.22 in 1940.

Mechanization.—Data available early in 1941[2] indicate continuation of the sharp advance in the mechanical loading of bituminous coal in 1940.

Sales of mechanical loading equipment for use in bituminous-coal mines, in terms of total capacity, increased 11.6 percent in 1940 over 1939. Reports from 32 manufacturers show sales of 233 mobile loaders for 1940 as against 292 in 1939 and 344 in the peak year 1936. Sales of conveyors at bituminous and anthracite mines totaled 1,762 in 1940 compared with 1,311 in 1939 and 994 in 1936. Trends from 1900 to 1939 are shown in figure 9.

Mechanical cleaning.—Sales of mechanical cleaning equipment in 1940 (see Coal Age, February 1941, p. 59) indicate a substantial gain over earlier years in mechanically cleaned coal. The total capacity of cleaning plants sold in 1940 is estimated at 12,000 net tons of cleaned coal an hour.

Trend of employment.—Estimates on the average number of men employed at bituminous-coal mines in 1940 indicate a slight rise over the 1939 figure of 422,000 which is based upon returns to the Bureau of the Census. Indexes compiled by the Bureau of Labor Statistics upon the basis of a sample that includes more than half the workers

[2] Coal Age, February 1941, p. 59, and Mining Congress Journal, February 1941, p. 23.

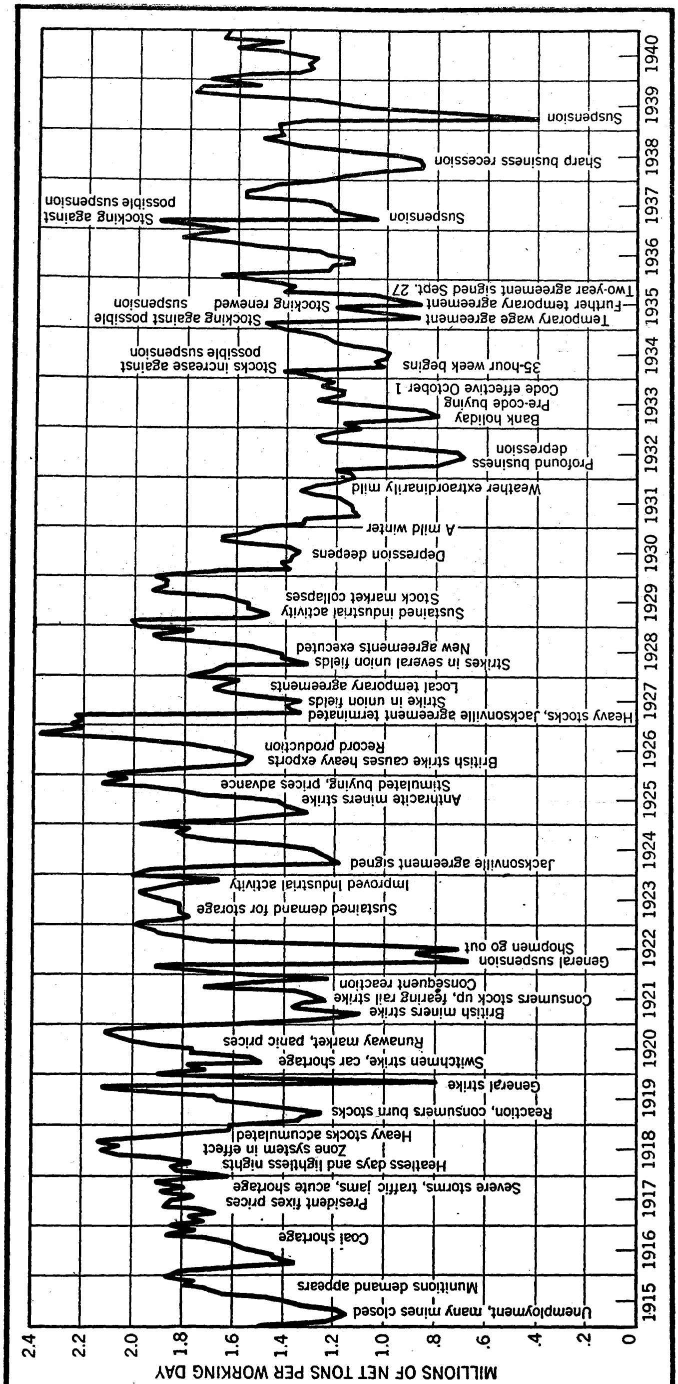

FIGURE 2.—Average production of bituminous coal per working day in each month, 1915–40.

in the industry show an increase of almost 2 percent in employment for 1940 over 1939 if normal operations during the April–May suspension are assumed in 1939. Reports from mining departments of several States indicate no substantial change for the same period. These data suggest an estimate of 431,000 employees for 1940. In comparison with 1929 (when the average number of men employed at bituminous-coal mines totaled 502,993) the 1940 figure represents a decrease of 72,000 (see fig. 9).

Statistics for employment of bituminous-coal workers cannot be interpreted satisfactorily without considering the intermittent operation that characterizes most coal mines. In 1939, for instance, it is

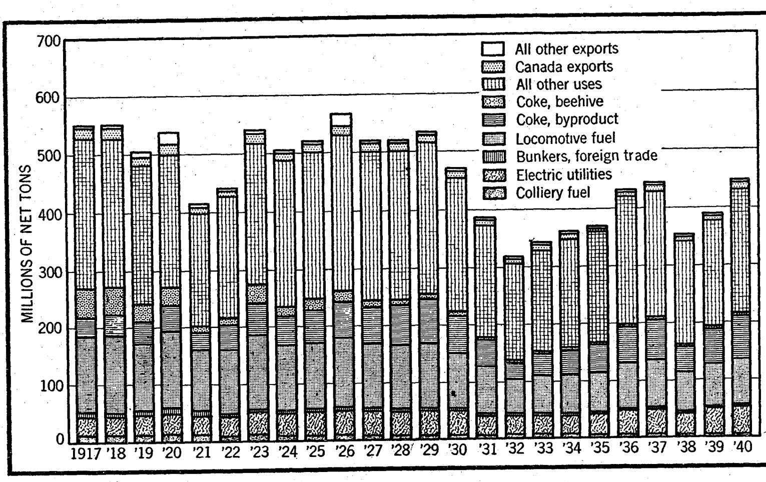

FIGURE 3.—Tonnage of bituminous coal absorbed by the principal branches of consumption, 1917–40.

estimated that the bituminous mines were operated an average of 179 days out of the 261 possible under the 5-day week of the union-wage agreement. Consequently, a substantial proportion of the manpower on the rolls of the industry was idle throughout the year, the number depending on the market and the season.

Trend of capacity.—The potential full-time output of active mines in the bituminous-coal industry increased 2 percent between 1938 and 1939. The coal industry reached its peak capacity in 1923 when (upon the basis of 308 operating days) the potential output was 970,000,000 tons. Subsequent liquidations forced the closing or abandonment of thousands of mines and reduced the indicated capacity to 622,000,000 tons in 1934. The potential output upon a 308-day basis was 676,000,000 tons in 1939. Under the 5-day week, full-time operation is limited to approximately 261 days. The potential capacity of operating mines upon a 261-day basis was 573,000,000 tons in 1939 compared with the total actual production of 393,065,000 tons.

Trend of fuel efficiency.—Since the World War period improvements in fuel engineering have contributed to a continuing decline in the market for coal for industrial uses. Although the effect of such improvements is cumulative from year to year the rate of decline is smaller in recent years, as the remaining margin of possible increase in fuel efficiency becomes progressively less.

The class I steam railroads had the same average coal consumption for coal-fired locomotives in 1940 as in 1939—115 pounds per 1,000 gross ton-miles of freight service (see fig. 6 and table 8). For all railroad freight service, including oil-burning and electric locomotives, the average consumption of energy, converted to coal equivalent, was reduced from 113 pounds per 1,000 gross ton-miles in 1939 to 112 pounds in 1940. During the same period, public-utility power plants lowered their average consumption of fuel from 1.39 pounds to 1.37 per kilowatt-hour. In the iron and steel industry the average consumption of coke in iron blast furnaces was increased from 1,778 pounds in 1939 to 1,781 in 1940 per net ton of pig iron produced, representing a drop from 2,547 to 2,541 pounds of coking coal per net

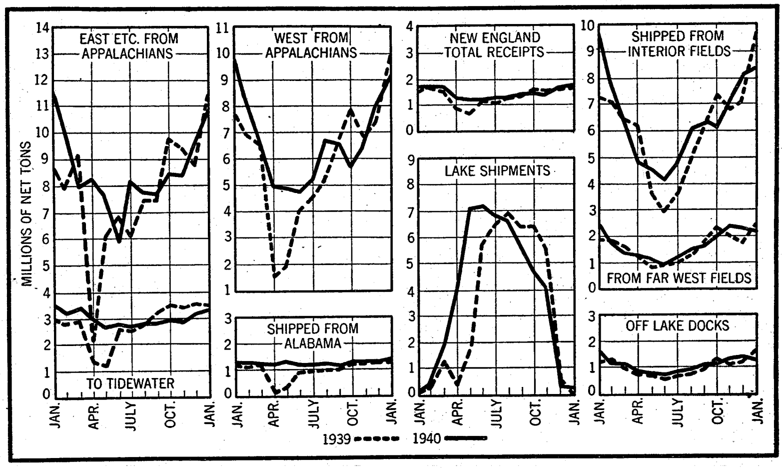

FIGURE 4.—Monthly movement of bituminous coal in the major channels of distribution, 1939–40.

ton (2,853 and 2,846 pounds per gross ton) of pig iron for 1939 and 1940, respectively.

Improvements in combustion practice among domestic consumers and small industrial and commercial establishments also are effecting decreases in the aggregate volume of fuel consumption. Furthermore, increasing economy in combustion methods is being supplemented by improvements in space-heating methods and by progress in building construction and insulation.

Competition of oil and gas.—In the competitive struggle between coal and oil in 1940 coal appeared to hold its own or gain slightly on oil. The consumption of coal by railroads in 1940 increased 7.0 percent over 1939, while the consumption of oil by railroads increased 7.1 percent during the same period. The consumption of coal by steamships in 1940 decreased 3.4 percent from 1939, while the consumption of oil by steamships declined 5.4 percent for the same period. Electric public utilities consumed 15.5 percent more coal in 1940 than in 1939 while consuming 3.7 percent less oil and 4.2 percent less gas during the same period. However, the kilowatt-hours produced by water power at electric public-utility power plants increased 8.5 percent in 1940 over 1939.

In domestic heating, comparable figures are available for mechanical firing equipment only. Estimates of sales of new equipment reflect a marked increase in the use of automatic coal-burning equipment. Sales of domestic stokers (under 61 pounds an hour capacity) using bituminous coal rose from 78,332 in 1939 to 123,167 in 1940—a 57-percent increase—whereas sales of oil burners for domestic use rose from 165,711 to 197,755, a 19-percent increase. This does not entirely represent the relative positions of the two competing fuels in new plants because the oil-burner sales cover virtually all installations in which oil is used, while sales of mechanical stokers do not consider new installations of hand-fired equipment.

TABLE 1.—*Salient statistics of the bituminous-coal industry in the United States, 1939–40*

[All tonnage figures represent net tons]

	1939	1940	Change in 1940 (percent)
Production	[1] 393,065,000	[1] 453,245,000	+15.3
Exports to Canada and Mexico [2]	9,975,919	13,537,342	+35.7
Exports overseas and all other [2]	1,614,559	2,928,586	+81.4
Imports [2]	355,115	371,571	+4.6
Consumption in the United States (calculated)[3]	[1] 377,978,637	[1] 430,723,643	+14.0
Stocks at end of year:			
Industrial consumers and retail yards	44,571,000	50,998,000	+14.4
Stocks on upper Lake docks	7,590,254	6,998,258	−7.8
Unbilled loads, at mines or in classification yards [4]	1,533,100	1,298,300	−15.3
Price indicators (average per net ton):			
Average cost of railroad fuel purchased, f. o. b. mines [5]	$1.91	$1.88	−1.6
Average cost of coking coal at merchant byproduct ovens [6]	$4.57	$4.40	−3.7
Average cost of bunker coal to vessels in foreign trade [7]	$4.83	[1] $4.81	−0.4
Average value of exports to all countries (at port)[8]	$3.69	[1] $3.69	
Average retail price—38 cities [9]	$8.52	[1] $8.60	+0.9
Average railroad freight charge per net ton [10]	$2.23	$2.22	−0.4
Underground loading machinery sold to bituminous mines: [11]			
Mobile loading machines (number)	292	233	−20.2
Scrapers (number)	18	36	+100.0
Conveyors, including those with duckbills (units)	1,095	1,573	+43.7
Pit-car loaders (units)	2	3	+50.0
Average number of men employed at mines operating [12]	[1] 422,000	[1] 431,000	+2.1
Fuel-efficiency indicators:			
Pounds of coal per kw.-hr. at electric power plants [13]	1.39	[1] 1.37	−1.4
Pounds per 1,000 gross ton-miles—railroads [14]	113	[1] 112	−0.9

[1] Subject to revision.
[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.
[3] Production plus imports minus exports plus or minus net changes in consumers' stocks.
[4] Association of American Railroads.
[5] Interstate Commerce Commission. Excludes freight charges.
[6] As reported by coke operators to the Bureau of Mines.
[7] Computed from records of the Bureau of Foreign and Domestic Commerce.
[8] Computed from records of the Bureau of Foreign and Domestic Commerce. The figure represents the average value at the point of export of shipments to all foreign countries, including Canada.
[9] Bureau of Labor Statistics.
[10] Average receipts per net ton of revenue bituminous coal originated, as reported by the Interstate Commerce Commission.
[11] Young, W. H., Anderson, R. L., Lamb, G. A., and Shore, F. M., Mechanization Sales: Coal Age, February 1941, pp. 59–61; and Mining Cong. Jour., February 1941, pp. 23–25.
[12] The estimate for 1939 is based upon incomplete returns to the Bureau of the Census. The figure for 1940 is estimated from various sources, including the employment index of the Bureau of Labor Statistics and State mine inspectors' reports.
[13] Federal Power Commission.
[14] Interstate Commerce Commission; includes coal equivalent of fuel oil consumed.

The bituminous figures shown in table 3 are preliminary estimates based upon railroad carloadings and river shipments of coal and beehive coke, supplemented by direct reports from a number of mining companies, local coal operators' associations and detailed monthly production statistics compiled by the State Mine Departments of Colorado, Illinois, Pennsylvania, Washington, and West Virginia. In making the estimates, allowance is made for commercial truck shipments, local sales, and colliery fuel and for small trucking mines producing over 1,000 tons a year. Where a mine is on the border between two States, the production is accredited to the State from which the coal is extracted rather than that in which the tipple is situated.

The estimates given are based upon the latest information available and differ in some instances from the current figures previously published in the Weekly Coal Reports.

TABLE 2.—*Preliminary estimates of production of bituminous coal in the United States, by weeks, 1939–40* [1]

1939				1940			
Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)	Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)
Jan. 7	7,782,000	5.1	1,526,000	Jan. 6	8,932,000	5.1	1,751,000
14	8,122,000	6	1,354,000	13	10,069,000	6	1,678,000
21	8,295,000	6	1,383,000	20	9,954,000	6	1,659,000
28	8,717,000	6	1,453,000	27	10,363,000	6	1,727,000
Feb. 4	8,220,000	6	1,370,000	Feb. 3	10,208,000	6	1,701,000
11	8,782,000	6	1,464,000	10	9,931,000	6	1,655,000
18	8,668,000	6	1,445,000	17	9,093,000	6	1,516,000
25	8,736,000	5.9	1,481,000	24	9,105,000	5.9	1,543,000
Mar. 4	8,577,000	6	1,430,000	Mar. 2	8,794,000	6	1,466,000
11	8,148,000	6	1,358,000	9	8,173,000	6	1,362,000
18	7,792,000	6	1,299,000	16	8,442,000	6	1,407,000
25	7,541,000	6	1,257,000	23	8,013,000	6	1,336,000
Apr. 1	7,118,000	5.3	1,343,000	30	8,420,000	6	1,403,000
8	1,687,000	6	281,000	Apr. 6	6,953,000	5.1	1,363,000
15	1,946,000	6	324,000	13	7,662,000	6	1,277,000
22	2,663,000	6	444,000	20	7,297,000	6	1,216,000
29	3,386,000	6	564,000	27	7,851,000	6	1,309,000
May 6	2,804,000	6	467,000	May 4	7,987,000	6	1,331,000
13	1,085,000	6	181,000	11	7,818,000	6	1,303,000
20	5,095,000	6	849,000	18	7,541,000	6	1,257,000
27	6,168,000	6	1,028,000	25	7,839,000	6	1,307,000
June 3	5,815,000	5.4	1,077,000	June 1	7,456,000	5.4	1,381,000
10	6,320,000	6	1,053,000	8	7,962,000	6	1,327,000
17	6,376,000	6	1,063,000	15	7,756,000	6	1,293,000
24	6,391,000	6	1,065,000	22	7,898,000	6	1,316,000
July 1	6,682,000	6	1,114,000	29	8,066,000	6	1,344,000
8	5,917,000	5	1,183,000	July 6	7,159,000	5	1,432,000
15	7,062,000	6	1,177,000	13	8,244,000	6	1,374,000
22	7,130,000	6	1,188,000	20	7,775,000	6	1,296,000
29	7,413,000	6	1,236,000	27	8,090,000	6	1,348,000
Aug. 5	7,377,000	6	1,230,000	Aug. 3	8,218,000	6	1,370,000
12	7,529,000	6	1,255,000	10	8,544,000	6	1,424,000
19	7,520,000	6	1,253,000	17	8,915,000	6	1,486,000
26	7,830,000	6	1,305,000	24	8,883,000	6	1,481,000
Sept. 2	8,211,000	6	1,369,000	31	9,072,000	6	1,512,000
9	7,785,000	5	1,557,000	Sept. 7	7,954,000	5	1,591,000
16	9,060,000	6	1,510,000	14	9,139,000	6	1,523,000
23	9,344,000	6	1,557,000	21	9,321,000	6	1,554,000
30	10,210,000	6	1,702,000	28	10,201,000	6	1,700,000
Oct. 7	10,460,000	6	1,743,000	Oct. 5	8,761,000	6	1,460,000
14	10,715,000	6	1,786,000	12	8,346,000	6	1,391,000
21	10,687,000	6	1,781,000	19	8,289,000	6	1,382,000
28	10,661,000	6	1,777,000	26	8,810,000	6	1,468,000
Nov. 4	10,582,000	6	1,764,000	Nov. 2	8,665,000	6	1,444,000
11	10,276,000	5.6	1,835,000	9	8,974,000	5.5	1,632,000
18	10,151,000	6	1,692,000	16	9,750,000	5.5	1,773,000
25	9,280,000	5.1	1,820,000	23	9,440,000	5.2	1,815,000
Dec. 2	9,119,000	5.9	1,546,000	30	9,712,000	5.8	1,674,000
9	9,217,000	6	1,536,000	Dec. 7	9,871,000	6	1,645,000
16	8,979,000	6	1,497,000	14	9,878,000	6	1,646,000
23	9,274,000	6	1,546,000	21	9,934,000	6	1,656,000
30	8,360,000	5	1,672,000	28	7,956,000	5	1,591,000
				Jan. 4, 1941	[2] 3,761,000	[2] 2	[3] 1,755,000
	393,065,000	305.3	1,287,000		453,245,000	306.5	1,479,000

[1] Includes for purposes of historical comparison and statistical convenience, the production of lignite.
[2] Figures represent output and number of working days in that part of week included in the calendar year shown.
[3] Average daily production for the entire week and not for the working days in the calendar year shown.

TABLE 3.—*Estimated monthly production of coal in the United States, by States, 1939–40, in thousands of net tons*

State	January	February	March	April	May	June	July	August	September	October	November	December	Total
1939													
Alabama	1, 197	1, 145	1, 268	133	368	966	988	1, 053	1, 067	1, 255	1, 257	1, 298	11, 995
Alaska	11	11	11	12	13	15	9	12	15	14	12	11	146
Arkansas	125	129	63	8	7	6	21	145	173	193	122	130	1, 122
Colorado	668	667	548	416	196	217	243	398	515	690	678	654	5, 890
Georgia [1]	2	2	3	3	3	2	1	1	2	2	2	2	25
Illinois	4, 904	4, 868	4, 458	3, 800	2, 494	1, 929	2, 406	3, 197	3, 854	5, 064	4, 688	4, 788	46, 450
Indiana	1, 726	1, 668	1, 685	1, 508	860	797	880	1, 093	1, 340	1, 702	1, 687	1, 704	16, 650
Iowa	334	327	332	268	118	120	156	215	253	320	295	312	3, 050
Kansas	286	327	233	200	98	87	148	240	288	350	331	332	2, 920
Kentucky:													
Eastern	3, 012	2. 800	2, 907	255	1, 510	3, 075	3, 130	3, 604	3, 774	4, 218	3, 595	2, 850	34, 730
Western	805	838	702	797	510	326	398	584	705	806	778	826	8, 075
Maryland	144	128	173	2	84	111	94	115	130	167	162	158	1, 468
Michigan	50	46	56	4	11	18	9	32	46	54	56	52	434
Missouri	381	365	314	280	170	122	167	194	250	352	332	348	3, 275
Montana	273	266	232	171	162	180	162	210	238	336	302	278	2, 810
New Mexico	132	121	115	112	78	57	82	89	86	115	112	107	1, 206
North Carolina	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
North Dakota	240	287	176	87	60	68	67	80	188	360	258	218	2, 089
Ohio	1, 920	1, 750	1, 994	160	854	1, 487	1, 532	1, 753	1, 861	2, 334	2, 126	1, 861	19, 632
Oklahoma	132	128	74	53	29	26	34	115	124	177	154	132	1, 178
Pennsylvania (bituminous)	8, 047	7, 673	8, 694	151	3, 736	7, 065	7, 117	8, 196	9, 178	11, 453	11, 212	9, 668	92, 190
South Dakota	5	7	• 3	1	2	2	1	1	4	10	7	7	50
Tennessee	492	500	486	150	257	387	430	484	498	579	532	485	5, 280
Texas	65	60	65	61	65	65	72	78	76	70	68	65	810
Utah	350	382	268	200	98	135	134	217	372	453	393	338	3, 340
Virginia	1, 163	1, 053	1, 100	181	660	1, 122	1, 108	1, 308	1, 392	1, 605	1, 384	1, 154	13, 230
Washington	155	156	160	134	90	110	103	124	164	174	172	148	1, 690
West Virginia:													
Southern [2]	6, 548	6, 039	6, 666	99	3, 980	7, 086	7, 352	8, 617	8, 663	9, 773	8, 880	6, 993	80, 696
Northern [3]	2, 433	2, 279	2, 551	137	1, 359	2, 256	2, 197	2, 417	2, 655	3, 153	3, 130	2, 675	27, 242
Wyoming	486	471	446	430	225	318	350	444	554	614	575	470	5, 383
Other Western States	2	1	2	(4)	(4)	(4)	(4)	(4)	(4)	1	1	2	9
Total, bituminous coal [5]	36. 088	34, 494	35, 785	9, 813	18, 097	28, 155	29, 391	35, 016	38, 465	46, 394	43, 301	38, 066	393, 065
Pennsylvania anthracite [6]	5, 019	4, 169	3, 652	5, 367	5, 141	3, 577	2, 951	3, 883	4, 840	4, 985	3, 989	3, 914	51, 487
Grand total	41, 107	38, 663	39, 437	15, 180	23, 238	31, 732	32, 342	38, 899	43, 305	51, 379	47, 290	41, 980	444, 552

1940													
Alaska	10	10	11	12	13	15	9	12	12	10	18	18	150
Alabama	1, 330	1, 317	1, 232	1, 236	1, 302	1, 192	1, 185	1, 258	1, 160	1, 330	1, 245	1, 363	15, 150
Arkansas [7]	539	359	142	64	78	83	164	325	344	287	375	403	3, 163
Colorado	930	673	468	414	340	249	310	453	560	555	767	797	6, 516
Georgia [1]	3	4	3	3	2	2	2	1	2	2	2	3	29
Illinois	5, 980	5, 090	4, 350	3, 173	3, 007	2, 842	3, 077	3, 856	3, 995	4, 077	4, 637	5, 411	49, 495
Indiana	2, 107	1, 894	1, 550	1, 295	1, 200	1, 095	1, 175	1, 503	1, 542	1, 440	1, 714	2, 050	18, 565
Iowa	380	295	230	182	180	170	174	207	245	235	292	318	2, 908
Kansas [8]	961	754	555	385	354	330	377	491	552	535	658	784	6, 736
Kentucky:													
Eastern	3, 850	3, 498	2, 910	3, 085	3, 460	3, 153	3, 450	3, 610	3, 284	3, 220	3, 150	3, 062	39, 732
Western	1, 320	970	695	560	504	433	535	682	712	635	761	861	8, 668
Maryland	167	158	137	114	102	91	98	114	105	120	127	145	1, 478
Michigan	66	60	57	33	10	6	10	33	38	43	42	42	440
Missouri	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
Montana	298	253	198	214	210	184	198	225	218	298	347	331	2, 974
New Mexico	125	102	74	89	82	80	82	72	79	88	95	113	1, 081
North Carolina	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
North Dakota [9]	320	212	177	117	76	57	76	96	142	288	400	295	2, 256
Ohio	2, 092	1, 900	1, 730	1, 570	1, 780	1, 824	1, 942	1, 987	1, 857	1, 650	1, 820	1, 940	22, 092
Oklahoma	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)
Pennsylvania (bituminous)	9, 899	8, 822	8, 583	7, 984	8, 624	8, 452	9, 449	9, 865	9, 944	10, 782	10, 240	10, 263	112, 907
South Dakota	(9)	(9)	(9)	(9)	(9)	(9)	(9)	(9)	(9)	(9)	(9)	(9)	(9)
Tennessee	594	567	464	532	527	442	470	497	477	460	465	515	6, 010
Texas	69	78	53	67	68	65	52	47	41	41	40	40	661
Utah	426	270	220	192	158	154	202	332	368	340	420	442	3, 524
Virginia	1, 436	1, 289	1, 156	1, 143	1, 296	1, 110	1, 265	1, 310	1, 260	1, 270	1, 195	1, 220	14, 950
Washington	182	134	120	119	104	114	118	130	150	146	185	186	1, 688
West Virginia:													
Southern [2]	8, 440	7, 544	7, 235	7, 364	8, 519	7, 597	8, 454	8, 711	8, 371	7, 879	7, 711	7, 357	95, 182
Northern [3]	2, 825	2, 546	2, 485	2, 449	2, 541	2, 364	2, 620	2, 760	2, 683	2, 401	2, 660	2, 786	31, 120
Wyoming	625	477	407	393	359	296	396	433	506	564	642	650	5, 748
Other Western States	2	1	2	1	(4)	(4)	(4)	(4)	3	4	4	5	22
Total bituminous coal [5]	44, 976	39, 277	35, 244	32, 790	34, 896	32, 400	35, 890	39, 010	38, 650	38, 700	40, 012	41, 400	453, 245
Pennsylvania anthracite [6]	5, 783	3, 648	3, 881	3, 853	4, 070	4, 492	4, 534	3, 883	4, 172	4, 355	3, 980	4, 834	51, 485
Grand total	50, 759	42, 925	39, 125	36, 643	38, 966	36, 892	40, 424	42, 893	42, 822	43, 055	43, 992	46, 234	504, 730

[1] North Carolina included with Georgia.
[2] Includes operations on the N. & W., C. & O., Virginian, K. & M., and B. C. & G., and on the B. & O. in Kanawha, Mason, and Clay Counties. Excludes output of a mine whose tipple is in McDowell County, W. Va., but whose coal comes chiefly from Tazewell County, Va., and therefore is credited to Virginia.
[3] Rest of State, including the Panhandle district, and Grant, Mineral, and Tucker Counties.
[4] Less than 500 tons.
[5] Includes the output of lignite for historical comparison and statistical convenience.
[6] U. S. Bureau of Mines. Includes colliery fuel, dredge and washery coal, and shipments by truck from authorized operations. Does not include an unknown amount of bootleg product.
[7] Oklahoma included with Arkansas.
[8] Missouri included with Kansas.
[9] South Dakota included with North Dakota.

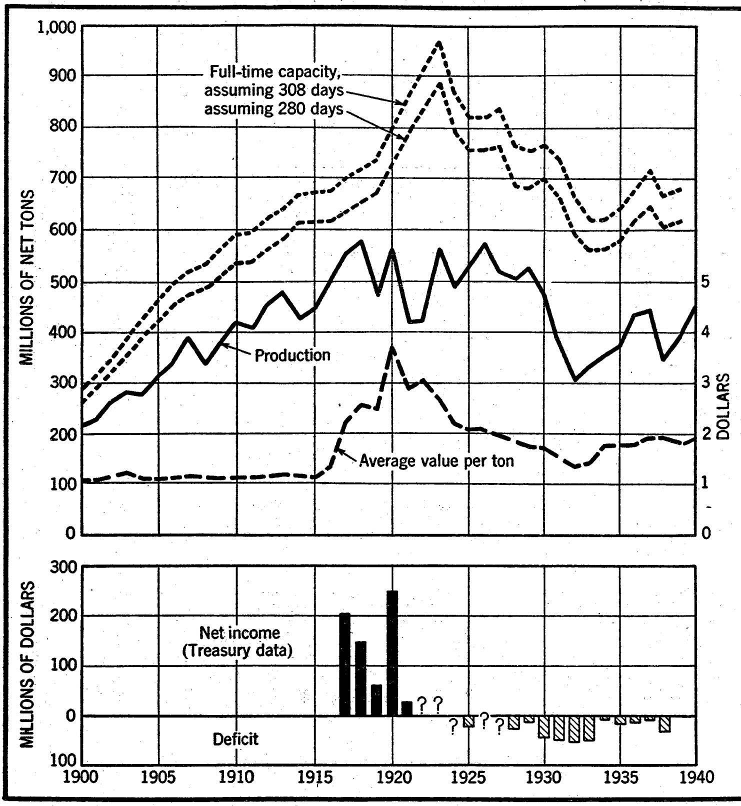

FIGURE 5.—Trends of bituminous-coal production, realization, mine capacity, and net income or deficit in the United States, 1900–1940.

TABLE 4.—*Changes in the United States consumption of bituminous coal by such classes of consumers as report currently and by all other consumers, 1929 and 1934–40, in thousands of net tons* [1]

[Information on several other classes of consumers is available for certain years. The items shown in this table are selected because they are available in strictly comparable form for each year]

Year	Consumed in the United States								Exported [2]		Total of consumption and exports [8]
	Colliery fuel	Electric power utilities [3]	Bunkers, foreign trade [2]	Locomotive fuel, class I roads [4]	Coke [5] Beehive ovens	Coke [5] By-product ovens	All other uses [6]	Total consumption [7]	To Canada and Mexico	To other countries (seaborne)	
1929	4,663	44,937	4,287	113,894	10,028	76,759	264,987	519,555	14,727	2,702	536,984
1934	3,175	33,555	1,321	70,496	1,635	44,343	192,518	347,043	10,213	656	357,912
1935	3,103	34,807	1,576	71,335	1,469	49,046	198,956	360,292	9,044	698	370,034
1936	3,227	42,025	1,622	81,130	2,698	63,244	228,850	422,796	9,912	743	433,451
1937	3,052	44,766	1,832	82,667	4,927	69,575	221,678	428,497	12,052	1,093	441,642
1938	2,493	40,212	1,352	68,794	1,360	45,266	185,173	344,650	9,561	929	355,140
1939 [9]	2,810	46,223	1,477	73,833	2,298	61,216	190,122	377,979	9,976	1,614	389,569
1940 [9]	3,241	53,398	1,426	78,966	4,803	76,583	212,307	430,724	13,537	2,929	447,190

[1] Comparable data for other earlier years in Minerals Yearbook, 1937, p. 799.
[2] Bureau of Foreign and Domestic Commerce.
[3] Geological Survey and Federal Power Commission. Represents all coal consumed by public utility power plants in power generation, including a small amount of anthracite.
[4] Interstate Commerce Commission. Represents bituminous coal consumed as locomotive fuel by class I steam railways, excluding switching and terminal companies. During more recent years, data are available on the consumption of coal by all classes of railroads and all uses, that is, total railway consumption, which was 80,454,720 net tons in 1940.
[5] Bureau of Mines.
[6] Obtained by subtracting the known items from the calculated total consumption. Includes general manufacturing, domestic, and many miscellaneous uses.
[7] Production plus imports minus exports, plus or minus changes in consumers' stocks.
[8] Includes imports.
[9] Subject to revision.

TABLE 5.—*Stocks of bituminuos coal in hands of commercial consumers and of anthracite and bituminous coal in retail dealers' yards in the United States, 1939–40*

Date	Total stock of bituminous coal estimated (net tons)	Days' supply at current rate of consumption on date of stock taking									
		Byproduct coke plants	Steel plants	Other industrials	Coal-gas plants	Electric utilities	Retail yards, bituminous	Railroads	Cement mills	Total bituminous	Retail yards, anthracite
1939											
Jan. 1	40,720,000	49	25	35	54	71	25	24	32	35	37
Feb. 1	39,720,000	48	27	34	49	72	23	25	51	35	29
Mar. 1	39,887,000	48	32	31	45	78	19	29	46	34	25
Apr. 1	40,505,000	46	40	33	47	86	21	34	35	37	22
May 1	31,746,000	32	29	32	41	81	22	32	24	35	35
June 1	25,413,000	24	25	32	32	69	33	27	20	34	61
July 1	26,991,000	24	23	32	41	61	54	23	16	34	71
Aug. 1	29,725,000	30	24	39	48	61	56	22	19	37	61
Sept. 1	33,624,000	34	23	40	55	61	49	22	20	38	58
Oct. 1	36,943,000	34	22	43	58	59	32	20	24	35	47
Nov. 1	42,020,000	35	20	42	62	58	38	21	26	35	57
Dec. 1	45,542,000	38	19	42	58	60	34	22	29	36	58
Dec. 31	44,571,000	37	21	40	56	60	26	23	32	34	37
1940											
Jan. 1	44,571,000	37	21	40	56	60	26	23	32	34	37
Feb. 1	40,222,000	30	18	32	48	57	16	18	43	27	25
Mar. 1	39,077,000	30	21	32	45	63	16	21	52	28	23
Apr. 1	35,108,000	28	21	31	43	71	13	20	38	27	17
May 1	35,721,000	27	23	35	36	80	21	20	33	32	24
June 1	39,203,000	31	22	42	59	82	41	22	29	39	37
July 1	41,563,000	32	24	50	69	80	57	22	28	43	40
Aug. 1	45,438,000	35	26	56	74	80	61	25	30	47	46
Sept. 1	48,111,000	36	26	56	66	79	59	27	32	47	56
Oct. 1	51,122,000	40	28	59	62	81	50	26	32	47	51
Nov. 1	51,564,000	43	24	49	64	73	50	23	28	44	49
Dec. 1	51,872,000	45	23	44	59	75	41	23	26	41	57
Dec. 31	50,998,000	45	26	42	51	74	28	23	27	38	45

TABLE 6.—*Trends in distribution of bituminous coal in the United States, 1923, 1929, and 1936–40*

[For details and sources of data see Monthly Report on Distribution of Coal Shipments; tonnage figures shown in thousands of net tons]

	1923		1929		1936		1937		1938		1939		1940 (preliminary)	
	M net tons	Percent	M net tons	Percent	M net tons	Percent	M net tons	Percent	M net tons	Percent	M net tons	Percent	M net tons	Percent
New England receipts:														
Via rail across the Hudson	9,634	41.9	6,781	31.9	5,078	28.8	4,885	27.5	4,104	29.2	4,626	28.5	4,892	28.2
Via tidewater from northern ports	3,703	16.1	1,570	7.4	755	4.3	364	2.0	125	.9	222	1.4	148	.9
Via tidewater from southern ports	9,671	42.0	12,875	60.7	11,774	66.9	12,553	70.5	9,808	69.9	11,390	70.1	12,268	70.9
Total New England	23,008	100.0	21,226	100.0	17,607	100.0	17,802	100.0	14,037	100.0	16,238	100.0	17,308	100.0
Tidewater loadings:														
By ports:														
At New York and Philadelphia	14,693	39.2	12,226	32.1	9,203	29.7	9,683	29.2	8,565	31.1	9,404	28.9	10,148	28.6
At Baltimore, Hampton Roads, and Charleston	22,828	60.8	25,825	67.9	21,823	70.3	23,467	70.8	19,018	68.9	23,083	71.1	25,291	71.4
Total	37,521	100.0	38,051	100.0	31,026	100.0	33,150	100.0	27,583	100.0	32,487	100.0	35,439	100.0
By fields of origin:														
From Pennsylvania, Maryland, and northern West Virginia	19,760	52.7	15,516	40.8	11,344	36.6	11,859	35.8	10,394	37.7	12,165	37.4	12,987	36.6
From southern low-volatile fields	13,619	36.3	17,103	44.9	15,021	48.4	16,180	48.8	13,274	48.1	16,012	49.3	17,707	50.0
From southern high-volatile fields	4,142	11.0	5,432	14.3	4,661	15.0	5,111	15.4	3,915	14.2	4,310	13.3	4,745	13.4
Total	37,521	100.0	38,051	100.0	31,026	100.0	33,150	100.0	27,583	100.0	32,487	100.0	35,439	100.0
By destinations:														
To New England	13,374	35.6	14,445	38.0	12,530	40.4	12,916	39.0	9,933	36.0	11,612	35.7	12,416	35.0
Foreign	5,122	13.7	2,852	7.5	837	2.7	1,249	3.8	1,029	3.7	1,691	5.2	2,989	8.4
Bunkers	5,442	14.5	5,507	14.5	1,648	5.3	1,758	5.3	1,280	4.7	1,453	4.5	1,428	4.0
Inside capes and other tonnage	13,583	36.2	15,247	40.0	16,011	51.6	17,227	51.9	15,341	55.6	17,731	54.6	18,606	52.6
Total	37,521	100.0	38,051	100.0	31,026	100.0	33,150	100.0	27,583	100.0	32,487	100.0	35,439	100.0
Lake Erie loadings (cargo and fuel):														
By fields of origin:														
From Ohio	6,417	20.9	3,734	9.5	2,908	6.4	3,231	7.1	2,390	6.8	2,356	5.7	2,646	5.5
From Pittsburgh and other Pennsylvania	9,980	32.4	8,586	21.8	11,222	24.7	11,763	26.0	8,019	22.8	9,259	22.5	11,578	24.1
From Moundsville, Fairmont, and Cumberland-Piedmont	3,277	10.7	2,184	5.5	1,648	3.6	2,319	5.1	1,389	4.0	1,963	4.8	2,357	4.9
From southern West Virginia, high-volatile	4,994	16.2	10,233	26.0	10,459	23.0	10,975	24.3	8,329	23.7	10,883	26.5	12,025	25.0

From southern West Virginia, low-volatile	2,871	9.3	7,656	19.4	10,103	22.3	8,428	18.6	7,612	21.7	8,665	21.1	10,372	21.6
From east Kentucky, Tennessee, and Virginia	3,229	10.5	6,991	17.8	9,101	20.0	8,530	18.9	7,392	21.0	7,998	19.4	9,133	18.9
Total	30,768	100.0	39,384	100.0	45,441	100.0	45,246	100.0	35,131	100.0	41,124	100.0	48,111	100.0
By destinations (cargo only):														
To American points	24,172	81.5	31,943	84.2	37,184	84.5	35,123	80.6	27,656	80.9	33,188	83.3	37,804	81.2
To Canadian points	5,475	18.5	6,007	15.8	6,835	15.5	8,479	19.4	6,510	19.1	6,672	16.7	8,778	18.8
Total	29,647	100.0	37,950	100.0	44,019	100.0	43,602	100.0	34,166	100.0	39,860	100.0	46,582	100.0
Across Lake Michigan car ferry	1,373		1,282		799		650		588		592		612	
West-bound rail to Mississippi Valley (revenue all-rail shipments, excluding railroad fuel, Lake coal, and movement to Kentucky points):														
From Ohio fields	22,970	14.7	12,912	7.8	11,811	9.6	11,861	9.5	8,042	8.7	9,052	8.4	9,807	8.0
From Pennsylvania fields	15,853	10.1	21,885	13.3	15,593	12.6	15,091	12.1	9,620	10.4	12,200	11.4	15,195	12.4
From northern W. Va. and Cumberland-Piedmont	2,509	1.6	5,464	3.3	3,425	2.8	3,521	2.8	2,615	2.8	3,227	3.0	3,467	2.8
From southern West Virginia, high-volatile	17,525	11.2	25,148	15.3	17,641	14.3	17,293	13.9	13,668	14.8	15,099	14.0	16,943	13.8
From southern West Virginia, low-volatile	13,535	8.6	23,691	14.4	19,140	15.5	19,575	15.8	13,335	14.5	15,946	14.8	19,536	15.9
From east Kentucky, Tennessee, and Virginia	17,789	11.3	24,057	14.6	17,659	14.3	17,953	14.5	14,120	15.3	15,749	14.7	18,340	14.9
Total from Appalachian fields	90,181	57.5	113,157	68.7	85,269	69.1	85,294	68.6	61,400	66.5	71,273	66.3	83,288	67.8
From Illinois	48,401	30.9	34,863	21.2	26,362	21.4	26,625	21.4	20,719	22.5	24,879	23.1	27,618	22.5
From Indiana	14,549	9.3	10,589	6.4	9,822	8.0	10,594	8.5	8,501	9.2	9,455	8.8	10,223	8.3
From west Kentucky [1]	3,569	2.3	6,175	3.7	1,873	1.5	1,859	1.5	1,661	1.8	1,917	1.8	1,758	1.4
Total from Middle West fields	66,519	42.5	51,627	31.3	38,057	30.9	39,078	31.4	30,881	33.5	36,251	33.7	39,599	32.2
Grand total	156,700	100.0	164,784	100.0	123,326	100.0	124,372	100.0	92,281	100.0	107,524	100.0	122,887	100.0
Total shipments from other groups (all shipments including, in this case, nonrevenue railroad fuel):[2]														
From Michigan fields	1,086	[3] .2	745	[3] .1	210	(4)	181	(3 4)	166	(3 4)	120	(3 4)	99	(3 4)
From upper-Lake commercial docks, all deliveries	(5)		16,689	[3] 3.1	13,768	[3] 3.1	13,518	[3] 3.1	10,845	[3] 3.1	11,111	[3] 2.9	12,054	[3] 2.7
From Iowa, Missouri, and Kansas	12,222	[3] 2.2	9,488	[3] 1.8	7,647	[3] 1.7	7,202	[3] 1.6	6,528	[3] 1.9	6,278	[3] 1.6	6,855	[3] 1.5
From Arkansas, Oklahoma, and Texas	5,125	[3] .9	6,337	[3] 1.2	3,784	[3] .9	3,739	[3] .8	3,126	[3] .9	3,006	[3] .8	3,597	[3] .8
From Far West fields	30,286	[3] 5.4	29,705	[3] 5.6	20,849	[3] 4.7	21,867	[3] 4.9	17,612	[3] 5.1	18,432	[3] 4.7	19,602	[3] 4.3
From Alabama field	19,569	[3] 3.5	17,503	[3] 3.3	11,539	[3] 2.6	11,771	[3] 2.7	10,382	[3] 3.0	11,075	[3] 2.8	14,327	[3] 3.2

[1] The figures for west Kentucky cover in recent years a much smaller percentage of the field's production than do those for Illinois and Indiana and may not be fully comparable with earlier years.
[2] Excluding commercial sales by truck and wagon, except from upper Lake docks. Figures for 1939 are subject to revision.
[3] Percentage of total national shipments from all mines, all destinations.
[4] Less than 0.1 percent.
[5] Data not available.

TABLE 7.—*Indicators of effect of fuel economy on consumption of coal in the United States per unit of performance since the World War of 1914–18*

	Pounds	Reduction from base period (percent)
Steam railroads:		
Pounds per 1,000 gross ton-miles freight service:		
Average, 1919–20	170	----------
Average, 1939	113	33.5
Average, 1940	112	34.1
Pounds per passenger-train car-mile:		
Average, 1919–20	18.5	----------
Average, 1939	14.8	20.0
Average, 1940	15.0	18.9
Electric public utility power plants:		
Pounds per kilowatt-hour, 1919	3.2	----------
Pounds per kilowatt-hour, 1939	1.4	56.2
Pounds per kilowatt-hour, 1940	1.4	56.2
Iron and steel—pounds coking coal per gross ton of pig: [1]		
1918	3,577	----------
1939	2,853	20.2
1940	2,846	20.4
Coke manufacture: Savings of heat values through recovery of gas, tar, light oils, and breeze by extension of byproduct in place of beehive coking, 1913–40, expressed as percent of coal used for all coke in 1940 [2]	----------	20.2

[1] Includes only savings through higher yields of merchantable coke per ton of coal charged and lower consumption of coke per ton of iron. Excludes economies through recovery of byproducts, which are treated in next item.
[2] These byproducts are used in part for boiler fuel, in part for metallurgical purposes, in part for domestic heating and cooking, and to a small extent for automotive fuel.

SOURCES OF DATA AND ACKNOWLEDGMENTS

Bituminous-coal production statistics for 1939 and 1940 are preliminary estimates based upon (1) weekly or monthly reports of railroad carloadings of coal and beehive coke by all the important carriers, (2) shipments by river as reported by the United States Army Engineers, (3) direct reports from a number of mining companies, (4) monthly production statements compiled by various local operators' associations, including the following: Central Pennsylvania Coal Producers Association, Hazard Coal Operators Association, Kanawha Coal Operators Association, North Dakota Board of Railroad Commissioners, Utah Coal Operators Association, Virginia Operators Association, Winding Gulf Operators Association, and Operators Association of the Williamson Field. Especial acknowledgment for detailed monthly production reports is made to Thomas Allen, Colorado inspector of coal mines; James McSherry, director, Illinois Department of Mines and Minerals; Jonas Waffle, managing director, Coal Trade Association of Indiana; Richard Maize, secretary, Pennsylvania Department of Mines; N. P. Rhinehart, chief, West Virginia Department of Mines; and J. E. Bergin, chief inspector, Washington Department of Mines.

In the estimates for 1939 and 1940 allowance has been made for commercial truck shipments, local sales and colliery fuel, and small trucking or wagon mines producing over 1,000 tons a year. Production of mines on the border between two States has been credited to the State from which the coal is extracted rather than that in which the tipple is situated. If the coal is mined from lands in both States the tonnage has been apportioned accordingly.

The data in this report on the output of bituminous coal in 1938 (tables 13 to 37) are based upon detailed annual reports of production and mine operation courteously furnished by the producers and present data not available when the last preceding volume in this series was published. As in previous years, all but a small percentage of the output was covered by the reports submitted. For the remaining output not directly reported, consisting chiefly of small mines, it has been possible to obtain data of reasonable accuracy from the records

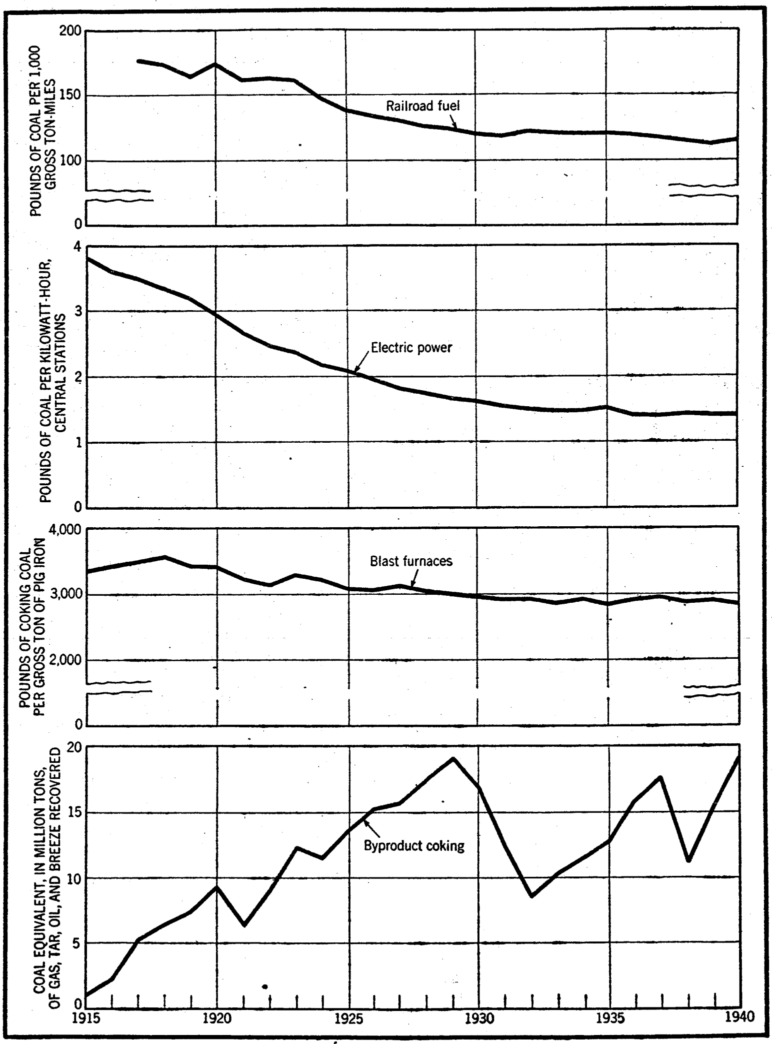

FIGURE 6.—Trends of fuel efficiency in the United States, 1915–40.

of the State mine departments, which have statutory authority to require such reports, or in a few instances from railroad carloadings.

Acknowledgment is made to the many individuals and agencies, both public and private, who have cooperated generously in making the survey possible. Special acknowledgment is made to officials of central cleaning plants and manufacturers of mechanical loading and cleaning equipment.

RELATIVE RATE OF GROWTH OF COAL, OIL, AND WATER POWER, 1889–1940

According to preliminary data, the total supply of available energy in the form of coal, oil, and natural gas, and water power in 1940 was 27,095 trillion B. t. u.—a 10.3-percent increase over 1939 (see fig. 7). The figures are expressed in British thermal units because some common denominator is necessary for such unlike quantities as tons of coal, barrels of oil, and cubic feet of gas. Table 8 summarizes the equivalent of each of the fuels in trillions of British thermal units. Water power is represented by the equivalent fuel required to perform the same work. The table covers the years since 1933. Details for 1889 to 1932 are given in Minerals Yearbook, 1937, page 807.

In converting water power to its fuel equivalent, two alternative assumptions have been made. The first, as in previous issues of these tables, assumes a *constant* fuel equivalent of 4.02 pounds of coal for each kilowatt-hour of water power produced throughout the entire period from 1889 to 1940. This factor was selected because it represents, in round numbers, the average efficiency of all central stations generating steam-electric power in 1913, the midpoint of the period under review. The usefulness of the *constant* factor lies in showing the rate at which water power is being developed. It permits direct comparison between the relative increase in kilowatt-hours of water power and the corresponding increase (or decrease) in tons of coal, barrels of oil, or cubic feet of gas produced. On the other hand, the constant factor makes no allowance for the fact that coal and other fuels produced today are used more efficiently than formerly.

To throw light on the influence of improving fuel efficiency, a second computation of the energy equivalent of water power has therefore been made. This assumes a *prevailing* fuel equivalent, diminishing year by year, which represents the average performance of all fuel-burning central electric stations for the year in question. This average has declined from about 7.05 pounds of coal per kilowatt-hour in 1899 to 1.37 pounds in 1940. (The *prevailing* factor is thus much above the *constant* factor in 1899 and much below it in 1940.) The *prevailing* fuel equivalent indicates more nearly the quantity of fuel that would have been needed in any one year to generate the same power in a steam-electric station. It should be noted, however, that the ultimate uses to which the water power generated is put often displace fuel burned much less efficiently than in central stations and that in any instance no other important branch of fuel consumption has made advances in fuel efficiency approaching that of the central stations.

As these tables attempt to determine the total energy from all fuels and from water power, the ideal factor for converting water power into fuel equivalent would be the average efficiency of all forms of fuel consumption in each year. No basis for determining such an all-embracing average exists at present, but enough is known to make certain that it would show much less reduction from 1899 to 1940 than did the central stations. For the present, a just comparison of the changing contributions of water power and of fuel to the national energy supply would lie somewhere between the results shown by the *constant* equivalent and the *prevailing central-station* equivalent in these tables.

As in earlier issues of these tables, the figures for oil and natural gas represent the entire production of crude petroleum and of gas. Most of this production does not come into direct competition with coal. Much of the supply of both oil and gas is used in regions of the country, such as California and portions of the Southwest, where coal is available only at unusually high cost because of heavy transport charges. Nearly half of the natural gas is used in the field for drilling or operating oil and gas wells and pipe lines or for the manufacture of carbon black. More than half the oil is used in the form of gasoline, kerosene, and lubricants, for which purposes coal cannot well compete, except at very much higher levels of oil prices. Even these refined

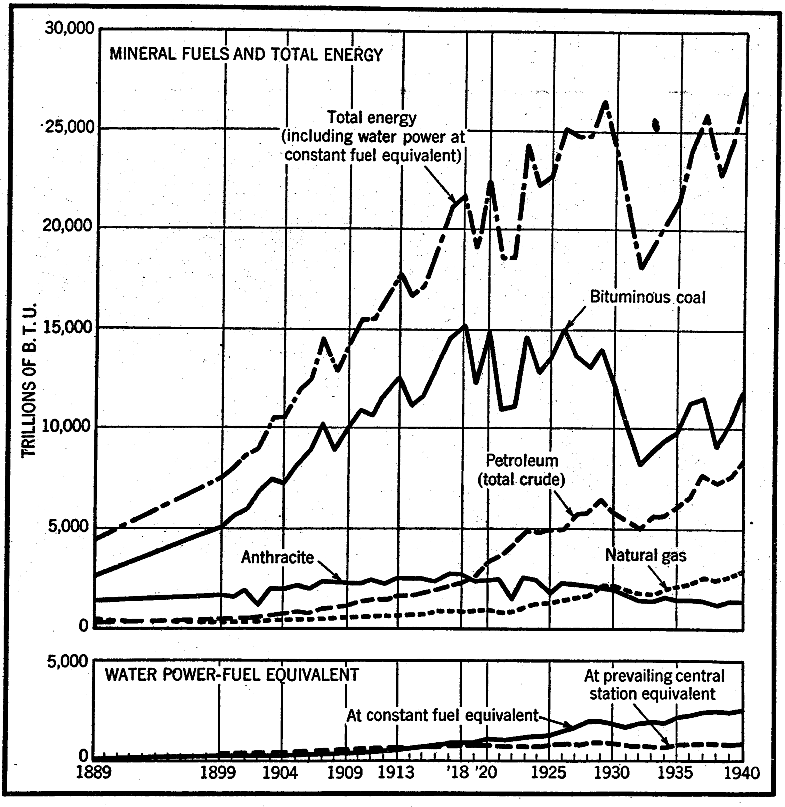

FIGURE 7.—Annual supply of energy from mineral fuels and water power in the United States, 1889–1940.

products, however, involve a certain measure of indirect competition with coal, for the energy market of the country is becoming more fluid and competitive, and a demand that cannot be met by one source of supply tends to fall back on the others.

The subject of interfuel competition is exceedingly complex, and an elaborate analysis and the accumulation of data not now available would be required to determine even approximately how much of any one fuel actually has been displaced either by other fuels or by water power. The present tables do not permit determination of such displacement; their purpose is rather to measure the long-time trends in the total demand for energy.

The figures for anthracite represent the output from established operations only and do not include bootleg or stolen coal, the amount of which is not accurately known. The bootleg tonnage has been estimated by the Commonwealth of Pennsylvania Anthracite Coal Industry Commission at the rate of 2,400,000 tons a year during 1936 and 1937, which is equivalent to 5 percent of the output of the legitimate operations. (Trade estimates place the figure as high as 3,000,000 to 3,500,000 tons.) The Pennsylvania Department of Mines estimates the bootleg tonnage at 2,500,000 tons in 1938 and 3,500,000 in 1939. The Anthracite Institute estimates the bootleg tonnage at approximately 4,000,000 tons in 1940. If this additional item of 3,500,000 tons were included, the total energy from anthracite in 1939 would be 1,496 trillion B. t. u. and the total energy from all sources 24,669 trillion B. t. u. If the additional item of 4,000,000

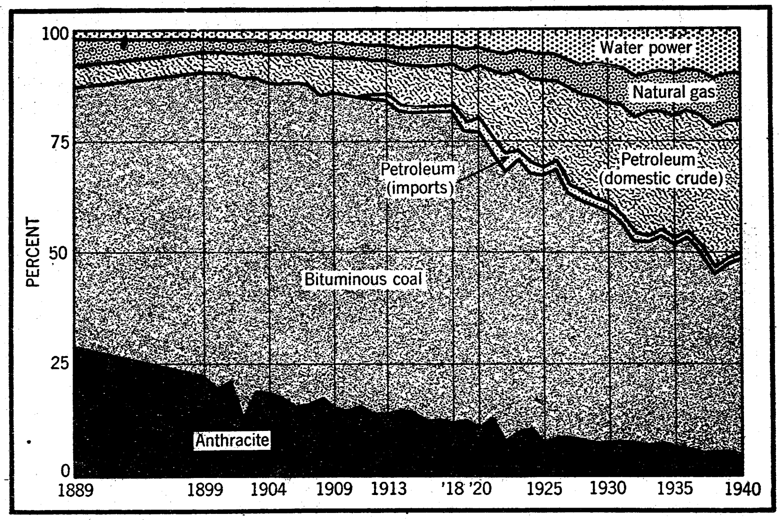

FIGURE 8.—Percentage of total B. t. u. equivalent contributed by the several sources of energy, counting water power at constant fuel equivalent, 1889–1940. If water power is counted at the prevailing fuel equivalent of central stations in each year, its proportion is 3.2 percent in 1899 and 3.5 percent in 1940, and the proportions of the other sources of energy are affected accordingly.

tons were included, the total energy from anthracite in 1940 would be 1,470 trillion B. t. u. and the total energy from all sources 27,204 trillion B. t. u.

Table 9 compares the relative increase in the several sources of energy by means of index numbers in which production for 1918 is represented by 100. Production of anthracite in 1940 was 49 percent below 1918 (45 percent if bootleg coal is included) and of bituminous coal 22 percent below 1918. Production of domestic petroleum increased 280 percent and natural gas 270 percent over 1918.

There was an increase of 213 percent in the amount of water power developed (represented by the constant fuel equivalent).

Table 10 gives the percentage composition of the total energy supply on the alternative assumptions of water power at constant and at prevailing central-station equivalents in fuel (see fig. 8). On the assumption of constant equivalent, the proportion contributed by water power has increased from 1.8 percent in 1899 to 9.7

in 1940. On the assumption of prevailing central-station equivalent, it has remained substantially unchanged between 3 and 4 percent. As already noted, the truth lies somewhere between the two assumptions. Upon either basis, water power furnishes a relatively small fraction of the total energy budget of the Nation, although, of course, a much larger fraction of the electric power produced by public utilities.

TABLE 8.—*Annual supply of energy from mineral fuels and water power in the United States, 1933–40,*[1] *in trillions of B. t. u.*[2]

Year	Pennsylvania anthracite	Bituminous coal	Total coal	Petroleum (total crude, including that refined)		Natural gas (total production)	Total petroleum and natural gas	Total mineral fuels	Water power (fuel equivalent)		Grand total energy	
				Domestic production	Imports				At constant fuel equivalent[3]	At prevailing central station equivalent[4]	Water power at constant fuel equivalent	Water power at prevailing central station equivalent
1933	1,348	8,741	10,089	5,434	191	1,672	7,297	17,386	1,931	711	19,317	18,097
1934	1,555	9,415	10,970	5,448	213	1,904	7,565	18,535	1,896	698	20,431	19,233
1935	1,419	9,756	11,175	5,980	193	2,060	8,233	19,408	2,207	806	21,615	20,214
1936	[5]1,485	11,504	12,989	6,598	194	2,330	9,122	22,111	2,256	812	24,367	22,923
1937	[5]1,410	11,673	13,083	7,675	165	2,588	10,428	23,511	2,446	871	25,957	24,382
1938	[5]1,255	9,132	10,387	7,286	158	2,468	9,912	20,299	2,466	866	22,765	21,165
1939[6]	[5]1,400	10,298	11,698	7,590	199	2,663	10,452	22,150	2,423	838	24,573	22,988
1940[6]	[5]1,361	11,875	13,236	8,111	256	2,872	11,239	24,475	2,620	893	27,095	25,368

[1] Comparable data for earlier years in Minerals Yearbook, 1937, p. 807.
[2] The unit heat values employed are: Anthracite, 13,600 B. t. u. per pound; bituminous coal, 13,100 B. t. u. per pound; petroleum, 6,000,000 B. t. u. per barrel; natural gas, 1,075 B. t. u. per cubic foot. Water power includes installations owned by manufacturing plants and mines, as well as Government and privately owned public utilities. The fuel equivalent of water power is calculated from the kilowatt-hours of power produced wherever available, as is true of all public utility plants since 1919. Otherwise the fuel equivalent is calculated from the reported horsepower of installed water wheels, assuming a capacity factor of 20 percent for manufacturers and mines and of 40 percent for public utilities.
[3] Assuming 4.02 pounds per kilowatt-hour, which is the average of central electric station practice in 1913, the midpoint of the period for which data are available.
[4] Assuming the average central-station practice for each of the years for which data are available, which declined from about 7.05 pounds per kilowatt-hour in 1899 to 1.39 pounds in 1939.
[5] Does not include an unknown amount of bootleg or stolen coal. If this were included, the energy for anthracite would be approximately 1,550 trillion B. t. u. in 1936; 1,476 in 1937; 1,323 in 1938; 1,496 in 1939; and 1,470 in 1940, and the total energy would be increased accordingly.
[6] Subject to revision.

TABLE 9.—*Index numbers for relative rate of growth of coal, oil, and water power in the United States*[1]

[The figures are expressed as a percentage of the 1918 rate]

Year	Pennsylvania anthracite	Bituminous coal	Total coal	Petroleum (total crude)		Natural gas (total production)	Total petroleum and natural gas	Total mineral fuels	Water power (at constant fuel equivalent)	Grand total	
				Domestic production	Imports					With water power at constant fuel equivalent	With water power at prevailing central station equivalent
1933	50	57	56	252	90	205	229	82	231	87	83
1934	58	62	61	255	94	246	241	88	227	94	89
1935	53	64	63	280	85	266	262	92	264	99	93
1936	55	76	73	309	86	301	291	105	270	112	106
1937	[2]52	77	73	359	73	334	332	112	292	119	112
1938	[2]47	60	58	341	70	318	316	97	295	104	98
1939[3]	[2]52	68	65	355	88	344	333	105	289	113	106
1940[3]	[2]51	78	74	380	113	370	358	117	313	124	117

[1] Comparable data for earlier years in Minerals Yearbook, 1937, p. 809.
[2] If illicit or bootleg anthracite were included, the index for 1937 would be 55; that for 1938, 49; for 1939, 56; and for 1940, 55.
[3] Subject to revision.

Coal remained the largest source of energy in 1940, contributing 48.8 percent with water power counted at constant fuel equivalent and 52.2 percent with water power at prevailing central-station equivalent.

TABLE 10.—*Percent of total B. t. u. equivalent contributed by the several mineral fuels and water power in the United States, 1933–40* [1]

Year	Pennsylvania anthracite	Bituminous coal	Total coal	Petroleum (total crude)		Natural gas (total production)	Total petroleum and natural gas	Total mineral fuels	Water power, fuel equivalent	Grand total, including water power
				Domestic production	Imports					
	Water power counted at constant fuel equivalent of approximately 4 lb. per kilowatt-hour									
1933	7.0	45.2	52.2	28.1	1.0	8.7	37.8	90.0	10.0	100.0
1934	7.6	46.1	53.7	26.7	1.0	9.3	37.0	90.7	9.3	100.0
1935	6.6	45.1	51.7	27.7	.9	9.5	38.1	89.8	10.2	100.0
1936	6.1	47.2	53.3	27.1	.8	9.5	37.4	90.7	9.3	100.0
1937	[2] 5.4	45.0	50.4	29.6	.6	10.0	40.2	90.6	9.4	100.0
1938	[2] 5.5	40.1	45.6	32.0	.7	10.8	43.5	89.1	10.9	100.0
1939 [3]	[2] 5.7	41.9	47.6	30.9	.8	10.8	42.5	90.1	9.9	100.0
1940 [3]	[2] 5.0	43.8	48.8	29.9	1.0	10.6	41.5	90.3	9.7	100.0
	Water power counted at prevailing central-station equivalent for year									
1933	7.4	48.4	55.8	30.0	1.1	9.2	40.3	96.1	3.9	100.0
1934	8.1	49.0	57.1	28.3	1.1	9.9	39.3	96.4	3.6	100.0
1935	7.0	48.3	55.3	29.5	1.0	10.2	40.7	96.0	4.0	100.0
1936	6.5	50.2	56.7	28.8	.8	10.2	39.8	96.5	3.5	100.0
1937	[2] 5.8	47.8	53.6	31.5	.7	10.6	42.8	96.4	3.6	100.0
1938	[2] 5.9	43.2	49.1	34.4	.7	11.7	46.8	95.9	4.1	100.0
1939 [3]	[2] 6.1	44.8	50.9	33.0	.9	11.6	45.5	96.4	3.6	100.0
1940 [3]	[2] 5.4	46.8	52.2	32.0	1.0	11.3	45.3	96.5	3.5	100.0

[1] Comparable data for earlier years in Minerals Yearbook, 1937, p. 810.
[2] If bootleg coal were included the proportion from anthracite would be 5.7 percent in 1937, 5.8 in 1938, 6.1 in 1939 and 5.4 in 1940 at *constant* and 6.0 in 1937, 6.2 in 1938, 6.5 in 1939 and 5.8 in 1940 at *prevailing* water power equivalents.
[3] Subject to revision.

TREND OF AVERAGE VALUE PER TON, F. O. B. MINES, 1929–39

Before the Bituminous Coal Act of 1937 was passed the most valuable single index of the trend of prices at the mines was the "average value per ton, f. o. b. mines," as given in the familiar annual coal reports of the Bureau of Mines, United States Department of the Interior. This series was referred to in Bureau of Mines reports as representing "bituminous coal" and covered all coal other than Pennsylvania anthracite produced in the United States. It represented the bituminous-coal industry as the term ordinarily was used in the trade and included the lignite of the Dakotas, Texas, and Montana, as well as any small tonnages of hard coal produced outside of Pennsylvania.

With the passage of the Coal Act the Bureau of Mines relinquished the collection of statistics relating to bituminous coal, effective June 30, 1937, but continued to compile data regarding lignite. Effective on the same date, the Coal Commission became responsible for the compilation of data on bituminous coal, although it did not attempt to collect data regarding lignite, which was specifically exempted by the act. The records of the Commission (now the Bituminous Coal

Division, United States Department of the Interior) relate to all coal other than lignite and Pennsylvania anthracite.

To permit comparison of the old and new series, therefore, the lignites must be separated from the bituminous coals, though for the convenience of the student the combined average for the two is continued in a form as nearly comparable as possible to the old series (see table 11).

A more important change in the two series relates to the treatment of selling expenses. The old Bureau of Mines series of "value at the mines" excluded the selling cost. The reporting operator was asked to state the "amount received at the mines f. o. b. cars less the selling expense." No details were asked regarding the items included in the value, and no systematic effort was made to follow up the exclusion of selling expenses. It was realized at the time that some producers might find it impractical to exclude selling costs and that some part of the selling expenses of the industry might be included in the results. Nevertheless, the reports were checked for consistency from year to year, the questions were retained in the same form without change, and the results are believed to have been comparable from one year to the next. The new series of the Coal Commission represents the total or gross realization on all coal produced and specifically includes the selling cost.

The two sets of data may not be precisely comparable with respect to coal produced but not sold on the commercial market. In the Bureau of Mines series the reporting operator was instructed that the "value of coal not sold but used by producer, also mine fuel and coal made into coke, should be estimated at average prices that might have been received." The instructions of the Coal Commission regarding such items were in effect similar, though given in greater detail.

A comparison of the two series is possible for 1936. In that year the average value a ton upon the old (Bureau of Mines) basis amounted to \$1.761 per ton for bituminous coal, excluding lignite. The average gross realization, as determined from information collected by the Coal Commission, was \$1.831 per ton. The difference amounts to \$0.07 per ton—an amount somewhat less than the average selling expenditure computed per ton of all coal produced, as reported to the Coal Commission. The comparison confirms previous indications that the great majority of operators reporting in earlier years had followed instructions and omitted selling expenses in computing the average value but that some of them had included the selling expense. The change in method of reporting should be kept in mind in comparing the two sets of data. As the reports to the Commission were submitted on a detailed accounting return and made under oath they are to be accepted. The returns of earlier years, upon a voluntary basis and not in all instances uniform as to treatment of selling costs, seem to have been thoroughly comparable from one year to the next and afford the best available index to the rise and fall of the mine prices received by operators down to 1936.

TABLE 11.—*Trend of average value in the United States of bituminous coal and lignite per ton, f. o. b. mines, 1929–39*

Year	Bituminous[1] coal (subject to regulation under 1937 Act)	Lignite[2]	Total
Average value per ton less selling expense (Bureau of Mines series):			
1929	$1.782	$1.548	$1.781
1930	1.702	1.556	1.701
1931	1.542	1.410	1.541
1932	1.313	1.313	1.313
1933	1.337	1.188	1.336
1934	1.751	1.387	1.749
1935	1.772	1.120	1.767
1936	1.761	1.061	1.756
Average gross realization, including selling expense (Coal Commission series):			
1936	1.831	[3] 1.061	1.826
1937	1.946	[3] 1.080	1.939
1938	1.955	[3] 1.071	1.947
1939	[4] 1.854	[3] 1.135	1.853

[1] Includes all coal produced other than Pennsylvania anthracite and the lignite included in the second column.
[2] North Dakota, South Dakota, and the lignite counties of Montana and Texas.
[3] Figures of the Bureau of Mines, excluding selling expense as before. Data on sales realization were not collected from lignite mines by the Coal Commission, now Bituminous Coal Division.
[4] Estimated from incomplete returns to Bureau of the Census. Producers were asked by that Bureau to exclude selling expenses in reporting value, but a number of them included such expenses.

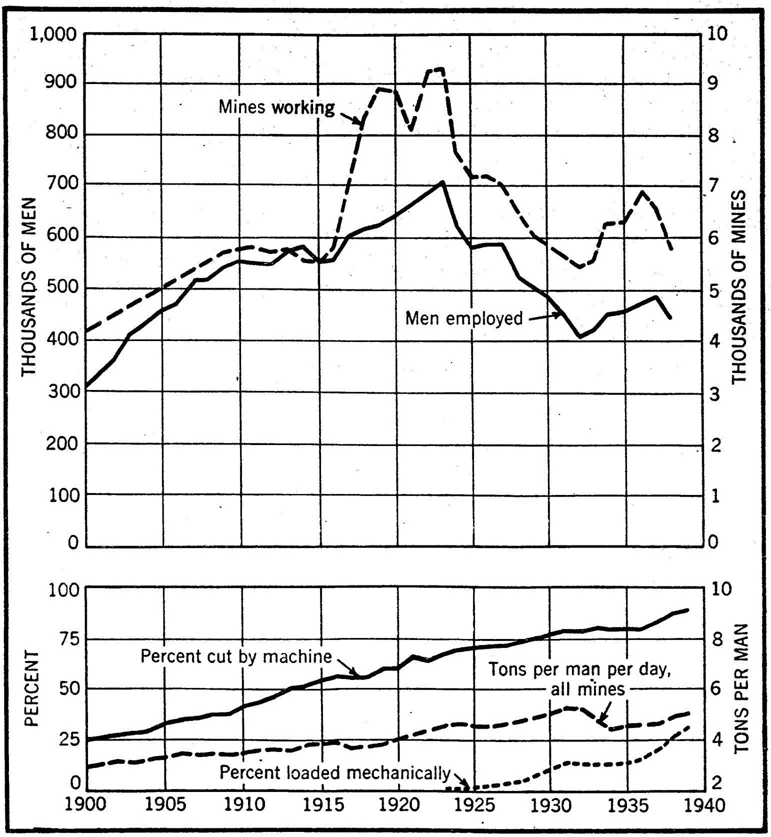

FIGURE 9.—Trends of employment, mechanization, and output per man at bituminous-coal mines, 1900–1939.

FINAL BITUMINOUS STATISTICS FOR 1938

SUMMARY BY DISTRICTS

TABLE 12.—*Number of mines, production, men employed, days operated, man-days of labor, and output per man per day in the United States in 1938, by price areas and districts*

[Districts as defined in the Bituminous Coal Act of 1937. Exclusive of product of wagon mines producing less than 1,000 tons]

Minimum price area and producing district	Number of active mines	Net tons					Number of employees				Average number of days mines operated	Man-days of labor	Average tons per man per day
		Loaded at mines for shipment by rail or water	Shipped by truck or wagon	Coal used by employees or taken by locomotives at tipple or other uses at mines	Used for power and heat or made into coke at mines [1]	Total production	Underground	Surface		Total			
								In strip pits	All others				
PRICE AREA 1													
District 1. Eastern Pennsylvania [2]	744	29, 604, 131	1, 631, 903	1, 488, 199	[1] 524, 277	33, 248, 510	46, 928	57	6, 403	53, 388	161	8, 570, 409	3. 88
District 2. Western Pennsylvania	551	40, 784, 523	3, 402, 480	1, 419, 261	[1] 787, 934	46, 394, 198	55, 125	556	7, 833	63, 514	153	9, 700, 324	4. 78
District 3. Northern West Virginia	175	18, 495, 832	176, 825	327, 357	[1] 73, 244	19, 073, 258	15, 653	-------	2, 609	18, 262	164	2, 991, 468	6. 38
District 4. Ohio	599	14, 848, 698	3, 311, 408	328, 913	101, 599	18, 590, 618	23, 306	920	3, 167	27, 393	145	3, 984, 353	4. 67
District 5. Michigan	11	166, 143	292, 572	8, 978	26, 788	494, 481	1, 099	-------	106	1, 205	163	195, 825	2. 53
District 6. Panhandle	43	1, 926, 336	422, 794	785, 213	2, 381	3, 136, 724	2, 989	56	406	3, 451	193	667, 381	4. 70
District 7. Southern Numbered 1	255	42, 120, 819	211, 901	454, 211	[1] 242, 676	43, 029, 607	43, 952	-------	7, 947	51, 899	178	9, 228, 284	4. 66
District 8. Southern Numbered 2	704	72, 177, 342	970, 621	738, 532	[1] 600, 418	74, 486, 913	81, 880	4	12, 746	94, 630	171	16, 172, 256	4. 61
Total, Price Area 1 [3]	3, 082	220, 123, 824	10, 420, 504	5, 550, 664	2, 359, 317	238, 454, 309	270, 932	1, 593	41, 217	313, 742	164	51, 510, 300	4. 63
PRICE AREA 2													
District 9. West Kentucky	149	6, 588, 235	596, 953	101, 299	81, 259	7, 367, 746	7, 879	60	1, 453	9, 392	132	1, 236, 001	5. 96
District 10. Illinois	564	34, 562, 842	6, 281, 452	363, 901	703, 890	41, 912, 085	29, 217	1, 698	7, 448	38, 363	149	5, 704, 535	7. 35
District 11. Indiana	301	12, 483, 953	1, 813, 808	309, 599	151, 124	14, 758, 484	6, 244	1, 935	2, 350	10, 529	149	1, 570, 984	9. 40
District 12. Iowa	261	1, 642, 445	1, 412, 311	31, 853	16, 578	3, 103, 187	6, 234	322	816	7, 372	136	1, 000, 795	3. 10
Total, Price Area 2	1, 275	55, 277, 475	10, 104, 524	806, 652	952, 851	67, 141, 502	49, 574	4, 015	12, 067	65, 656	145	9, 512, 315	7. 06

See footnotes at end of table.

TABLE 12.—*Number of mines, production, men employed, days operated, man-days of labor, and output per man per day in the United States in 1938, by price areas and districts*—Continued

[Districts as defined in the Bituminous Coal Act of 1937. Exclusive of product of wagon mines producing less than 1,000 tons]

Minimum price area and producing district	Number of active mines	Net tons: Loaded at mines for shipment by rail or water	Net tons: Shipped by truck or wagon	Net tons: Coal used by employees or taken by locomotives at tipple or other uses at mines	Net tons: Used for power and heat or made into coke at mines [1]	Net tons: Total production	Number of employees: Underground	Number of employees: Surface: In strip pits	Number of employees: Surface: All others	Number of employees: Total	Average number of days mines operated	Man-days of labor	Average tons per man per day
PRICE AREA 3 [3]													
District 13. Southeastern	260	11, 062, 575	675, 177	117, 710	[1] 69, 490	11, 924, 952	19, 744	91	2, 908	22, 743	178	4, 055, 430	2. 94
PRICE AREA 4													
District 14. Arkansas-Oklahoma	104	1, 501, 426	24, 441	2, 056	10, 654	1, 538, 577	4, 042	86	705	4, 833	114	550, 342	2. 80
PRICE AREA 5													
District 15. Southwestern:													
Bituminous coal	353	5, 696, 676	1, 241, 839	33, 232	54, 180	7, 025, 927	6, 666	1, 609	1, 611	9, 886	157	1, 555, 365	4. 52
Lignite (Texas)	8	813, 096	21, 302	6, 245	5, 576	846, 219	446	22	38	506	219	110, 768	7. 64
Total, Price Area 5	361	6, 509, 772	1, 263, 141	39, 477	59, 756	7, 872, 146	7, 112	1, 631	1, 649	10, 392	160	1, 666, 133	4. 72
PRICE AREA 6													
District 16. Northern Colorado	58	1, 283, 801	869, 532	56, 973	55, 846	2, 266, 152	2, 235	10	348	2, 593	197	511, 888	4. 43
District 17. Southern Colorado [4]	168	3, 220, 214	623, 218	38, 629	[1] 151, 461	4, 033, 522	5, 470		1, 221	6, 691	153	1, 025, 740	3. 93
District 18. New Mexico [5]	27	498, 874	68, 915	8, 613	31, 946	608, 348	1, 176		318	1, 494	164	245, 505	2. 48
Total, Price Area 6	253	5, 002, 889	1, 561, 665	104, 215	239, 253	6, 908, 022	8, 881	10	1, 887	10, 778	165	1, 783, 133	3. 87
PRICE AREA 7													
District 19. Wyoming [6]	66	4, 850, 881	215, 204	33, 559	105, 471	5, 205, 115	3, 477	44	907	4, 428	181	802, 769	6. 48
District 20. Utah	58	2, 591, 922	314, 075	18, 942	[1] 22, 012	2, 946, 951	2, 338		738	3, 076	156	479, 733	6. 14
Total, Price Area 7	124	7, 442, 803	529, 279	52, 501	127, 483	8, 152, 066	5, 815	44	1, 645	7, 504	171	1, 282, 502	6. 36

PRICE AREA 8													
District 21. North-South Dakota	180	1,492,522	437,474	160,415	7,746	2,098,157	685	367	368	1,420	173	246,258	8.52
PRICE AREA 9													
District 22. Montana	78	2,524,145	• 191,291	13,000	3,614	2,732,050	1,126	40	359	1,525	174	265,784	10.28
PRICE AREA 10													
District 23. Washington [7]	54	1,149,909	384,562	13,896	19,934	1,568,301	1,993	--------	603	2,596	163	423,764	3.70
Alaska	6	151,656	------------	231	2,795	154,682	100	--------	44	144	204	29,413	5.26
Total, Price Area 10	60	1,301,565	384,562	14,127	22,729	1,722,983	2,093	--------	647	2,740	165	453,177	3.80
Grand total, areas listed above [8]	5,777	312,238,996	25,592,058	6,860,817	[1] 3,852,893	348,544,764	370,004	7,877	63,452	441,333	162	71,325,374	4.89

[1] Includes coal made into beehive coke at mines in the following districts in 1938: District 1, 160,266; District 2, 604,987; District 3, 7,020; District 7, 36,709; District 8, 441,055; District 13, 10,000; District 17, 84,172; District 20, 15,667—a grand total of 1,359,876 tons in 1938.

[2] Includes Maryland, and Grant, Mineral, and Tucker Counties, W. Va.

[3] According to the act, the Minimum Price Area 1 includes that part of Southeastern District 13 comprising Van Buren, Warren, and McMinn Counties, Tenn. Production in these counties is negligible and has been included here in Price Area 3.

[4] Includes Colfax County, N. Mex.

[5] Includes Arizona and California, but excludes Colfax County, N. Mex.

[6] Includes Idaho.

[7] Includes Oregon.

[8] For purposes of historical comparison and statistical convenience, the figures include the output of lignite and of anthracite and semianthracite outside of Pennsylvania. Note that no district organization has been created for District 21, North and South Dakota, the output of which is usually classified in the coal trade as lignite.

STRIPPING OPERATIONS

TABLE 13.—*Stripping operations of all types in bituminous-coal fields of the United States, in 1938, by States and counties*

[Returns for mines that recover coal both by stripping and by underground operations do not permit separating men engaged in stripping from those engaged in other work. For this reason the figures of men employed represent all persons working at these mines, including those underground. The total tons produced by both methods at these same mines are also shown]

State and county	Number of strip pits	Number of power shovels			Coal produced (net tons)		Number of employees				Average number of days mines operated	Percent of county or State total mined by stripping	Man-days of labor	Average tons per man per day
		Steam	Electric	All others	Mined by stripping	Total at same mines	Underground	Surface		Total				
								In strip pits	All others					
Alabama: Blount, Marion, Tuscaloosa, and Walker	6	5	--------	6	36,490	36,490	--------	91	36	127	78	[1] 1.4	9,951	3.67
Arkansas: Franklin and Sebastian	5	2	--------	1	27,628	27,628	--------	65	8	73	80	[1] 4.6	5,874	4.70
Illinois:														
Adams, Bureau, Edgar, Grundy, Henry, Jackson, Knox, Peoria, Randolph, Schuyler, and Will	14	--------	18	16	3,614,970	3,614,970	--------	603	440	1,043	227	55.2	236,296	15.30
Fulton	8	--------	17	5	2,523,770	2,523,770	--------	331	324	655	207	85.8	135,579	18.61
La Salle	6	1	2	9	154,234	154,234	--------	102	35	137	133	43.5	18,279	8.44
Perry	5	3	13	4	2,390,451	2,390,451	--------	364	283	647	192	80.5	124,135	19.26
St. Clair	3	--------	3	7	475,495	475,495	--------	72	61	133	188	21.1	24,990	19.03
Saline	3	1	3	--------	708,514	708,514	--------	85	83	168	220	22.9	36,957	19.17
Vermilion	3	--------	--------	5	171,633	171,633	--------	37	17	54	144	11.0	7,785	22.05
Williamson	7	2	3	9	531,225	531,225	--------	104	86	190	137	25.0	26,018	20.42
Total, Illinois	49	7	59	55	10,570,292	10,570,292	--------	1,698	1,329	3,027	202	25.2	610,039	17.33
Indiana:														
Clay	25	9	6	37	1,037,201	1,037,201	--------	428	161	589	170	91.2	100,388	10.33
Daviess, Fountain, Knox, Spencer, and Vermillion	11	--------	2	16	398,484	398,484	--------	115	103	218	148	17.2	32,227	12.36
Greene	15	7	8	15	1,392,779	1,392,779	--------	345	206	551	172	73.0	94,911	14.67
Owen	5	--------	--------	8	91,507	91,507	--------	62	38	100	80	98.9	8,014	11.42
Pike	11	3	13	11	2,467,859	2,467,859	--------	522	307	829	175	93.2	144,984	17.02
Sullivan	5	3	1	9	417,204	417,204	--------	101	78	179	161	29.9	28,825	14.47
Vigo	5	2	4	2	839,779	839,779	--------	183	92	275	191	29.1	52,483	16.00
Warrick	5	--------	4	10	827,369	827,369	--------	179	142	321	164	80.2	52,791	15.67
Total, Indiana	82	24	38	108	7,472,182	7,472,182	--------	1,935	1,127	3,062	168	50.6	514,623	14.52

Iowa:														
Davis, Greene, Keokuk, Monroe, Wapello, and Warren	7		2	6	88,042	88,042		78	18	96	110	21.5	10,558	8.34
Mahaska	10			11	172,364	172,364		107	25	132	182	83.3	24,063	7.16
Marion	11			15	190,360	190,360		107	29	136	197	43.0	26,750	7.12
Van Buren	3			2	10,384	10,384		13	3	16	200	54.8	3,200	3.25
Webster	3			4	4,705	4,705		17	2	19	66	17.0	1,258	3.74
Total, Iowa	34		2	38	465,855	465,855		322	77	399	165	[1] 42.1	65,829	7.08
Kansas:														
Bourbon	6	2	2	1	161,117	161,117		54	25	79	210	100.0	16,589	9.71
Cherokee	6	2	6	3	498,638	498,638		144	78	222	171	96.7	37,930	13.15
Crawford	20	12	13	5	1,245,629	1,245,629		455	168	623	155	69.6	96,469	12.91
Labette	4			4	10,657	10,657		15	3	18	179	100.0	3,222	3.31
Linn and Osage	3	2			11,987	11,987		12	2	14	171	12.6	2,388	5.02
Total, Kansas	39	18	21	13	1,928,028	1,928,028		680	276	956	164	72.6	156,598	12.31
Kentucky: Christian and Hopkins	3	1	2	4	604,180	620,937	16	60	64	140	203	[1] 18.1	28,430	21.84
Missouri:														
Barton	8	6	4		239,442	239,442		125	52	177	103	97.5	18,205	13.15
Bates	4	4	2	1	577,884	577,884		162	65	227	157	98.6	35,697	16.19
Boone, Dade, Jasper, Johnson, Macon, Monroe, Morgan, Ralls, Randolph, and Warren	11	5	4	6	768,376	768,376		169	80	249	199	78.5	49,506	15.52
Callaway	3	2		3	113,306	113,306		44	8	52	233	100.0	12,140	9.33
Henry	8	7	5	3	570,972	570,972		203	78	281	167	98.1	46,954	12.16
Vernon	5	5		2	46,338	46,338		47	9	56	114	72.5	6,402	7.24
Total, Missouri	39	29	15	15	2,316,318	2,316,318		750	292	1,042	162	67.4	168,904	13.71
Montana lignite [2]	4			2	58,941	58,941		29	1	30	115	[3] 6.6	3,454	17.06
North Dakota lignite	58			31	1,262,808	1,262,808		344	142	486	180	61.6	87,288	14.47
Ohio:														
Carroll	8			10	67,579	67,579		42	2	44	212	23.7	9,329	7.24
Columbiana	12	7		10	176,874	176,874		102	6	108	130	48.1	14,080	12.56
Coshocton	3	1		3	20,854	36,726	12	15	8	35	216	11.9	7,546	4.87
Harrison	3	6		2	246,093	246,093		83	42	125	137	13.5	17,065	14.42
Hocking, Holmes, Mahoning, Perry, and Portage	7	4	1	10	244,990	254,530	6	97	18	121	229	19.3	27,688	9.19
Jackson	3	4		2	76,101	76,101		31	8	39	128	36.2	5,006	15.20
Jefferson	10	9	2	9	1,225,378	1,225,378		280	119	399	205	30.9	81,950	14.95
Muskingum	3			4	65,280	65,280		23	5	28	268	7.1	7,508	8.69
Stark	9	4		17	234,686	239,301	7	111	26	144	192	52.1	27,645	8.66
Tuscarawas	15			18	127,635	127,635		83	6	89	204	15.4	18,153	7.03
Vinton	5	1	2	6	43,334	43,334		53	20	73	101	56.7	7,397	5.86
Total, Ohio	78	36	5	91	2,528,804	2,558,831	25	920	260	1,205	185	[1] 24.4	223,367	11.46

See footnotes at end of table.

TABLE 13.—*Stripping operations of all types in bituminous-coal fields of the United States, in 1938, by States and counties*—Continued

[Returns for mines that recover coal both by stripping and by underground operations do not permit separating men engaged in stripping from those engaged in other work. For this reason the figures of men employed represent all persons working at these mines, including those underground. The total tons produced by both methods at these same mines are also shown]

State and county	Number of strip pits	Number of power shovels			Coal produced (net tons)		Number of employees				Average number of days mines operated	Percent of county or State total mined by stripping	Man-days of labor	Average tons per man per day
		Steam	Electric	All others	Mined by stripping	Total at same mines	Underground	Surface: In strip pits	Surface: All others	Total				
Oklahoma: Craig, Haskell, Muskogee, Rogers, and Wagoner	9	7	4	5	448,667	448,667		200	51	251	166	36.0	41,770	10.74
Pennsylvania:														
Allegheny	7	2		10	120,603	123,103	4	77	15	96	103	1.1	9,862	12.48
Beaver	9	2		17	350,359	350,359		148	28	176	230	84.2	40,457	8.66
Butler, Clarion, Clearfield, Crawford, Elk, Fayette, Jefferson, Lawrence, Lycoming, McKean, Mercer, and Tioga	18	6		20	202,297	208,240	9	163	91	263	96	1.2	25,315	8.23
Washington	7	2	2	6	458,368	717,071	359	225	100	684	157	3.6	107,472	6.67
Total, Pennsylvania	41	12	2	53	1,131,627	1,398,773	372	613	234	1,219	150	[1] 2.7	183,106	7.64
South Dakota lignite	5			2	44,049	44,049		23	7	30	224	91.7	6,718	6.56
Texas lignite	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(3)	(2)	(2)
West Virginia: Brooke and Hancock	5			10	226,504	226,504		56	26	82	222	[1] 18.4	18,204	12.44
Wyoming: Campbell, Carbon, and Converse	5	1	3	3	171,418	187,193	6	44	31	81	239	[1] 24.3	19,356	9.67
Other States [4]	3		4	3	1,113,064	1,113,064		47	23	70	232	[1] 90.9	16,239	68.54
Total, United States	465	142	155	440	30,406,855	30,736,560	419	7,877	3,984	12,280	176	8.7	2,159,750	14.23

[1] Percent of county totals, not State.
[2] Texas lignite included with Montana lignite.
[3] Percentage of total Texas and Montana lignite.
[4] Colorado, Montana bituminous, and Tennessee.

TABLE 14.—*Summary of operations of power strip pits proper in bituminous-coal fields of the United States in 1938, by States*

State	Number of strip pits	Number of power shovels: Steam	Number of power shovels: Electric	Number of power shovels: All others	Amount mined by stripping (net tons) [1]	Number of men employed [2]	Average number of days mines operated [2]	Average tons per man per day
Power strip pits proper:								
Alabama	6	5	-------	6	36,490	127	78	3.67
Arkansas	3	2	-------	1	13,165	37	79	4.51
Illinois	45	7	59	55	10,563,217	2,998	202	17.41
Indiana	78	24	38	108	7,463,350	3,046	169	14.54
Iowa	28	-------	2	38	454,011	367	165	7.49
Kansas	32	18	21	13	1,904,873	905	161	13.08
Missouri	36	29	15	15	2,303,408	1,019	162	13.96
Montana, North Dakota, South Dakota, and Texas (lignite)	16	-------	-------	35	1,304,160	391	205	16.24
Ohio	72	33	5	88	2,492,634	1,140	184	11.86
Oklahoma	9	7	4	5	448,667	251	166	10.74
Pennsylvania	33	7	2	49	946,192	601	150	10.47
West Virginia	5	-------	-------	10	226,504	82	222	12.44
Wyoming	4	1	3	2	161,418	66	241	10.13
Other States [3]	5	-------	6	6	1,703,674	177	228	42.19
Total	372	133	155	431	30,021,763	11,207	179	15.00
Horse stripping operations	83	-------	-------	-------	157,313	373	132	3.20
Mines combining stripping and underground methods in same operations [4]	10	9	-------	9	227,779	700	156	5.10
Grand total	465	142	155	440	30,406,855	12,280	176	14.23

[1] Exclusive of coal produced by underground mining in the same operation.
[2] Items in these columns include underground mining conducted in the same operation.
[3] Includes Colorado, Kentucky, Montana (bituminous), and Tennessee.
[4] Includes operations in Kentucky, Ohio, Pennsylvania, and Wyoming, in which output was obtained by both methods. In addition to 227,779 net tons produced by stripping, this group of 10 mines obtained 329,705 tons by underground methods, total production by both methods being 557,484 tons.

TABLE 15.—*Percent of total bituminous-coal production mined by stripping in the United States, 1926 and 1928–38, by States*

State	1926	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Alabama	1.6	1.9	1.8	1.1	0.6	0.9	0.6	0.6	0.4	0.4	0.3	0.3
Arkansas	13.6	6.5	4.7	3.9	2.5	3.4	3.3	2.9	3.0	3.4	1.9	2.3
Colorado	------	------	------	------	.3	.3	.4	.5	.1	.3	.3	.2
Illinois	5.0	7.8	8.9	11.4	14.3	19.6	15.0	14.9	16.6	17.9	22.2	25.2
Indiana	15.6	29.4	30.6	34.2	37.1	43.5	36.8	40.6	41.4	43.1	46.6	50.6
Iowa	------	------	------	------	------	3.3	7.9	7.4	6.5	6.9	11.5	15.0
Kansas	29.0	42.9	34.3	43.1	58.0	60.6	64.9	69.7	64.8	68.8	68.0	72.6
Kentucky	1.6	1.1	.7	.7	.2	(1)	------	------	(1)	.1	.4	1.6
Michigan	------	------	------	------	------	------	------	3.0	2.4	------	------	------
Missouri	41.3	47.7	49.3	53.7	63.8	63.3	62.6	65.3	64.5	61.8	64.9	67.4
Montana	26.1	35.5	35.8	35.3	34.5	35.2	36.5	43.4	41.6	[2]34.3	[2]34.5	[2]32.1
North Dakota	37.2	45.8	46.2	54.2	59.4	58.6	61.2	61.4	58.1	61.7	59.9	61.6
Ohio	9.1	15.2	7.5	5.0	4.6	5.8	5.1	5.8	9.7	10.2	9.8	13.6
Oklahoma	16.0	14.8	13.1	13.0	16.6	21.6	20.8	25.2	24.4	22.3	29.1	36.0
Pennsylvania	.7	.8	.5	.6	.5	.3	.3	.4	.5	.7	.8	1.5
South Dakota	------	------	------	26.5	85.0	86.9	85.9	85.2	49.7	81.1	89.6	91.7
Tennessee	.1	1.5	.9	.3	------	------	------	------	------	------	------	.1
Texas	25.2	28.0	28.2	15.0	15.2	11.7	10.1	12.7	12.1	(2)	(2)	(2)
Washington	------	------	------	------	------	.1	------	------	------	------	------	------
West Virginia	.1	(1)	(1)	------	(1)	------	(1)	(1)	(1)	(1)	(1)	.2
Wyoming	.8	1.1	1.1	1.4	1.8	2.4	2.3	2.7	2.6	2.5	2.8	3.3
Other States	(3)	(3)	(3)	------	------	------	------	------	------	------	------	------
Total United States	3.0	4.0	3.8	4.2	5.0	6.3	5.5	5.8	6.4	6.4	7.1	8.7

[1] Less than 0.1 percent.
[2] Texas included with Montana.
[3] Not calculated because figures are not comparable from year to year.

TABLE 16.—*Number of coal-cutting machines in bituminous-coal mines, average output per machine, and percentage of total product of underground mines cut by machines in the United States, in 1938, by States*

State	Number of coal-cutting machines in use—					Average output per machine (net tons)	Percent of total product of underground mines cut by machines
	Track mounted		Other types		Total		
	Permissible	Other	Permissible	Other			
Alabama	24	24	59	292	399	20,298	73.5
Arkansas	9	4	108	36	157	6,519	87.5
Colorado	53	68	116	208	445	9,417	74.1
Illinois	46	101	253	661	1,061	26,906	91.1
Indiana	69	20	50	128	267	24,728	90.6
Iowa	3		71	30	104	10,569	41.7
Kansas	6		12	11	29	6,511	26.0
Kentucky	142	94	352	821	1,409	25,609	95.1
Maryland	5	2	17	13	37	14,712	42.5
Michigan	22		15	14	51	9,696	100.0
Missouri	6	3	31	49	89	8,651	68.8
Montana and Texas	6	3	3	55	67	22,827	62.3
New Mexico	28	12	10	2	52	7,831	33.3
North Dakota			15	7	22	24,350	68.0
Ohio	13	51	210	609	883	17,572	96.6
Oklahoma	17	13	37	14	81	8,269	84.1
Pennsylvania	288	72	1,642	1,266	3,268	18,782	80.2
Tennessee	22	1	42	94	159	21,284	75.7
Utah	24	6	44	56	130	21,252	93.7
Virginia	53	44	85	94	276	41,236	92.7
Washington	1		43	6	50	13,941	44.5
West Virginia	308	442	408	1,323	2,481	35,349	94.3
Wyoming		7	43	241	291	16,147	93.4
Other States				2	2	1,920	66.5
Total United States [1]	1,145	[2] 967	3,666	[2] 6,032	11,810	23,566	87.5

[1] Includes figures on lignite compiled by L. Mann, Bureau of Mines; see lignite tables, 1938.
[2] Probably includes some "permissible" machines not so specified by the operators.

POWER DRILLING IN UNDERGROUND BITUMINOUS-COAL MINES

Although power drills have been in use in bituminous-coal mines for over 50 years, it is only within the last 15 years that the number in use has shown a marked increase. Portable electric power drills were introduced in 1917. Power drills are now in use or have been on trial in nearly every coal-producing county in the United States.

Table 17 shows the coal produced in underground mines in working places where shot holes were power-drilled during 1936 and 1938. The total quantity produced by power drills increased from 111,950,000 net tons in 1936 to 122,581,133 in 1938 (9.5 percent). In 1936 the following States led in underground tonnage from working places where shot holes were power-drilled: Illinois, 24.2 percent; Pennsylvania, 19.0 percent; West Virginia, 17.5 percent; Kentucky, 11.2 percent; and Indiana, 7.2 percent. In 1938 they were: West Virginia, 21.7 percent; Illinois, 19.8 percent; Pennsylvania, 17.1 percent; Kentucky, 14.1 percent; and Indiana, 4.9 percent. The tonnage produced by pneumatic drills decreased from 10.6 percent of the total in 1936 to 9.1 percent in 1938, while the tonnage from electric drills increased from 89.4 percent to 90.9 in the same period.

TABLE 17.—*Coal produced in underground bituminous mines in the United States in working places where shot holes were power-drilled, 1936 and 1938,[1] in net tons*

State	By drills, 1936			By drills, 1938		
	Electric	Compressed air	Total	Electric	Compressed air	Total
Alabama Tennessee	3,810,000	160,000	3,970,000	5,598,859	236,711	5,835,570
Alaska	----------	----------	----------	(2)	(2)	(2)
Arkansas Oklahoma Texas	240,000	----------	240,000	(2)	(2)	270,983
Colorado	780,000	10,000	790,000	2,055,700	----------	2,055,700
Illinois	27,110,000	10,000	27,120,000	24,099,565	139,302	24,238,867
Indiana	8,010,000	----------	8,010,000	5,975,859	----------	5,975,859
Iowa Kansas Missouri	80,000	----------	80,000	164,084	----------	164,084
Kentucky	12,490,000	----------	12,490,000	16,689,787	645,300	17,335,087
Maryland	(2)	----------	(2)	329,345	----------	329,345
Michigan	(2)	----------	(2)	57,051	----------	57,051
Montana	1,200,000	120,000	1,320,000	1,134,423	308,142	1,442,565
New Mexico	160,000	----------	160,000	(2)	----------	(2)
North Dakota[3]	(2)	----------	(2)	(2)	----------	(2)
Ohio	4,800,000	----------	4,800,000	4,622,619	----------	4,622,619
Pennsylvania	10,380,000	10,860,000	21,240,000	13,501,549	7,510,243	21,011,792
Utah	2,400,000	10,000	2,410,000	2,482,569	----------	2,482,569
Virginia	2,830,000	10,000	2,840,000	3,769,283	292,344	4,061,627
Washington	490,000	560,000	1,050,000	210,669	891,397	1,102,066
West Virginia	19,530,000	110,000	19,640,000	25,557,705	1,007,917	26,565,622
Wyoming	5,180,000	50,000	5,230,000	(2)	(2)	4,838,980
Undistributed	560,000	----------	560,000	5,129,086	171,624	190,747
Total United States	100,050,000	11,900,000	111,950,000	111,378,153	11,202,980	122,581,133

[1] Data for 1937 not available.
[2] Included under "Undistributed."
[3] Compiled by Bureau of Mines.

The States showing the highest percentage of deep-mined production power-drilled in 1938 were Wyoming, Montana, Utah, Indiana, Illinois, and Washington.

The following summary gives the number of electric and pneumatic drills in use in coal and rock in 1938:

TABLE 18.—*Electric and pneumatic drills in use in coal and rock in the United States in 1938*

Use	Drills		
	Electric	Pneumatic	Total
Coal	3,616	303	3,919
Coal and rock	1,043	311	1,354
Rock	412	851	1,263
Total United States	5,071	1,465	6,536

Table 19 shows the technologic improvement of the coal industry in regard to power drilling, machine cutting, and mechanical loading, by States, in 1936 and 1938. The national deep-mined output of bituminous coal power-drilled increased from 27.2 percent in 1936 to 38.5 in 1938; machine cutting from 84.8 to 87.5; and loading by mechanical devices from 16.3 to 26.7.

TABLE 19.—*Percent of output of deep-mined bituminous coal power-drilled, cut by machines, and mechanically loaded in each State, 1936 and 1938* [1]

State	Power-drilled		Cut by machines		Mechanically loaded [2]	
	1936	1938	1936	1938	1936	1938
Alabama	23.0	37.7	72.8	73.5	14.3	18.3
Tennessee			70.0	75.7	5.7	12.2
Arkansas			81.2	87.5	33.3	59.2
Oklahoma	6.8	13.8	78.4	84.1	(3)	14.9
Texas				.6		
Colorado	11.6	36.4	68.6	74.1	8.2	21.5
Illinois	64.9	77.3	88.4	91.1	62.4	74.5
Indiana	79.0	82.0	90.3	90.6	70.5	81.1
Iowa			35.7	41.7	(3)	(3)
Kansas	1.3	3.7	28.3	26.0		
Missouri			58.6	68.8		
Kentucky	26.3	45.7	93.7	95.1	1.4	8.6
Maryland	(3)	25.7	35.6	42.5	(3)	(3)
Michigan	(3)	11.5	98.3	100.0		
Montana [4]	75.0	88.6	92.9	93.9	83.2	87.3
New Mexico	10.0	(3)	25.8	33.3	(3)	(3)
North Dakota [4]	(3)	(3)	68.0	68.0	(3)	(3)
Ohio	22.2	28.8	94.6	96.6	9.5	24.1
Pennsylvania	19.5	27.4	76.9	80.2	8.3	15.8
Utah	74.2	84.2	87.4	93.7	41.8	66.9
Virginia	24.4	33.1	90.2	92.7	6.7	15.0
Washington	57.9	70.3	35.9	44.5	33.6	42.2
West Virginia	16.7	28.5	92.0	94.3	7.4	22.1
Wyoming	92.8	96.2	94.5	93.4	92.0	94.2
Undistributed	17.6	8.7	20.6	11.3	8.4	15.1
Total United States	27.2	38.5	84.8	87.5	16.3	26.7

[1] Data for 1937 not available.
[2] Includes mobile loaders, scrapers, duckbills, other self-loading conveyors, pit-car loaders, and hand loaded conveyors.
[3] Included under "Undistributed."
[4] Includes lignite.

During 1938, 1,061 mines employed power drills; in 350 of these mines they were used in drilling coal only, in 415 they were used in both coal and rock, and in 296 they were used in drilling rock only.

Table 20 gives the total bituminous deep-mined production at mines using power drills in 1938, by States. At mines using power drills in coal only, 18.4 percent (58,488,723 tons) of the Nation's deep-mined output was produced. In the mines where power drills were used in coal and rock, 34.6 percent (109,985,045 tons) of the total underground production was accomplished, whereas the mines using power drills in rock only produced 17.2 percent (54,922,320 tons), accounting for 70.2 percent of the national deep-mined output from mines employing power drills.

TABLE 20.—*Total production of deep-mined bituminous coal at mines using power drills in the United States, in 1938*

[The figures indicate, for example, that in Colorado 33.5 percent of all the deep-mined production of the State came from mines using one or more power drills in coal only, 22.1 percent from mines using power drills in coal and rock, 18.0 percent from mines using power drills in rock only, a total of 73.6 percent for the State]

State	Total production				Percent of deep mined production for area			
	Mines using power drills							
	In coal only	In coal and rock	In rock only	In coal only, coal and rock, and rock only	In coal only	In coal and rock	In rock only	In coal only, coal and rock, and rock only
Alabama and Tennessee	1,083,817	8,407,024	1,850,527	11,341,368	7.0	54.3	11.9	73.2
Alaska	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Arkansas [2]	277,862	199,438	531,851	1,009,151	14.1	10.1	27.1	51.3
Colorado	1,892,894	1,247,275	1,016,577	4,156,746	33.5	22.1	18.0	73.6
Illinois	10,235,645	14,799,542	464,907	25,500,094	32.7	47.2	1.5	81.4
Indiana	3,288,872	2,740,296	9,431	6,038,599	45.2	37.6	.1	82.9
Iowa, Kansas, and Missouri	285,684	54,451	145,982	486,117	6.4	1.2	3.2	10.8
Kentucky	9,116,370	16,023,994	4,916,534	30,056,898	24.0	42.2	13.0	79.2
Maryland	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Michigan		72,236	315,532	387,768		14.6	63.8	78.4
Montana	(1)	(1)		(1)	(1)	(1)		(1)
New Mexico		(1)	(1)	(1)		(1)	(1)	(1)
North Dakota	(1)			(1)	(1)			(1)
Ohio	1,029,830	5,321,064	1,608,257	7,959,151	6.4	33.1	10.0	49.5
Oklahoma	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Pennsylvania	6,604,567	26,164,874	20,842,425	53,611,866	8.6	34.2	27.2	70.0
Utah	1,026,331	1,655,138		2,681,469	34.8	56.2		91.0
Virginia	1,072,522	3,679,760	2,824,591	7,576,873	8.7	30.0	23.0	61.7
Washington	460,830	892,002		1,352,832	29.4	56.9		86.3
West Virginia	16,918,112	26,767,887	19,959,510	63,645,509	18.2	28.8	21.4	68.4
Wyoming	4,104,643	805,906		4,910,549	81.6	16.0		97.6
Undistributed	1,090,744	1,154,158	436,196	2,681,098	18.4	19.5	7.4	45.3
Total, United States	58,488,723	109,985,045	54,922,320	223,396,088	18.4	34.6	17.2	70.2

[1] Included under "Undistributed."
[2] Oklahoma included with Arkansas.

MECHANICAL LOADING

Mechanical loading of coal in the United States continued to advance in 1938, when 95,244,505 tons were loaded, compared with 94,183,837 in 1937. Mechanical loading in the bituminous mines increased from 83,500,000 tons in 1937 to 85,092,836 in 1938, while that in the Pennsylvania anthracite region declined from 10,683,837 tons in 1937 to 10,151,669 in 1938. Although the total tonnage mechanically loaded in bituminous mines in 1938 represented only a small increase over the estimated figure for 1937 (1.9 percent), the proportion of deep-mined coal loaded mechanically increased from 20.2 percent of the total production in 1937 to 26.7 percent in 1938.

Illinois continued to lead in tonnage in the bituminous fields; West Virginia, Pennsylvania, Indiana, Wyoming, Ohio, and Kentucky followed in the order named. Although Arkansas and Utah do not show large increases in tonnage, there were high percentage gains in 1938 over 1937.

Table 21 shows the tonnage loaded mechanically by States, 1935–38.

TABLE 21.—*Coal loaded mechanically underground in the United States, 1935–38, by States, in net tons*

State	1935	1936	1937 (estimated) [1]	1938
Bituminous:				
Alabama	1,303,653	1,741,452	2,100,000	2,017,045
Arkansas	292,064	522,411	550,000	692,462
Colorado	197,319	557,548	1,018,039	1,216,745
Illinois	20,513,082	26,110,068	28,344,362	23,363,426
Indiana	5,767,696	7,146,090	7,426,306	5,905,834
Iowa	----------	(2)	(2)	(2)
Kentucky	533,250	658,747	1,300,000	3,252,688
Maryland	(2)	(2)	(2)	(2)
Missouri	(2)	----------	----------	----------
Montana	1,291,373	1,464,121	1,431,000	1,378,954
New Mexico	(2)	(2)	(2)	(2)
North Dakota	(2)	(2)	(2)	(2)
Ohio	1,488,303	2,049,075	3,204,102	3,863,471
Oklahoma	(2)	(2)	(2)	119,008
Pennsylvania	6,469,485	9,033,855	11,951,639	12,090,021
Tennessee	233,579	290,220	450,000	545,677
Utah	898,118	1,358,543	1,835,000	1,972,941
Virginia	651,807	779,232	1,500,000	1,846,806
Washington	429,617	608,488	838,000	660,596
West Virginia	2,059,322	8,712,935	15,490,863	20,530,906
Wyoming	4,530,032	5,189,263	5,300,000	4,740,527
Undistributed	518,524	754,824	760,689	895,729
Total bituminous	47,177,224	66,976,872	83,500,000	85,092,836
Pennsylvania anthracite [3]	9,279,057	10,827,946	10,683,837	10,151,669
Total United States	56,456,281	77,804,818	94,183,837	95,244,505

[1] For sources of estimates, see Minerals Yearbook, 1939 (p. 798).
[2] Included under "Undistributed."
[3] Minerals Yearbook, 1939 (p. 857).

Sales of mechanical loading equipment in 1940.—Sales of equipment for the mechanical loading of coal showed an increase in 1940 over 1939 for all items except mobile loaders. Sales of mobile loaders totaled 233 units in 1940 compared with 292 in 1939—a decrease of 20.2 percent. Total sales of scraper loading units amounted to 39 in 1940 compared with 26 in 1939—an increase of 50 percent. Conveyor sales, which included hand-loaded face conveyors and those equipped with duck-bills or other self-loading heads, were 1,762 units in 1940 compared with 1,311 in 1939—a 34.4-percent increase. Sales for each year, 1933–40, are shown in table 22.

TABLE 22.—*Units of mechanized loading equipment sold to bituminous and anthracite mines in the United States, as reported by manufacturers, 1933–40* [1]

Type of equipment	1933	1934	1935	1936	1937	1938	1939	1940	Percent increase or decrease, 1940 over 1939
Mobile loaders	41	55	115	344	292	241	292	233	−20.2
Scrapers [2]	65	34	22	28	29	10	26	39	+50.0
Conveyors [3]	396	610	681	994	1,095	990	1,311	1,762	+34.4
Pit-car loaders	18	26	28	11	32	139	2	3	+50.0

[1] The figures for 1933–36 included reports from 28 manufacturers. In 1937, 1 manufacturer indicated that he was no longer producing this type of equipment and accordingly was dropped from the active list; however, at the same time another manufacturer was added to the list, and the number of reporting firms remained at 28. In 1938, 1 manufacturer of material-handling machinery began the production of underground loading equipment; and in 1939, 2 new manufacturers entered the field, increasing the total number reporting to 31. Figures for 1940 include reports from 32 manufacturers.
[2] Reported as scrapers or scraper haulers and hoists.
[3] Includes hand-loaded conveyors and those equipped with duckbills and other self-loading heads. As sales of both loading heads and shaker conveyors are counted, the figures involve a certain measure of overlap, which cannot be determined accurately. It should also be noted that a small number of conveyors sold in recent years, particularly in 1936–38, were for use in conjunction with mobile loading machines.

TABLE 23.—*Sales of mechanized loading equipment in the United States, 1939–40, compared with total number of machines in active use in preceding years*

Type of equipment	Number of machines in active use [1]								Number of machines sold [2]	
	1930	1931	1932	1933	1934	1935	1936	1938	1939	1940
Bituminous mines:										
Mobile loading machines	545	583	548	523	534	657	980	1,405	292	233
Scrapers	150	146	128	93	119	78	106	117	18	36
Pit-car loaders	2,876	3,428	3,112	2,453	2,288	2,098	1,851	1,392	2	3
Conveyors equipped with duckbills and other self-loading heads	140	165	159	132	157	179	234	346	[4] 1,095	[4] 1,573
Hand-loaded conveyors—number of units	(3)	(3)	(3)	525	574	670	936	1,526		
Anthracite mines (Pennsylvania):										
Mobile loading machines	384	5	11	18	14	1	504	(5)	------	------
Scrapers		457	479	455	517	507		545	8	3
Pit-car loaders		28	24	19	25	22			------	------
Conveyors equipped with duckbills and other self-loading heads	421	1	17	12	13	30	1,790	[5] 1,831	[4] 216	[4] 189
Hand-loaded conveyors—number of units		547	818	940	1,338	1,563				

[1] As reported by mine operators. Data for 1937 not available for bituminous mines. Minerals Yearbook, 1939 (p. 857) shows 539 scrapers and 1,855 conveyors and pit-car loaders, including a few mobile loaders in the anthracite mines for 1937.
[2] As reported by manufacturers.
[3] Number of units not reported in these years.
[4] Reported as face conveyors (hand-loaded), "shaker drives," and "duckbills." The figures of numbers sold in 1939 and 1940 are not exactly comparable with the number in use in 1938, because of uncertainties in defining what constitutes a conveyor and because of certain overlaps in the reporting of duckbill loading heads and shaker conveyors.
[5] Mobile loading machines included with conveyors and pit-car loaders.

TABLE 24.—*Comparison of mobile loaders, scrapers, and conveyors in actual use in coal mines in the United States in 1938 with sales reported, 1939–40, by States and regions*

State and region	Mobile loaders			Scrapers			Conveyors [1]		
	In use, 1938	Sales 1939	Sales 1940	In use, 1938	Sales 1939	Sales 1940	In use, 1938	Sales 1939	Sales 1940
BITUMINOUS									
Northern Appalachian States:									
Pennsylvania	164	89	94	32	1	7	476	225	225
Maryland	------	------	------	------	------	------		------	
Ohio	70	17	23	------	------	1	29	45	178
Michigan	------	------	------	------	------	------	------		4
Southern Appalachian States:									
Alabama	23	7	6	32	8	10	134	82	54
Kentucky	47	28	18	9	------	------	117	131	134
Tennessee	3		------		------	------	43	41	26
West Virginia	266	85	59		9	18	443	375	724
Virginia	27	8	4	------	------	------		52	43
Middle Western States:									
Illinois	504	28	8	------	------	------	37	28	25
Indiana	158	12	7	------	------	------		2	22
Trans-Mississippi States [2]	143	18	14	44	------	------	593	114	138
Total bituminous	1,405	292	233	117	18	36	1,872	1,095	1,573
ANTHRACITE									
Pennsylvania	(3)	------	------	545	8	3	[3] 1,831	216	189
Total United States	1,405	292	233	662	26	39	3,703	1,311	1,762

[1] Includes hand-loaded conveyors and conveyors equipped with duckbills or other self-loading heads.
[2] Includes Arkansas, Colorado, Iowa, Montana, New Mexico, North Dakota, Oklahoma, Utah, Washington, and Wyoming.
[3] Mobile loaders and pit-car loaders included with conveyors.

The number of units of mechanized loading equipment sold in 1939 and 1940 compared with the total number of machines in active use in preceding years is shown in table 23. The reports of sales of conveyor equipment are not strictly comparable with reports of the number of units actually in use.

Table 24 shows the comparison, by regions and classes of equipment, of loading machinery in active use in 1938 with the sales reported in 1939–40.

Detailed statistics of mechanical loading in biiuminous mines in 1938, by types of equipment.—In 1938, 85,092,836 net tons of bituminous coal were loaded mechanically. Table 25 shows the tonnage loaded by the various classes of equipment. Similar data for 1937 are not available. The comparative change in the tonnage loaded by principal types of machines in 1936 and 1938 is shown in table 26. The net increase in 1938 over 1936 was 18,115,964 tons (27 percent).

The following classes of equipment showed increases in tonnage loaded in 1938 over 1936: Hand-loaded conveyors, 49.1 percent; mobile loading machines, 41.1; and duckbills and other self-loading conveyors, 31.1. The other two classes (scraper loaders and pit-car loaders) decreased in tonnage loaded in 1938 compared with 1936.

TABLE 25.—*Bituminous coal loaded mechanically underground in the United States in 1938 by types of machine*

Type of machine	Net tons	Percent
Loaded by machine:		
Mobile loading machines	57,824,252	91.7
Scraper loaders	1,030,468	1.6
Conveyors equipped with duckbills and other self-loading devices	4,248,434	6.7
Total loaded by machine	63,103,154	100.0
Handled by conveyors:		
Conveyors equipped with duckbills and other self-loading devices	4,248,434	16.2
Pit-car loaders	5,652,562	21.5
Hand-loaded conveyors	16,337,120	62.3
Total handled by conveyors	26,238,116	100.0
Recapitulation, less duplications:		
Mobile loading machines	57,824,252	68.0
Scraper loaders	1,030,468	1.2
Conveyors equipped with duckbills and other self-loading devices	4,248,434	5.0
Pit-car loaders	5,652,562	6.6
Hand-loaded conveyors	16,337,120	19.2
Grand total loaded mechanically	85,092,836	100.0

TABLE 26.—*Comparative change in tonnage of bituminous coal loaded by principal types of machines in the United States, 1936 and 1938* [1]

Type of machine	1936 (net tons)	1938 (net tons)	Increase or decrease, 1938	
			Net tons	Percent
Mobile loading machines	40,969,625	57,824,252	+16,854,627	+41.1
Scraper loaders	1,272,466	1,030,468	−241,998	−19.0
Duckbills and other self-loading conveyors	3,240,411	4,248,434	+1,008,023	+31.1
Total loaded by machines	45,482,502	63,103,154	+17,620,652	+38.7
Pit-car loaders	10,538,331	5,652,562	−4,885,769	−46.4
Other hand-loaded conveyors	10,956,039	16,337,120	+5,381,081	+49.1
Grand total	66,976,872	85,092,836	+18,115,964	+27.0

[1] Data for principal types of machines not available for 1937. The total tons loaded mechanically for that year as estimated from sales of new equipment, State mine inspectors' reports, and other sources was 83,500,000 net tons.

TABLE 27.—*Mechanical loading underground in bituminous-cool mines in the United States, in 1938 by States*

[Table includes all soft-coal mines that produced any part of their tonnage with the aid of mechanical loading devices in 1938. The mines have been grouped into 3 classes. First includes those mines in which all of the tonnage mechanically loaded was obtained with machines that substantially eliminate hand shoveling—mobile loaders, scrapers, and duckbill-equipped conveyors. It should be noted, however, that some of these mines make use of conveyors in conjunction with mobile loaders to perform the initial phase of transportation. Second class includes those mines in which all the tonnage loaded mechanically was obtained with hand-loaded conveyors or pit-car loaders. Third class includes mines that load with both types of machines]

State	Number of mines				Number of machines					Production mechanically loaded (net tons)			Total production of mechanized mines (net tons)			
	Using loading machines only [1]	Using conveyors only [2]	Using both loading machines and conveyors	Total	Mobile loading machines	Scrapers	Conveyors equipped with duckbills and other self-loading devices	Pit-car loaders	Installations of hand-loaded conveyors [3]	Loaded by machines [1]	Handled by conveyors [2]	Total	Mines using loading machines only [1]	Mines using conveyors only [2]	Mines using both loading machines and conveyors	Total
Alabama	13	19	5	37	23	32	7	(4)	20	798, 434	1, 218, 611	2, 017, 045	2, 062, 553	4, 435, 184	533, 212	7, 030, 949
Arkansas	2	24	1	27	(4)	(4)	------	------	25	125, 589	566, 873	692, 462	(4)	532, 133	(4)	692, 928
Colorado	19	11	3	33	31	------	54	(4)	12	716, 716	500, 029	1, 216, 745	1, 507, 973	817, 917	333, 258	2, 659, 148
Illinois	39	10	19	68	504	------	------	685	4	20, 536, 226	2, 827, 200	23, 363, 426	16, 000, 799	728, 240	7, 960, 312	24, 689, 351
Indiana	20	9	5	34	158	------	------	73	2	5, 595, 977	309, 857	5, 905, 834	4, 827, 852	249, 989	889, 699	5, 967, 540
Iowa	------	2	------	2	------	------	------	------	2	------	(4)	(4)	------	(4)	------	(4)
Kentucky	26	20	9	55	47	(4)	47	84	23	2, 138, 725	1, 113, 963	3, 252, 688	4, 587, 749	3, 192, 042	3, 915, 066	11, 694, 857
Maryland	------	3	------	3	------	------	------	------	3	------	(4)	(4)	------	(4)	------	(4)
Montana	5	------	1	6	42	------	(4)	(4)	------	(4)	(4)	1, 378, 954	(4)	------	(4)	1, 378, 954
New Mexico	2	------	------	2	(4)	(4)	------	------	------	(4)	------	(4)	(4)	------	------	(4)
North Dakota	2	------	------	2	(4)	------	------	------	------	(4)	------	(4)	(4)	------	------	(4)
Ohio	10	7	2	19	70	------	(4)	------	9	3, 694, 907	168, 564	3, 863, 471	5, 293, 308	(4)	(4)	6, 434, 995
Oklahoma	3	5	------	8	------	10	------	------	5	50, 033	68, 975	119, 008	50, 033	139, 718	------	189, 751
Pennsylvania	37	51	13	101	164	32	9	262	59	6, 141, 863	5, 948, 158	12, 090, 021	13, 272, 915	10, 651, 230	5, 284, 194	29, 208, 339
Tennessee	2	6	4	12	3	(4)	10	------	10	140, 556	405, 121	545, 677	(4)	(4)	730, 606	1, 635, 301
Utah	9	5	1	15	33	------	10	------	6	1, 570, 746	402, 195	1, 972, 941	1, 810, 441	(4)	(4)	2, 454, 993
Virginia	10	3	------	13	27	------	------	------	3	(4)	(4)	1, 846, 806	(4)	(4)	------	2, 839, 290
Washington	------	6	------	6	------	------	------	(4)	5	------	660, 596	660, 596	------	727, 282	------	727, 282
West Virginia	62	86	27	175	266	4	11	147	101	14, 520, 116	6, 010, 790	20, 530, 906	18, 174, 172	16, 593, 524	8, 941, 728	43, 709, 424
Wyoming	14	3	10	27	27	(4)	192	69	7	4, 010, 192	730, 335	4, 740, 527	2, 694, 806	273, 726	1, 862, 436	4, 830, 968
Undistributed	------	------	------	------	10	39	6	72	------	3, 063, 074	1, 058, 415	895, 729	4, 188, 690	3, 262, 674	958, 788	1, 340, 179
Total, 1938	275	270	100	645	1, 405	117	346	1, 392	296	63, 103, 154	21, 989, 682	85, 092, 836	74, 471, 291	41, 603, 659	31, 409, 299	147, 484, 249
Total, 1936	184	192	60	436	980	106	234	1, 851	185	45, 482, 502	21, 494, 370	66, 976, 872	59, 026, 012	39, 487, 242	27, 455, 503	125, 968, 757
Percent change, 1938 over 1936	+49.5	+40.6	+66.7	+47.4	+43.9	+10.4	+47.9	−24.8	+60.0	+38.7	+2.3	+27.0	+26.2	+5.4	+14.4	+17.1

[1] Includes mobile loading machines, scrapers, and conveyors equipped with duckbills and other self-loading heads. Some mines in this class also use conveyors in conjunction with mobile loaders to perform initial phase of transportation.
[2] Includes hand-loaded conveyors and pit-car loaders.
[3] Number of mines in which hand-loaded conveyors (other than pit-car loaders) were used.
[4] Included under "Undistributed."

TABLE 28.—*Comparative changes in bituminous coal loaded mechanically underground in the United States by principal types of machines 1936 and 1938, by States, in net tons*

State	1936			1938			Increase or decrease 1938						Percent handled by each class			
							Net tons			Percent			1936		1938	
	Loaded by machines [1]	Handled by conveyors [2]	Total	Loaded by machines [1]	Handled by conveyors [2]	Total	Loaded by machines [1]	Handled by conveyors [2]	Total	Loaded by machines	Handled by conveyors	Total	Loaded by machines	Handled by conveyors	Loaded by machines	Handled by conveyors
Alabama	541, 005	1, 200, 447	1, 741, 452	798, 434	1, 218, 611	2, 017, 045	+257, 429	+18, 164	+275, 593	+47. 6	+1. 5	+15. 8	[3] 31. 1	68. 9	39. 6	60. 4
Arkansas	(4)	(4)	522, 411	125, 589	566, 873	692, 462	(4)	(4)	+170, 051	(4)	(4)	+32. 6	(4)	(4)	18. 1	81. 9
Colorado	344, 598	212, 950	557, 548	716, 716	500, 029	1, 216, 745	+372, 118	+287, 079	+659, 197	+108. 0	+134. 8	+118. 2	61. 8	38. 2	58. 9	41. 1
Illinois	18, 607, 302	7, 502, 766	26, 110, 068	20, 536, 226	2, 827, 200	23, 363, 426	+1, 928, 924	−4, 675, 566	−2, 746, 642	+10. 4	−62. 3	−10. 5	[5] 71. 3	[6] 28. 7	[5] 87. 9	[6] 12. 1
Indiana	6, 402, 957	743, 133	7, 146, 090	5, 595, 977	309, 857	5, 905, 834	−806, 980	−433, 276	−1, 240, 256	−12. 6	−58. 3	−17. 4	[5] 89. 6	[6] 10. 4	[5] 94. 8	[6] 5. 2
Iowa	------	(4)	(4)	------	(4)	(4)	------	(4)	(4)	------	(4)	(4)	------	100. 0	------	100. 0
Kentucky	85, 012	573, 735	658, 747	2, 138, 725	1, 113, 963	3, 252, 688	+2, 053, 713	+540, 228	+2, 593, 941	+2, 415. 8	+94. 2	+393. 8	[7] 12. 9	87. 1	65. 8	34. 2
Maryland	------	(4)	(4)	------	(4)	(4)	------	(4)	(4)	------	(4)	(4)	------	100. 0	------	100. 0
Montana	1, 239, 069	225, 052	1, 464, 121	(4)	(4)	1, 378, 954	(4)	(4)	−85, 167	(4)	(4)	−5. 8	[7] 84. 6	[8] 15. 4	(4)	(4)
New Mexico	(4)	------	(4)	(4)	------	(4)	(4)	------	(4)	(4)	------	(4)	100. 0	------	100. 0	------
North Dakota	(4)	------	(4)	(4)	------	(4)	(4)	------	(4)	(4)	------	(4)	[5] 100. 0	------	[5] 100. 0	------
Ohio	2, 002, 526	46, 549	2, 049, 075	3, 694, 907	168, 564	3, 863, 471	+1, 692, 381	+122, 015	+1, 814, 396	+84. 5	+262. 1	+88. 5	[9] 97. 7	[10] 2. 3	[9] 95. 6	[10] 4. 4
Oklahoma	(4)	------	(4)	50 033	68, 975	119, 008	(4)	(4)	(4)	(4)	(4)	(4)	100. 0	------	[11] 42. 0	[10] 58. 0
Pennsylvania	3, 455, 323	5, 578, 532	9, 033, 855	6, 141, 863	5, 948, 158	12, 090, 021	+2, 686, 540	+369, 626	+3, 056, 166	+77. 8	+6. 6	+33. 8	[7] 38. 2	61. 8	[7] 50. 8	[12] 49. 2
Tennessee	91, 975	198, 245	290, 220	140, 556	405, 121	545, 677	+48, 581	+206, 876	+255, 457	+52. 8	+104. 4	+88. 0	31. 7	[10] 68. 3	25. 8	[10] 74. 2
Utah	1, 248, 483	110, 060	1, 358, 543	1, 570, 746	402, 195	1, 972, 941	+322, 263	+292, 135	+614, 398	+25. 8	+265. 4	+45. 2	[5] 91. 9	8. 1	[7] 79. 6	[10] 20. 4
Virginia	159, 884	619, 348	779, 232	(4)	(4)	1. 846, 806	(4)	(4)	+1, 067, 574	(4)	(4)	+137. 0	[5] 20. 5	[10] 79. 5	(4)	(4)
Washington	(4)	(4)	608, 488	------	660, 596	660, 596	(4)	(4)	+52, 108	(4)	(4)	+8. 6	(4)	(4)	------	100. 0
West Virginia	6, 334, 220	2, 378, 715	8, 712, 935	14, 520, 116	6, 010, 790	20, 530, 906	+8, 185, 896	+3, 632, 075	+11, 817, 971	+129. 2	+152. 7	+135. 6	[9] 72. 7	[10] 27. 3	[9] 70. 7	[12] 29. 3
Wyoming	4, 313, 885	875, 378	5, 189, 263	4, 010, 192	730, 335	4, 740, 527	−303, 693	−145, 043	−448, 736	−7. 0	−16. 6	−8. 6	83. 1	16. 9	84. 6	15. 4
Undistributed	656, 263	1, 229, 460	754, 824	3, 063, 074	1, 058, 415	895, 729	(13)	(13)	(13)	(13)	(13)	(13)	(13)	(13)	(13)	(13)
Total	45, 482, 502	21, 494, 370	66, 976, 872	63, 103, 154	21, 989, 682	85, 092, 836	+17, 620, 652	+495, 312	+18, 115, 964	+38. 7	+2. 3	+27. 0	67. 9	32. 1	74. 2	25. 8

[1] Includes mobile loaders, scrapers, and duckbills. Data for 1937 not available.
[2] Includes hand-loaded conveyors and pit-car loaders. Data for 1937 not available.
[3] Principally by scrapers.
[4] Included under "Undistributed."
[5] Entirely by mobile loaders.
[6] Principally by pit-car loaders.
[7] Principally by mobile loaders.
[8] Entirely by pit-car loaders.
[9] Virtually all by mobile loaders.
[10] Entirely by conveyors.
[11] Entirely by scrapers.
[12] Principally by conveyors.
[13] Included in total; tons loaded and percentage by types not given because State groups are not comparable in 1936 and 1938.

Mechanical loading by States.—Illinois continued to lead all other States during 1938, with 23,363,426 tons of mechanically loaded coal. It was followed by West Virginia, with 20,530,906 tons; Pennsylvania, with 12,090,021; Indiana, with 5,905,834; and Wyoming, with 4,740,527. These five States accounted for 78.3 percent of the total output of mechanically loaded bituminous coal in the United States in 1938. Details of the number of mines and machines, tonnages mechanically loaded, and total production of mechanized mines, by States, are given in table 27.

In terms of tonnage increase of mechanically loaded coal in 1938 over 1936, West Virginia led with 11,817,971 net tons, which was more than half of the total increase of all States. Other States, in order of tonnage increase, were Pennsylvania, 3,056,166 tons; Kentucky, 2,593,941; Ohio, 1,814,396; and Virginia, 1,067,574. Illinois, Indiana, and Wyoming had less tonnage mechanically loaded in 1938 than in 1936. Details are shown in table 28. In comparing 1938 with 1936, it should be remembered that the total United States production decreased from 439,087,903 tons in 1936 to 348,544,764 in 1938, 20.6 percent.

Percentage of deep-mined output mechanically loaded.—The degree of mechanization can best be measured by comparing the percentage of coal mechanically loaded underground to the total output of all underground mines. In the United States this percentage has increased from 12.0 percent in 1933 to 26.7 in 1938. Individual States range from 94.2 percent in Wyoming to 8.6 in Kentucky during 1938.

TABLE 29.—*Percent of underground bituminous coal in the United States loaded mechanically in each State, 1926 and 1928–38*

State	1926	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Alabama	0.5	3.5	5.3	13.4	18.8	15.9	16.0	11.8	15.4	14.3	16.9	18.3
Arkansas	------	(1)	11.6	16.6	18.5	15.4	17.0	25.1	26.6	33.3	37.1	59.2
Colorado	(1)	.8	1.5	1.5	2.0	2.8	1.4	1.3	3.3	8.2	14.2	21.5
Illinois	3.1	13.5	33.0	48.0	59.4	57.0	53.9	52.6	55.3	62.4	70.6	74.5
Indiana	11.1	21.0	25.7	32.3	39.1	42.8	48.6	61.4	62.5	70.5	78.3	81.1
Iowa	1.8	(1)	(1)	(1)	(1)	(1)	(1)	------	------	(1)	(1)	(1)
Kansas	------	------	------	------	------	------	------	------	------	------	------	------
Kentucky	.3	1.0	1.4	1.9	2.2	3.1	2.2	1.9	1.3	1.4	2.8	8.6
Maryland	(1)	(1)	(1)	(1)	3.5	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Michigan	(1)	(1)	------	------	------	------	(1)	------	------	------	------	------
Missouri	------	4.3	6.2	6.1	6.8	(1)	6.3	(1)	(1)	------	------	------
Montana	------	17.1	32.3	57.0	65.9	78.0	79.5	79.1	80.1	[2] 58.1	[2] 56.3	[2] 56.2
New Mexico	(1)	(1)	2.4	(1)	(1)	5.9	(1)	(1)	(1)	(1)	(1)	(1)
North Dakota	(1)	------	------	------	(1)	(1)	------	(1)	(1)	(1)	(1)	(1)
Ohio	.5	4.9	(1)	(1)	6.5	6.5	5.5	5.8	7.8	9.5	14.1	24.1
Oklahoma	------	(1)	.8	(1)	(1)	(1)	------	(1)	(1)	(1)	(1)	14.9
Pennsylvania	.6	2.1	3.0	5.7	9.1	9.9	8.5	7.3	7.1	8.3	10.9	15.8
South Dakota	------	------	------	------	------	------	------	------	------	------	------	------
Tennessee	(1)	(1)	(1)	1.0	2.0	(1)	(1)	(1)	5.6	5.7	8.6	12.2
Texas	------	------	------	------	------	------	------	------	------	(2)	(2)	(2)
Utah	2.6	18.1	17.8	20.2	25.7	26.4	20.6	24.9	30.5	41.8	48.2	66.9
Virginia	7.7	6.7	7.7	7.9	8.0	5.3	4.5	4.1	6.7	6.7	10.9	15.0
Washington	------	(1)	10.8	18.4	24.9	22.8	19.4	24.6	27.6	33.6	41.9	42.2
West Virginia	1.4	1.6	1.9	1.8	1.7	.9	.8	1.4	2.1	7.4	13.1	22.1
Wyoming	17.7	41.3	45.3	47.7	56.6	66.2	75.8	84.1	89.8	92.0	92.2	94.2
Other States	------	------	[3] 57.5	[3] 42.1	[3] 4.2	------	------	------	------	------	------	------
Undistributed	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)
Total	1.8	4.5	7.4	10.5	13.1	12.3	12.0	12.2	13.5	16.3	20.2	26.7

[1] Included under "Undistributed."
[2] Texas included with Montana.
[3] North Carolina only.
[4] Not calculated because figures are not comparable from year to year.

Table 30 shows the contribution of each State to the total coal loaded mechanically in underground bituminous mines. The five most important States in regard to coal loaded mechanically were the same in 1928 as in 1938, but West Virginia and Wyoming exchanged their order of importance; West Virginia went from fifth place in 1928 to second in 1938 and Wyoming from second place in 1928 to fifth in 1938.

The percentages in 1938 were Illinois, 27.5; West Virginia, 24.1; Pennsylvania, 14.2; Indiana, 6.9; and Wyoming, 5.6.

TABLE 30.—*Percent of United States underground bituminous coal loaded mechanically in each State, 1928–38*

State	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937[1]	1938
Alabama	2.8	2.5	4.4	4.7	3.5	3.7	2.6	2.8	2.6	2.5	2.4
Arkansas	(2)	.5	.5	.4	.4	.4	.5	.6	.8	.7	.8
Colorado	.4	.4	.3	.3	.4	.2	.2	.4	.8	1.2	1.4
Illinois	32.3	48.2	48.6	47.5	42.9	45.3	44.6	43.5	39.0	33.9	27.5
Indiana	11.3	8.7	7.4	7.4	9.0	11.2	13.0	12.2	10.7	8.9	6.9
Iowa	(2)	(2)	(2)	(2)	(2)	(2)	------	------	(2)	(2)	(2)
Kentucky	2.8	2.1	2.1	1.9	3.1	2.1	1.8	1.1	1.0	1.6	3.8
Maryland	(2)	(2)	(2)	.1	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Michigan	(2)	------	------	------	------	------	------	------	------	------	------
Missouri	.4	.3	.2	.2	(2)	.2	(2)	(2)	------	------	------
Montana	1.7	1.9	2.4	2.2	3.0	2.9	2.8	2.7	2.2	1.7	1.6
New Mexico	(2)	.2	(2)	(2)	.2	(2)	(2)	(2)	(2)	(2)	(2)
North Carolina	------	.1	(3)	(3)	------	------	------	------	------	------	------
North Dakota	------	------	------	(2)	(2)	------	(2)	(2)	(2)	(2)	(2)
Ohio	3.0	------	------	2.7	2.4	2.7	2.7	3.2	3.1	3.8	4.5
Oklahoma	(2)	.1	(2)	(2)	(2)	------	(2)	(2)	(2)	(2)	.1
Pennsylvania	12.4	11.2	15.0	18.6	20.7	17.7	15.8	13.7	13.5	14.3	14.2
Tennessee	(2)	(2)	.1	.2	(2)	(2)	(2)	.5	.4	.5	.7
Utah	4.1	2.4	1.8	1.8	2.1	1.4	1.5	1.9	2.0	2.2	2.3
Virginia	3.7	2.6	1.8	1.6	1.1	1.0	.9	1.4	1.2	1.8	2.2
Washington	(2)	.7	.9	1.0	1.0	.7	.8	.9	.9	1.0	.8
West Virginia	10.2	7.1	4.7	3.5	2.1	2.1	3.3	4.4	13.0	18.6	24.1
Wyoming	12.4	7.9	6.3	5.8	7.5	7.8	8.6	9.6	7.7	6.4	5.6
Undistributed[4]	2.5	3.1	3.5	.1	.6	.6	.9	1.1	1.1	.9	1.1
Total United States	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Based upon the estimates shown in table 21.
[2] Included under "Undistributed."
[3] Less than 0.05.
[4] Not comparable from year to year.

TABLE 31.—*Bituminous coal in the United States mined underground and from strip pits and method of loading underground, 1926 and 1928–38, by States, in net tons*

State	1926				
	Mined by stripping	Mined underground			Grand total production
		Hand-loaded	Machine-loaded	Total	
Alabama	332,499	20,556,660	111,803	20,668,463	21,000,962
Arkansas	198,095	1,260,922	—	1,260,922	1,459,017
Colorado	—	(1)	(1)	10,637,225	10,637,225
Illinois	3,466,098	63,865,304	2,035,521	65,900,825	69,366,923
Indiana	3,617,236	17,402,033	2,166,737	19,568,770	23,186,006
Iowa	—	4,541,162	84,325	4,625,487	4,625,487
Kansas	1,282,426	3,134,054	—	3,134,054	4,416,480
Kentucky	988,566	61,754,133	181.763	61,935,896	62,924,462
Maryland	—	(1)	(1)	3,078,353	3,078,353
Michigan	—	(1)	(1)	686,707	686,707
Missouri	1,243,723	1,764,772	—	1,764,772	3,008,495
Montana	730,677	2,067,083	—	2,067,083	2,797,760
New Mexico	—	(1)	(1)	2,817,923	2,817,923
North Dakota	509,219	(1)	(1)	861,025	1,370,244
Ohio	2,538,455	25,211,457	122,576	25,334,033	27,872,488
Oklahoma	454,574	2,388,099	—	2,388,099	2,842,673
Pennsylvania	1,012,400	151,173,660	855,578	152,029,238	153,041,638
South Dakota	—	14,428	—	14,428	14,428
Tennessee	4,600	(1)	(1)	5,784,141	5,788,741
Texas	275,517	815,641	—	815,641	1,091,158
Utah	—	4,259,174	114,619	4,373,793	4,373,793
Virginia	—	13,046,906	1,086,480	14,133,386	14,133,386
Washington	—	2,586,568	—	2,586,568	2,586,568
West Virginia	155,882	141,352,822	2,000,636	143,353,458	143,509,340
Wyoming	52,859	5,317,125	1,142,304	6,459,429	6,512,288
Other States [2]	59,869	164,571	—	164,571	224,440
Undistributed	—	23,745,521	119,853	—	—
Total United States	16,922,695	546,422,095	10,022,195	556,444,290	573,366,985

State	1928				
	Mined by stripping	Mined underground			Grand total production
		Hand-loaded	Machine-loaded	Total	
Alabama	333,186	16,674,576	613,600	17,288,176	17,621,362
Arkansas	107,164	(1)	(1)	1,553,809	1,660,973
Colorado	—	9,766.214	81,493	9,847,707	9,847,707
Illinois	4,339,442	44,638,024	6,970,733	51,608,757	55,948,199
Indiana	4,823,012	9,129,390	2,426,178	11,555,568	16,378,580
Iowa	—	(1)	(1)	3,683,635	3,683,635
Kansas	1,206,420	1,603,304	—	1,603,304	2,809,724
Kentucky	701,619	60,560,410	598,350	61,158,760	61,860,379
Maryland	—	(1)	(1)	2,686,979	2,686,979
Michigan	—	(1)	(1)	617,342	617,342
Missouri	1,778,507	1,870,109	83,805	1,953,914	3,732,421
Montana	1,181,004	1,776,596	366,595	2,143,191	3,324,195
New Mexico	—	(1)	(1)	2,711,851	2,711,851
North Dakota	756,131	893,799	—	893,799	1,649,930
Ohio	2,373,704	12,615,669	651,852	13,267,521	15,641,225
Oklahoma	516,522	(1)	(1)	2,984,803	3,501,325
Pennsylvania	1,076,871	127,443,377	2,681,915	130,125,292	131,202,163
South Dakota	—	13,929	—	13,929	13,929
Tennessee	85,428	(1)	(1)	5,525,531	5,610,959
Texas	330,599	851,435	—	851,435	1,182,034
Utah	—	3,964,788	877,756	4,842,544	4,842,544
Virginia	—	11,106,519	794,414	11,900,933	11,900,933
Washington	—	(1)	(1)	2,519,901	2,519,901
West Virginia	48,809	130,713,197	2,190,153	132,903,350	132,952,159
Wyoming	71,769	3,817,466	2,682,448	6,499,914	6,571,683
Other States [2]	58,390	214,448	—	214,448	272,838
Undistributed	—	21,743,910	539,941	—	—
Total United States	19,788,577	459,397,160	21,559,233	480,956,393	500,744,970

See footnotes at end of table.

TABLE 31.—*Bituminous coal in the United States mined underground and from strip pits and method of loading underground, 1926 and 1928–38, by States, in net tons*—Continued

State	1929					1930				
	Mined by stripping	Mined underground			Grand total production	Mined by stripping	Mined underground			Grand total production
		Hand-loaded	Machine-loaded	Total			Hand-loaded	Machine-loaded	Total	
Alabama	318,228	16,692,031	933,664	17,625,695	17,943,923	174,477	13,339,529	2,056,052	15,395,581	15,570,058
Arkansas	79,703	1,428,028	187,377	1,615,405	1,695,108	59,140	1,229,478	244,816	1,474,294	1,533,434
Colorado		9,773,227	147,514	9,920,741	9,920,741		8,074,250	122,660	8,196,910	8,196,910
Illinois	5,374,813	37,030,795	18,252,033	55,282,828	60,657,641	6,116,415	24,768,260	22,846,555	47,614,815	53,731,230
Indiana	5,613,108	9,457,255	3,273,995	12,731,250	18,344,358	5,639,212	7,347,567	3,503,183	10,850,750	16,489,962
Iowa		(1)	(1)	4,241,069	4,241,069		(1)	(1)	3,892,571	3,892,571
Kansas	1,021,689	1,954,282		1,954,282	2,975,971	1,046,601	1,383,328		1,383,328	2,429,929
Kentucky	395,669	59,254,667	812,264	60,066,931	60,462,600	343,498	49,876,341	989,156	50,865,497	51,208,995
Maryland		(1)	(1)	2,649,114	2,649,114		(1)	(1)	2,270,593	2,270,593
Michigan		804,869		804,869	804,869		661,113		661,113	661,113
Missouri	1,986,297	1,917,838	126,176	2,044,014	4,030,311	2,070,201	1,673,861	109,088	1,782,949	3,853,150
Montana	1,218,827	1,481,061	707,638	2,188,699	3,407,526	1,065,366	841,933	1,114,705	1,956,638	3,022,004
New Mexico		2,559,390	63,379	2,622,769	2,622,769		(1)	(1)	1,969,433	1,969,433
North Dakota	861,139	1,000,991		1,000,991	1,862,130	921,691	778,466		778,466	1,700,157
Ohio	1,767,681	(1)	(1)	21,921,796	23,689,477	1,118,203	(1)	(1)	21,433,775	22,551,978
Oklahoma	492,649	3,255,701	25,730	3,281,431	3,774,080	362,651	(1)	(1)	2,431,303	2,793,954
Pennsylvania	649,885	138,632,081	4,234,275	142,866,356	143,516,241	699,040	116,728,841	7,034,906	123,763,747	124,462,787
South Dakota		12,854		12,854	12,854	3,400	9,410		9,410	12,810
Tennessee	48,044	(1)	(1)	5,357,420	5,405,464	14,800	5,062,373	53,255	5,115,628	5,130,428
Texas	309,920	790,748		790,748	1,100,668	125,053	708,819		708,819	833,872
Utah		4,240,248	920,273	5,160,521	5,160,521		3,395,849	861,692	4,257,541	4,257,541
Virginia		11,763,892	984,414	12,748,306	12,748,306		10,042,986	864,391	10,907,377	10,907,377
Washington		2,248,301	273,026	2,521,327	2,521,327		1,877,722	424,206	2,301,928	2,301,928
West Virginia	13,062	135,808,178	2,697,615	138,505,793	138,518,855		119,244,237	2,228,401	121,472,638	121,472,638
Wyoming	72,749	3,630,072	3,001,969	6,632,041	6,704,790	82,611	3,140,824	2,864,698	6,005,522	6,088,133
Other States [2]	44,636	143,244	[3] 30,000	173,244	217,880		171,314	[3] 12,000	183,314	183,314
Undistributed		32,979,245	1,190,154				30,345,141	1,652,534		
Total United States	20,268,099	476,858,998	37,861,496	514,720,494	534,988,593	19,842,359	400,701,642	46,982,298	447,683,940	467,526,299

	1931					1932				
Alabama	74, 339	9, 686, 548	2, 237, 894	11, 924, 442	11, 998, 781	72, 738	6, 547, 660	1, 236, 541	7, 784, 201	7, 856, 939
Arkansas	29, 215	916, 820	207, 520	1, 124, 340	1, 153, 555	35, 326	844, 880	153, 265	998, 145	1, 033, 471
Colorado	18, 478	6, 453, 649	132, 242	6, 585, 891	6, 604, 369	16, 114	5, 426, 851	155, 756	5, 582, 607	5, 598, 721
Illinois	6, 325, 597	15, 400, 804	22, 576, 894	37, 977, 698	44, 303, 295	6, 551, 301	11, 563, 735	15, 359, 517	26, 923, 252	33, 474, 553
Indiana	5, 304, 894	5, 479, 007	3, 511, 264	8, 990, 271	14, 295, 165	5, 790, 857	4, 307, 371	3, 225, 345	7, 532, 716	13, 323, 573
Iowa	------------	(1)	(1)	3, 388, 355	3, 388, 355	127, 155	(1)	(1)	3, 735, 280	3, 862, 435
Kansas	1, 153, 159	833, 711	------------	833, 711	1, 986, 870	1, 183, 544	769, 341	------------	769, 341	1, 952, 885
Kentucky	66, 900	39, 017, 245	879, 476	39, 896, 721	39, 963, 621	2, 267	34, 204, 319	1, 092, 996	35, 297, 315	35, 299, 582
Maryland	------------	1, 935, 411	70, 362	2, 005, 773	2, 005, 773	------------	(1)	(1)	1, 428, 937	1, 428, 937
Michigan	------------	359, 403	------------	359, 403	359, 403	------------	446, 149	------------	446, 149	446, 149
Missouri	2, 308, 363	1, 223, 069	89, 065	1, 312, 134	3, 620, 497	2, 577, 219	(1)	(1)	1, 492, 379	4, 069, 598
Montana	820, 711	530, 758	1, 026, 583	1, 557, 341	2, 378, 052	748, 287	302, 727	1, 074, 211	1, 376, 938	2, 125, 225
New Mexico	------------	(1)	(1)	1, 552, 822	1, 552, 822	------------	1, 189, 472	73, 914	1, 263, 386	1, 263, 386
North Dakota	902, 949	(1)	(1)	616, 358	1, 519, 307	1, 019, 039	(1)	(1)	720, 619	1, 739, 658
Ohio	941, 910	18, 203, 701	1, 265, 384	19, 469, 085	20, 410, 995	805, 300	12, 254, 264	849, 887	13, 104, 151	13, 909, 451
Oklahoma	317, 500	(1)	(1)	1, 590, 894	1, 908, 394	271, 210	(1)	(1)	984, 256	1, 255, 466
Pennsylvania	441, 972	88, 366, 527	8, 850, 199	97, 216, 726	97, 658, 698	224, 512	67, 137, 789	7, 413, 561	74, 551, 350	74, 775, 862
South Dakota	23, 349	4, 136	------------	4, 136	27, 485	42, 669	6, 405	------------	6, 405	49, 074
Tennessee	------------	4, 626, 430	95, 118	4, 721, 548	4, 721, 548	------------	(1)	(1)	3, 537, 882	3, 537, 882
Texas	108, 897	607, 123	------------	607, 123	716, 020	74, 578	562, 012	------------	562, 012	636, 590
Utah	------------	2, 488, 982	861, 062	3, 350, 044	3, 350, 044	------------	2, 097, 773	754, 354	2, 852, 127	2, 852, 127
Virginia	------------	8, 922, 557	776, 123	9, 698, 680	9, 698, 680	------------	7, 285, 232	406, 948	7, 692, 180	7, 692, 180
Washington	------------	1, 387, 015	459, 446	1, 846, 461	1, 846, 461	961	1, 227, 515	362, 950	1, 590, 465	1, 591, 426
West Virginia	1, 891	99, 784, 477	1, 686, 804	101, 471, 281	101, 473, 172	------------	84, 843, 529	765, 206	85, 608, 735	85, 608, 735
Wyoming	92, 257	2, 125, 431	2, 775, 998	4, 901, 429	4, 993, 686	98, 051	1, 375, 049	2, 697, 863	4, 072, 912	4, 170, 963
Other States [2]	------------	154, 248	[3] 100	154, 348	154, 348	------------	155, 004	------------	155, 004	155, 004
Undistributed	------------	7, 087, 855	60, 574	------------	------------	------------	11, 704, 758	194, 595	------------	------------
Total United States	18, 932, 381	315, 594, 907	47, 562, 108	363, 157, 015	382, 089, 396	19, 641, 128	254, 251, 835	35, 816, 909	290, 068, 744	309, 709, 872

See footnotes at end of table.

TABLE 31.—*Bituminous coal in the United States mined underground and from strip pits and method of loading underground, 1926 and 1928–38, by States, in net tons*—Continued

State	1933					1934				
	Mined by stripping	Mined underground			Grand total production	Mined by stripping	Mined underground			Grand total production
		Hand-loaded	Machine-loaded	Total			Hand-loaded	Machine-loaded	Total	
Alabama	51,964	7,318,717	1,389,308	8,708,025	8,759,989	55,234	8,015,597	1,071,286	9,086,883	9,142,117
Arkansas	29,559	708,629	144,736	853,365	882,924	24,804	622,802	208,826	831,628	856,432
Colorado	21,584	5,137,216	70,967	5,208,183	5,229,767	24,324	5,121,533	65,076	5,186,609	5,210,933
Illinois	5,624,632	14,666,887	17,121,626	31,788,513	37,413,145	6,160,083	16,629,954	18,482,347	35,112,301	41,272,384
Indiana	5,065,076	4,473,621	4,222,355	8,695,976	13,761,052	6,000,613	3,390,344	5,402,686	8,793,030	14,793,643
Iowa	252,327	(1)	(1)	2,942,656	3,194,983	248,463	3,118,529		3,118,529	3,366,992
Kansas	1,439,529	778,093		778,093	2,217,622	1,747,110	761,144		761,144	2,508,254
Kentucky		35,309,974	789,755	36,099,729	36,099,729		37,781,606	743,629	38,525,235	38,525,235
Maryland		(1)	(1)	1,530,748	1,530,748		(1)	(1)	1,627,112	1,627,112
Michigan		(1)	(1)	406,584	406,584	18,522	603,219		603,219	621,741
Missouri	2,147,260	1,204,029	80,923	1,284,952	3,432,212	2,190,056	(1)	(1)	1,162,227	3,352,283
Montana	784,793	280,086	1,087,328	1,367,414	2,152,207	1,114,091	303,183	1,148,428	1,451,611	2,565,702
New Mexico		(1)	(1)	1,226,236	1,226,236		(1)	(1)	1,259,323	1,259,323
North Dakota	1,090,999	691,273		691,273	1,782,272	1,076,512	(1)	(1)	677,376	1,753,888
Ohio	1,006,204	17,553,891	1,028,668	18,582,559	19,588,763	1,201,416	18,352,750	1,136,398	19,489,148	20,690,564
Oklahoma	257,744	980,500		980,500	1,238,244	304,937	(1)	(1)	903,352	1,208,289
Pennsylvania	266,172	72,347,304	6,682,468	79,029,772	79,295,944	342,098	82,935,799	6,547,978	89,483,777	89,825,875
South Dakota	51,016	8,359		8,359	59,375	36,150	6,257		6,257	42,407
Tennessee		(1)	(1)	3,774,761	3,774,761		(1)	(1)	4,135,790	4,135,790
Texas	83,288	738,590		738,590	821,878	96,381	662,908		662,908	759,289
Utah		2,123,814	551,172	2,674,986	2,674,986		1,806,690	599,493	2,406,183	2,406,183
Virginia		7,808,337	370,305	8,178,642	8,178,642		8,991,725	384,956	9,376,681	9,376,681
Washington		1,123,210	270,858	1,394,068	1,394,068		1,042,306	340,685	1,382,991	1,382,991
West Virginia	3,832	93,545,423	794,280	94,339,703	94,343,535	29,533	96,739,924	1,364,936	98,104,860	98,134,393
Wyoming	94,202	949,045	2,969,920	3,918,965	4,013,167	119,314	677,043	3,571,604	4,248,647	4,367,961
Other States [2]		157,700		157,700	157,700		181,560		181,560	181,560
Undistributed		9,635,193	245,792				9,400,773	364,407		
Total United States	18,270,181	277,539,891	37,820,461	315,360,352	333,630,533	20,789,641	297,145,646	41,432,735	338,578,381	359,368,022

	1935					1936				
Alabama	32,136	7,168,721	1,303,653	8,472,374	8,504,510	52,154	10,435,681	1,741,452	12,177,133	12,229,287
Arkansas	34,189	807,026	292,064	1,099,090	1,133,279	55,115	1,045,261	522,411	1,567,672	1,622,787
Colorado	8,301	5,704,891	197,319	5,902,210	5,910,511	22,376	6,231,878	557,548	6,789,426	6,811,802
Illinois	7,410,087	16,602,300	20,513,082	37,115,382	44,525,469	9,112,669	15,703,862	26,110,068	41,813,930	50,926,599
Indiana	6,521,414	3,465,104	5,767,696	9,232,800	15,754,214	7,679,801	2,996,645	7,146,090	10,142,735	17,822,536
Iowa	237,092	3,413,071	----------	3,413,071	3,650,163	272,534	(1)	(1)	3,688,166	3,960,700
Kansas	1,740,319	945,845	----------	945,845	2,686,164	2,025,714	918,314	----------	918,314	2,944,028
Kentucky	509	40,227,180	533,250	40,760,430	40,760,939	31,897	46,831,306	658,747	47,490,053	47,521,950
Maryland	----------	(1)	(1)	1,678,059	1,678,059	----------	(1)	(1)	1,703,589	1,703,589
Michigan	15,000	613,384	----------	613,384	628,384	----------	626,145	----------	626,145	626,145
Missouri	2,351,288	(1)	(1)	1,294,708	3,645,996	2,460,749	1,524,250	----------	1,524,250	3,984,999
Montana	1,146,692	320,841	1,291,373	1,612,214	2,758,906	[4] 1,312,695	[4] 1,054,332	1,464,121	[4] 2,518,453	[4] 3,831,148
New Mexico	----------	(1)	(1)	1,388,877	1,388,877	----------	(1)	(1)	1,596,775	1,596,775
North Dakota	1,136,483	(1)	(1)	819,027	1,955,510	1,366,921	(1)	(1)	848,414	2,215,335
Ohio	2,048,399	17,616,449	1,488,303	19,104,752	21,153,151	2,458,116	19,602,887	2,049,075	21,651,962	24,110,078
Oklahoma	299,713	(1)	(1)	929,685	1,229,398	343,598	(1)	(1)	1,196,705	1,540,303
Pennsylvania	434,463	84,500,722	6,469,485	90,970,207	91,404,670	753,784	100,099,831	9,033,855	109,133,686	109,887,470
South Dakota	6,578	6,665	----------	6,665	13,243	33,517	7,814	----------	7,814	41,331
Tennessee	----------	3,904,223	233,579	4,137,802	4,137,802	----------	4,817,975	290,220	5,108,195	5,108,195
Texas	91,642	665,887	----------	665,887	757,529	(4)	(4)	----------	(4)	(4)
Utah	----------	2,048,800	898,118	2,946,918	2,946,918	----------	1,888,022	1,358,543	3,246,565	3,246,565
Virginia	----------	9,015,211	651,807	9,667,018	9,667,018	----------	10,882,404	779,232	11,661,636	11,661,636
Washington	----------	1,129,589	429,617	1,559,206	1,559,206	----------	1,203,616	608,488	1,812,104	1,812,104
West Virginia	396	97,119,343	2,059,322	99,178,665	99,179,061	1,523	109,211,248	8,712,935	117,924,183	117,925,706
Wyoming	132,591	514,519	4,530,032	5,044,551	5,177,142	142,694	448,633	5,189,263	5,637,896	5,780,590
Other States [2]	----------	167,003	----------	167,003	167,003	----------	176,245	----------	176,245	176,245
Undistributed	----------	5,591,832	518,524	----------	----------	----------	8,278,825	754,824	----------	----------
Total United States	23,647,292	301,548,606	47,177,224	348,725,830	372,373,122	28,125,857	343,985,174	66,976,872	410,962,046	439,087,903

See footnotes at end of table.

TABLE 31.—*Bituminous coal in the United States mined underground and from strip pits and method of loading underground, 1926 and 1928–38, by States, in net tons*—Continued

State	1937					1938				
	Mined by stripping	Mined underground			Grand total production	Mined by stripping	Mined underground			Grand total production
		Hand-loaded	Machine-loaded	Total			Hand-loaded	Machine-loaded	Total	
Alabama	36,268	10,304,054	2,100,000	12,404,054	12,440,322	36,490	9,007,958	2,017,045	11,025,003	11,061,493
Arkansas	28,472	932,281	550,000	1,482,281	1,510,753	27,628	476,957	692,462	1,169,419	1,197,047
Colorado	20,272	6,148,900	1,018,039	7,166,939	7,187,211	11,669	4,434,730	1,216,745	5,651,475	5,663,144
Illinois	11,448,732	11,808,544	28,344,362	40,152,906	51,601,638	10,570,292	7,978,367	23,363,426	31,341,793	41,912,085
Indiana	8,281,002	2,057,466	7,426,306	9,483,772	17,764,774	7,472,182	1,380,468	5,905,834	7,286,302	14,758,484
Iowa	418,951	(1)	(1)	3,218,103	3,637,054	465,855	(1)	(1)	2,637,332	3,103,187
Kansas	1,966,651	925,909		925,909	2,892,560	1,928,028	726,113		726,113	2,654,141
Kentucky	179,691	45,606,753	1,300,000	46,906,753	47,086,444	604,180	34,688,350	3,252,688	37,941,038	38,545,218
Maryland		(1)	(1)	1,548,980	1,548,980		(1)	(1)	1,281,413	1,281,413
Michigan		562,262		562,262	562,262		494,481		494,481	494,481
Missouri	2,654,167	1,437,227		1,437,227	4,091,394	2,316,318	1,119,800		1,119,800	3,436,118
Montana	[4] 1,335,911	[4] 1,108,634	1,431,000	[4] 2,539,634	[4] 3,875,545	[4] 1,158,047	[4] 1,073,734	1,378,954	[4] 2,452,688	[4] 3,610,735
New Mexico		(1)	(1)	1,714,955	1,714,955		(1)	(1)	1,239,037	1,239,037
North Dakota	1,347,355	(1)	(1)	903,482	2,250,837	1,262,808	(1)	(1)	787,291	2,050,099
Ohio	2,468,624	19,505,141	3,204,102	22,709,243	25,177,867	2,528,804	12,198,343	3,863,471	16,061,814	18,590,618
Oklahoma	465,935	(1)	(1)	1,134,360	1,600,295	448,667	677,057	119,008	796,065	1,244,732
Pennsylvania	853,944	98,196,706	11,951,639	110,148,345	111,002,289	1,131,627	64,482,889	12,090,021	76,572,910	77,704,537
South Dakota	42,094	4,885		4,885	46,979	44,049	4,009		4,009	48,058
Tennessee		4,762,471	450,000	5,212,471	5,212,471	2,289	3,924,437	545,677	4,470,114	4,472,403
Texas	(4)	(4)		(4)	(4)	(4)	(4)		(4)	(4)
Utah		1,974,476	1,835,000	3,809,476	3,809,476		974,010	1,972,941	2,946,951	2,946,951
Virginia		12,295,239	1,500,000	13,795,239	13,795,239		10,436,230	1,846,806	12,283,036	12,283,036
Washington		1,163,449	838,000	2,001,449	2,001,449		906,377	660,596	1,566,973	1,566,973
West Virginia	34,985	103,120,495	15,490,863	118,611,358	118,646,343	226,504	72,530,762	20,530,906	93,061,668	93,288,172
Wyoming	167,799	450,560	5,300,000	5,750,560	5,918,359	171,418	291,932	4,740,527	5,032,459	5,203,877
Other States [2]		155,953		155,953	155,953		188,725		188,725	188,725
Undistributed		7,759,191	760,689				5,049,344	895,729		
Total United States	31,750,853	330,280,596	83,500,000	413,780,596	445,531,449	30,406,855	233,045,073	85,092,836	318,137,909	348,544,764

[1] Included under "Undistributed."
[2] Includes Alaska, Arizona, California, Georgia, Idaho, Nevada, North Carolina, and Oregon.
[3] North Carolina only.
[4] Texas included with Montana.

MECHANICAL CLEANING

Although the total bituminous coal cleaned decreased from 65,000,000 net tons in 1937 to 63,454,588 in 1938, the percentage of the total output cleaned increased from 14.6 percent of the total in 1937 to 18.2 in 1938. In the following tables, the 1938 data are compared with 1936, as detailed statistics for 1937 are not available.

In 1938 the total quantity of bituminous coal mechanically cleaned increased 2,359,612 tons (3.9 percent) over 1936. The tonnage cleaned at the mines increased from 53,386,477 tons in 1936 to 57,998,341 in 1938, an 8.6-percent increase. The quantity of coal cleaned at central washeries operated by consumer steel companies in Colorado and Pennsylvania was 5,456,247 tons in 1938—a 29.2-percent decrease from 1936.

Table 32 shows data on bituminous coal mechanically cleaned by wet and pneumatic methods in 1936 and 1938.

TABLE 32.—*Bituminous coal mechanically cleaned by wet and pneumatic methods in the United States, 1936 and 1938,*[1] *in net tons of clean coal*

Method	1936	1938	Increase or decrease, 1938	
			Net tons	Percent
By wet methods:				
At the mines	42,795,529	47,730,138	+4,934,609	+11.5
At central washeries operated by consumers	7,708,499	5,456,247	−2,252,252	−29.2
Total wet methods	50,504,028	53,186,385	+2,682,357	+5.3
By pneumatic methods	10,590,948	10,268,203	−322,745	−3.0
Grand total	61,094,976	63,454,588	+2,359,612	+3.9

[1] The total tonnage of coal mechanically cleaned as estimated for 1937 was 65,000,000 tons, of which 7,866,360 tons were mechanically cleaned at central washeries operated by consumers.

Mechanical cleaning, by types of equipment.—The total tonnage of coal cleaned by wet washing methods reached 53,186,385 net tons in 1938—an increase of 2,682,357 tons (5.3 percent) over 1936. The quantity of coal cleaned by pneumatic methods was 10,268,203 tons in 1938—a decrease of 322,745 tons (3.0 percent) from 1936. Jigs and jigs in combination with concentrating tables were the only types that showed tonnage and percentage gains over 1936. Data on jigs in combination with upward-current classifiers were not shown separately in 1936. The tonnage cleaned by concentrating tables and launders and upward-current classifiers was less in 1938 than in 1936. The total tonnage cleaned by wet methods increased 5.3 percent in 1938 over 1936, while the coal cleaned by pneumatic methods decreased 3.0 percent in the same period.

During 1938, 301 wet washing and 73 pneumatic cleaning installations were in operation. Thirty-four tipples used both wet and dry methods in 1938 compared with 31 in 1936. In addition to the 31 plants using both wet and dry methods during 1936, two plants used two wet systems and one plant used three wet systems of equipment, thus accounting for four more duplications, or a total of 35 duplications in 1936. Deducting these duplications gives a net total of 307 plants that cleaned coal by mechanical methods in 1936 compared with 340 in 1938.

Details of coal cleaned in 1936 and 1938, by classes of equipment, are shown in table 33.

TABLE 33.—*Bituminous coal cleaned in the United States, 1936 and 1938,[1] by types of equipment in actual operation*

[Coal cleaned and plants operated by consumers at central washeries in Colorado and Pennsylvania are included]

Type of equipment	Plants in operation		Net tons of clean coal		Increase or decrease 1938 over 1936		Percent cleaned by each type	
	1936	1938	1936	1938	Net tons	Percent	1936	1938
Wet methods:								
Jigs	154	161	23,417,266	27,614,663	+4,197,397	+17.9	38.3	43.5
Concentrating tables	8	8	1,843,167	983,911	−859,256	−46.6	3.0	1.6
Jigs in combination with concentrating tables	16	19	2,612,666	2,790,930	+178,264	+6.8	4.3	4.4
Jigs in combination with launders and upward-current classifiers	(2)	8	(2)	2,026,699	+2,026,699	(2)	(2)	3.2
Launders and upward-current classifiers	98	105	22,630,929	19,770,182	−2,860,747	−12.6	37.1	31.1
Total wet methods	276	301	50,504,028	53,186,385	+2,682,357	+5.3	82.7	83.8
Pneumatic methods	66	73	10,590,948	10,268,203	−322,745	−3.0	17.3	16.2
Total, United States	[3] 342	[3] 374	61,094,976	63,454,588	+2,359,612	+3.9	100.0	100.0

[1] Data for 1937 not available by classes of equipment. See table 32, footnote 1, for estimate of total coal mechanically cleaned in 1937.
[2] This classification was not shown in 1936.
[3] Number of plants using both wet and pneumatic types was 31 in 1936 and 34 in 1938.

Mines served by cleaning plants, exclusive of those that ship to washeries operated by steel companies, produced a total of 108,237,541 tons (31.1 percent of the total bituminous output) in 1938. In this same group of mines, 57,998,341 tons were mechanically cleaned; therefore, 53.6 percent of the coal produced at mines with cleaning plants in 1938 was cleaned at the mine. This compares with 46.3 percent in 1936 and 45.3 in 1935. The remainder of the output (46.4 percent) presumably represents the larger sizes, which commonly are picked by hand.

TABLE 34.—*Total production of bituminous coal at mines in the United States equipped with cleaning plants, 1936 and 1938,[1] in net tons*

[Does not include any estimate for mines that may ship to consumer-operated plants]

Methods	1936	1938	Increase or decrease, 1938	
			Net tons	Percent
Wet methods:				
Jigs	48,975,308	49,073,725	+98,417	+0.2
Concentrating tables	1,194,635	775,916	−418,719	−35.0
Jigs in combination with concentrating tables	2,791,533	3,301,651	+510,118	+18.3
Jigs in combination with launders and upward-current classifiers	(2)	3,627,861	+3,627,861	(2)
Launders and upward-current classifiers	47,943,815	39,524,411	−8,419,404	−17.6
Total wet	100,905,291	96,303,564	−4,601,727	−4.6
Pneumatic methods	29,974,961	27,725,163	−2,249,798	−7.5
Grand total	130,880,252	124,028,727	−6,851,525	−5.2
Less duplication [3]	15,478,035	15,791,186	+313,151	+2.0
Net total	115,402,217	108,237,541	−7,164,676	−6.2
United States production of bituminous coal	439,087,903	348,544,764	−90,543,139	−20.6
Percent produced at mines with cleaning plants	26.3	31.1		

[1] Data for 1937 not available.
[2] This classification was not shown in 1936.
[3] Mines using both wet and pneumatic methods.

Table 34 shows the total production of coal at mines with cleaning plants, by methods of preparation, in 1936 and 1938.

Coal cleaning, by States.—The following States led in volume of total coal mechanically cleaned in the United States in 1938: Pennsylvania, 26.9 percent; West Virginia, 25.0; Illinois, 16.0; and Alabama, 14.3. These four States accounted for 82.2 percent of the total mechanically cleaned coal in 1938.

The States that showed outstanding gains in percentage of their total output mechanically cleaned were as follows: Kansas, Illinois, Missouri, Washington, and Indiana.

Table 35 gives detailed data, by States, on coal mechanically cleaned in 1936 and 1938. The nine States that cleaned more than 10 percent of their total output in 1938 are as follows: Alabama, 82.0 percent; Washington, 76.4; Kansas, 39.7; Missouri, 37.5; Illinois, 24.2; Pennsylvania, 21.9; Indiana, 17.4; West Virginia, 17.0; and Ohio, 11.4.

TABLE 35.—*Bituminous coal mechanically cleaned by wet and pneumatic methods in the United States, 1936 and 1938,*[1] *by States*

[Coal cleaned at central washeries operated by consumers in Colorado and Pennsylvania is included]

State	Clean coal (net tons)		Increase or decrease, 1938		Percent of State output mechanically cleaned	
	1936	1938	Net tons	Percent	1936	1938
Alabama	9,922,514	9,072,987	−849,527	−8.6	81.1	82.0
Colorado	713,678	458,876	−254,802	−35.7	10.5	8.1
Illinois	5,613,522	10,160,640	+4,547,118	+81.0	11.0	24.2
Indiana	2,198,067	2,564,010	+365,943	+16.6	12.3	17.4
Kansas	1,771,870 (Kansas and Missouri)	1,053,966	+571,576 (Kansas and Missouri)	+32.3 (Kansas and Missouri)	25.5 (Kansas and Missouri)	39.7
Missouri		1,289,480				37.5
Kentucky	514,647	1,270,274	+755,627	+146.8	1.1	3.3
Michigan	1,331,545 (Michigan and Ohio)	(2)	+789,799 (Michigan and Ohio)	+59.3 (Michigan and Ohio)	5.4 (Michigan and Ohio)	(2)
Ohio		2,121,344				11.4
Pennsylvania	21,584,403	17,047,977	−4,536,426	−21.0	19.6	21.9
Tennessee	257,987	258,089	+102	(3)	5.1	5.8
Virginia	473,992	814,478	+340,486	+71.8	4.1	6.6
Washington	1,203,783	1,197,054	−6,729	−.6	66.4	76.4
West Virginia	15,360,671	15,888,325	+527,654	+3.4	13.0	17.0
Other States [4]	148,297	257,088	+108,791	+73.4	--------	--------
Total	61,094,976	63,454,588	+2,359,612	+3.9	13.9	18.2

[1] Data for 1937 by States not available. See table 32, footnote 1, for estimates of total coal mechanically cleaned in 1937.
[2] Included with "Other States."
[3] Less than 0.05.
[4] Arkansas, Maryland, Montana, and New Mexico in 1936; Arkansas, Maryland, Michigan, Montana, New Mexico, Texas, and Utah in 1938.

Methods of mining at mines served by cleaning plants.—Mechanical loading both in underground mines and strip pits appears to be closely related to mechanical cleaning. Table 36 shows the mining methods at mines that have cleaning plants. Production of coal from strip mines in 1938 was 30,406,855 tons; 15,213,564 tons (50.0 percent) were from strip mines having mechanical cleaning tipples. This compares with 38.9 percent in 1936. There were 85,092,836 tons of underground coal loaded mechanically in 1938, of which 37,195,439 tons (43.7 percent) passed through tipples equipped with mechanical cleaning devices compared with 35.0 percent in 1936. Hand-loaded underground coal production in 1938 totaled 233,045,073 tons, of which 24.0 percent passed through tipples equipped with cleaning plants. This percentage in 1936 was 23.5.

TABLE 36.—*Method of mining used at mines in the United States served by cleaning plants, 1934–36 and 1938* [1]

Method of mining in use	Total production of mines with cleaning plants				Increase or decrease, 1938	
	1934	1935	1936	1938	Net tons	Percent
Mined from strip pits	7, 127, 710	9, 314, 425	10, 952, 733	15, 213, 564	+4, 260, 831	+38. 9
Mechanically loaded underground	10, 128, 745	15, 065, 777	23, 461, 832	37, 195, 439	+13,733,607	+58. 5
Hand-loaded underground	59, 052, 707	62, 786, 044	80, 987, 652	55, 828, 538	−25,159,114	−31. 1
Total mined	76, 309, 162	87, 166, 246	115, 402, 217	108, 237, 541	−7, 164, 676	−6. 2

[1] Data for 1937 not available.

Relation between raw coal, clean coal, and refuse.—For every 100 tons of raw coal cleaned at the mines during 1938, 88.6 tons of clean merchantable coal, on an average, were obtained, and 11.4 tons of refuse were discarded. Table 37 shows the tonnage, by States, of total production of mines with cleaning plants and the results of the cleaning operations. Many operators could not furnish exact figures on the raw coal or refuse, and in such instances estimates were made from all available information at hand.

TABLE 37.—*Relation between total production, raw coal, and refuse resulting from cleaning operations in the United States in 1938, by States, in net tons*

State	Total production of mines with cleaning plants	Result of cleaning operations			Percent of refuse to raw coal	Percent of clean coal to total mine production
		Raw coal	Clean coal	Refuse		
Alabama	9, 996, 236	10, 331, 667	9, 072, 987	1, 258, 680	12. 2	90. 8
Colorado	(1)	(1)	(1)	(1)	7. 9	28. 4
Illinois	22, 250, 483	12, 088, 929	10, 160, 640	1, 928, 289	16. 0	45. 7
Indiana	5, 577, 397	2, 929, 862	2, 564, 010	365, 852	12. 5	46. 0
Kansas	1, 154, 694	1, 326, 730	1, 053, 966	272, 764	20. 6	91. 3
Kentucky	3, 563, 124	1, 379, 298	1, 270, 274	109, 024	7. 9	35. 7
Missouri	1, 853, 189	1, 669, 089	1, 289, 480	379, 609	22. 7	69. 6
Ohio	2, 943, 578	2, 531, 440	2, 121, 344	410, 096	16. 2	72. 1
Pennsylvania	(1)	(1)	(1)	(1)	7. 1	62. 5
Tennessee	555, 302	288, 517	258, 089	30, 428	10. 5	46. 5
Virginia	3, 240, 211	919, 423	814, 478	104, 945	11. 4	25. 1
Washington	1, 363, 771	1, 381, 968	1, 197, 054	184, 914	13. 4	87. 8
West Virginia	34, 989, 017	17, 382, 009	15, 888, 325	1, 493, 684	8. 6	45. 4
Other States [2]	20, 750, 539	13, 250, 372	12, 307, 694	942, 678	9. 4	22. 9
Total at mines only	108, 237, 541	65, 479, 304	57, 998, 341	7, 480, 963	11. 4	53. 6
Consumer plants	----------	5, 727, 268	5, 456, 247	271, 021	4. 7	----------
Grand total	----------	71, 206, 572	63, 454, 588	7, 751, 984	10. 9	----------

[1] Included in "Other States."
[2] Tonnage figures include Arkansas, Colorado, Maryland, Michigan, Montana, New Mexico, Pennsylvania, Texas, and Utah. Percentage figures represent results for Arkansas, Maryland, Michigan, Montana, New Mexico, Texas, and Utah.

STATISTICS OF LIGNITE IN 1939 [3]

PRODUCTION OF LIGNITE

The Bureau of Mines prepares final statistics of the lignite industry from an annual canvass, by mail, of operators of lignite properties included in the areas mapped as "lignite" in Geological Survey Profes-

[3] Compiled by J. A. Corgan and A. Coleman, Coal Economics Division, Bureau of Mines.

sional Paper 100–A, The Coal Fields of the United States. Subbituminous coal is not included. The data on individual operations furnished by the producers are voluntary and confidential, as is customary in the statistical surveys of the Bureau of Mines.

The production of lignite in 1939 totaled 3,042,537 net tons, exclusive of many small mines producing less than 1,000 tons. Output in 1939 showed a slight increase over the 2,997,921 tons produced in 1938. The average value per ton was $1.13 in 1939 compared with $1.07 in 1938. The total employees in 1939 numbered 2,096 against 2,019 in 1938, while the average output per man per day for the same periods was 7.61 and 8.06 tons, respectively. The average number of days worked by the industry was 179 in 1939 compared with 184 in 1938. The length of the workday in most of the mines was 8 hours. Some mines showed a 7-hour day on their reports to the Bureau and a few a 9-hour day, while many of the small mines did not reply to this question. No labor disturbances were reported.

As for many years in the past, North Dakota was the chief producer of lignite in 1939, followed in order by Texas, South Dakota, and Montana. The North Dakota output comprised 70 percent of the total production, that of Texas 27, and the outputs of South Dakota and Montana, taken together, 3.

According to the Federal Power Commission, 1,538,174 tons of lignite were used in 1939 for generating electric energy in the United

TABLE 38.—*Summary of production, value, men employed, days operated, man-days of labor, and output per man per day at lignite mines in the United States in 1939, by States*

	North Dakota	South Dakota	Montana [1]	Texas	Total
Production (net tons):					
Loaded at mines for shipment	1,528,408	(2)	(2)	797,531	[2] 2,325,939
Commercial sales by truck or wagon	413,710	[2] 49,380	[2] 46,662	7,953	[2] 517,705
Other sales to local trade, or used by employees, or taken by locomotives at tipple	179,358	[3] 115	1,018	4,500	[3] 184,991
Used at mines for power and heat	9,776	(3)	88	4,038	[3] 13,902
Total production: 1939	2,131,252	49,495	47,768	814,022	3,042,537
1938	2,050,099	48,058	53,545	846,219	2,997,921
Value:					
Total: 1939	$2,425,000	$69,000	$83,000	$875,000	$3,452,000
1938	$2,380,000	$65,000	$88,000	$679,000	$3,212,000
Average per ton: 1939	$1.14	$1.39	$1.74	$1.07	$1.13
1938	$1.16	$1.35	$1.64	$.80	$1.07
Number of employees:					
Underground	666	18	67	489	1,240
Surface (including strip pits)	725	35	26	70	856
Total employees: 1939	1,391	53	93	559	2,096
1938	1,370	50	93	506	2,019
Average number of days mines operated: 1939	161	183	146	231	179
1938	174	170	162	219	184
Man-days of labor: 1939 [4]	248,755	8,502	13,565	129,120	399,942
1938	237,751	8,507	15,081	110,768	372,107
Average tons per man per day: 1939	8.57	5.82	3.52	6.30	7.61
1938	8.62	5.65	3.55	7.64	8.06

[1] Includes output of Custer, Dawson, McCone, Prairie, Richland, Roosevelt, Sheridan, Valley, and Wibaux Counties.
[2] Some shipments are included in commercial sales.
[3] A small amount of coal used at the mines is included in other sales to local trade.
[4] Based upon the "reported" number of man-shifts where the operator keeps a record thereof, otherwise upon the "calculated" number of man-shifts obtained by multiplying the average number of men employed underground and on the surface at each mine by the number of days worked by the mine and tipple, respectively. Using the "calculated" man-shifts throughout as developed before 1932, the average output per man per day was 8.59 in 1938 and 8.10 in 1939.

States. This tonnage is equivalent to 51 percent of the total production of the industry. The consumption in the West North Central Division was 468,512 tons. The West South Central and Mountain Divisions consumed 686,954 and 382,708 tons, respectively.

TABLE 39.—*Production, value, men employed, days operated, man-days of labor, and output per man per day at lignite mines in the United States in 1939, by States and counties.*

MONTANA

County	Total production (net tons	Value: Total (thousand dollars)	Value: Average per ton	Total number of employees	Man-days of labor [1]	Average number of days mine operated	Average tons per man per day [1]
Custer, Dawson, and Prairie	6,898	$11	$1.59	11	1,400	127	4.93
McCone	3,295	6	1.82	9	1,308	145	2.52
Richland	13,828	30	2.17	29	3,902	135	3.54
Roosevelt	4,527	6	1.33	12	1,568	131	2.89
Sheridan	15,148	24	1.58	25	4,295	172	3.53
Valley and Wibaux	4,072	6	1.47	7	1,092	156	3.73
Total: 1939	47,768	83	1.74	93	13,565	146	3.52
1938	53,545	88	1.64	93	15,081	162	3.55

NORTH DAKOTA

County	Total production (net tons	Value: Total (thousand dollars)	Value: Average per ton	Total number of employees	Man-days of labor [1]	Average number of days mine operated	Average tons per man per day [1]
Adams	45,975	$51	$1.11	77	11,179	145	4.11
Billings, Dunn, and Slope	5,231	8	1.53	10	1,231	123	4.25
Bowman	7,554	10	1.32	11	2,328	212	3.24
Burke	251,627	287	1.14	83	17,702	213	[2] 14.21
Burleigh	229,592	268	1.17	85	17,669	208	[2] 12.99
Divide	169,998	198	1.16	74	12,618	171	[2] 13.47
Golden Valley	6,000	7	1.17	13	2,023	156	2.97
Grant	23,832	30	1.26	32	5,265	165	4.53
Hettinger	12,779	15	1.17	23	3,388	147	3.77
McKenzie	5,414	9	1.66	12	2,116	176	2.56
McLean	146,120	186	1.27	177	24,065	136	6.07
Mercer	583,062	626	1.07	303	59,210	195	9.85
Morton	24,269	30	1.24	41	4,860	119	4.99
Mountrail	9,380	14	1.49	22	4,250	193	2.21
Oliver	6,158	6	.97	14	1,750	125	3.52
Stark	92,980	95	1.02	72	15,024	209	6.19
Ward	472,997	535	1.13	276	54,893	199	[2] 8.62
Williams	38,284	50	1.31	66	9,184	139	4.17
Total: 1939	2,131,252	2,425	1.14	1,391	248,755	179	8.57
1938	2,050,099	2,380	1.16	1,370	237,751	174	8.62

SOUTH DAKOTA

County	Total production (net tons	Value: Total (thousand dollars)	Value: Average per ton	Total number of employees	Man-days of labor [1]	Average number of days mine operated	Average tons per man per day [1]
Corson and Dewey	44,907	$61	$1.36	31	6,703	216	6.70
Harding and Meade	1,671	4	2.39	10	745	75	2.24
Perkins	2,917	4	1.37	12	1,054	88	2.77
Total: 1939	49,495	69	1.39	53	8,502	160	5.82
1938	48,058	65	1.35	50	8,507	170	5.65

TEXAS

County	Total production (net tons	Value: Total (thousand dollars)	Value: Average per ton	Total number of employees	Man-days of labor [1]	Average number of days mine operated	Average tons per man per day [1]
Bastrop and Milam	86,475	$66	$.76	116	17,446	150	4.96
Henderson, Titus, and Wood	727,547	809	1.11	443	111,674	252	6.51
Total: 1939	814,022	875	1.07	559	129,120	231	6.30
1938	846,219	679	.80	506	110,768	219	7.64

[1] 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 underground and on the surface of each mine by the number of days worked by the mine and tipple respectively. Using throughout the "calculated" man-shifts as developed before 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 was 3.52 in 1939 in Montana, 9.55 in North Dakota, 5.10 in South Dakota, and 6.31 in Texas.

[2] The output is obtained chiefly from strip pits, in which the production per man per day is large.

Detailed statistics of production in 1939 are presented in the following tables. Data on the industry in 1940 were not available in time for insertion in this chapter but will be published later as a supplement to the Weekly Anthracite-Beehive Coke Report and may be obtained upon request from the Coal Economics Division of the Bureau of Mines.

NUMBER AND SIZE OF LIGNITE MINES

For 1939 the Bureau of Mines received reports from 206 lignite mines (exclusive of many mines producing less than 1,000 tons a year). This is comparable with 212 mines reporting for 1938. Five mines produced 200,000 to 500,000 tons each, and the output of these mines amounted to 58 percent of the total production. Four mines reported an output of 50,000 to 200,000 tons each and accounted for 17 percent of the total tonnage; 20 mines in the 10,000- to 50,000-ton class reported 13 percent of the total production; and 177 mines producing less than 10,000 tons each accounted for 12 percent of the total output of the industry.

LENGTH OF WORKING DAY IN LIGNITE MINES

Reports from operators in the lignite fields in 1939 show that 141 mines, or 68 percent of the total mines reporting, were working an 8-hour day. The men employed at these mines numbered 1,512—72 percent of the total men employed at the lignite mines.

The following table summarizes the replies of mine operators to the question, "Number of hours operated per shift."

TABLE 40.—*Number of lignite mines in the United States having established working shift of certain length and number of men employed therein in 1939, by States*

State	7 hours		8 hours		9 hours		Not reporting and all others [1]		Total	
	Mines	Men	Mines	Men	Mines	Men	Mines	Men	Mines	Men
Montana	3	10	11	45	3	11	9	27	26	93
North Dakota	12	229	115	868	3	114	29	180	159	1,391
South Dakota			7	40			6	13	13	53
Texas			[2] 8	[2] 559	(3)	(3)			8	559
Total United States	15	239	141	1,512	6	125	44	220	206	2,096

[1] Includes mines where day was more than 9 or less than 7 hours or was irregular, or where it was changed during the year; also mines (1) where operator has included time when the men were entering or leaving the mine, (2) where operator has reported time of men in certain occupations where workday is longer than for other employees, as in stripping overburden, or (3) where work is staggered and 2 crews of men overlap. Many smaller mines failed to answer question.

[2] Includes data of 9-hour shift.

[3] Included in 8-hour shift.

LIGNITE LOADED FOR SHIPMENT BY INDIVIDUAL RAILROADS

TABLE 41.—*Lignite loaded for shipment by individual railroads in the United States in 1939, as reported by operators, in net tons*

Railroads	State	Quantity
Chicago, Milwaukee, St. Paul & Pacific	North Dakota South Dakota	51,428
Great Northern	Montana North Dakota	344,326
International-Great Northern	Texas	797,531
Missouri-Kansas-Texas	do	
Rockdale, Sandow & Southern	do	
St. Louis Southwestern of Texas	do	
Texas Short Line	do	
Minneapolis, St. Paul & Sault Ste. Marie	North Dakota	556,050
Northern Pacific	do	611,982
		2,361,317

METHODS OF RECOVERY

TABLE 42.—*Lignite mined in the United States in 1939, by methods and by States*

State	Mined by hand	Shot off the solid	Cut by machines [1]	From strip pits	Not specified	Total
Montana	[2] [3] 82,925	[2] 736,222	(3)	[2] 35,342	7,301	47,768
North Dakota	104,012	119,997	520,371	1,367,162	19,710	2,131,252
South Dakota	1,892			44,945	2,658	49,495
Texas	(2)	(2)		(2)		814,022
Total United States	[3] 188,829	856,219	[3] 520,371	1,447,449	29,669	3,042,537

[1] A total of 22 machines was used—14 "permissible" and 8 of other types.
[2] Montana includes Texas.
[3] Small amount of machine-cut coal is included in "Mined by hand."

STRIPPING OPERATIONS

The production of lignite from strip pits in 1939 amounted to 1,447,449 tons—48 percent of the total output of the industry. Most of the stripping was done in North Dakota, which produced 1,367,162 tons by that method. This represented 94 percent of all the strip-pit production and 45 percent of the total tonnage produced by the lignite industry. The tonnage from stripping operations in Montana, Texas, and South Dakota was only 80,287 tons. The number of employees working in the strip pits was 445, with an average output of 12 tons per man per day, and the average number of days worked was 195.

Detailed statistics for stripping operations in the lignite industry are shown in table 43.

TABLE 43.—*Summary of stripping operations that produced lignite in 1939, by States*

State	Number of strip pits[1]	Number of shovels, dragline excavators, and coal-loading machines[2]	Coal mined by stripping (net tons)	Total value at mines (thousand dollars)	Average value per ton	Number of employees: In strip pits	Number of employees: All others	Number of employees: Total	Average number of days mines operated	Man-days of labor[3]	Average tons per man per day[3]
Montana[4]	6	2	35,342	$25	$0.71	[5] 26	(5)	26	95	2,478	14.26
North Dakota	55	32	1,367,162	1,501	1.10	395	143	538	199	107,116	12.76
South Dakota	4	1	44,945	61	1.36	24	7	31	211	6,553	6.86
Texas	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)
Total	65	35	1,447,449	1,587	1.10	445	150	595	195	116,147	12.46

[1] Includes some pits in which the stripping is done by hand.
[2] In some cases the same equipment was used for stripping or excavating and for loading the coal; this duplication has been eliminated. In some cases coal was excavated by machine and loaded by hand.
[3] Based upon (1) the "reported" number of man-shifts where the operator keeps an accurate record thereof; otherwise upon (2) the "calculated" number of man-shifts obtained by multiplying the number of men employed at the tipple, in loading coal, etc., and in stripping overburden by the number of days worked in each department, insofar as separately reported by the operator.
[4] Texas included with Montana.
[5] "All others" are included in "In strip pits."

TABLE 44.—*World production of lignite (including brown coal), 1935–40, in metric tons* [1]

[Compiled by L. P. Lounsbery]

Country[1]	1935	1936	1937	1938	1939	1940
North America:						
Canada	3,241,118	3,507,895	3,352,316	3,153,377	3,093,514	3,294,621
United States	2,494,907	2,821,048	2,919,685	2,719,654	2,760,129	(2)
Europe:						
Albania	2,000	3,130	3,500	3,866	(2)	(2)
Bulgaria	1,565,971	1,576,098	1,732,119	1,855,198	2,134,051	(2)
Czechoslovakia	15,113,576	15,948,767	17,895,411	14,716,693	(2)	(2)
Faroe Islands				8,000	8,000	(2)
France	906,730	943,230	1,015,000	1,057,250	(2)	(2)
Germany	146,032,747	160,276,036	183,538,054	195,312,067	230,000,000	(2)
Austria	2,970,683	2,897,203	3,241,770	3,341,730	(2)	(2)
Greece	83,325	105,621	131,083	108,010	139,095	(2)
Hungary	6,717,677	7,105,004	8,055,123	8,320,000	(2)	(2)
Italy	545,482	768,563	1,059,231	872,950	1,058,000	(2)
Netherlands	86,204	88,779	143,057	170,637	196,810	(2)
Poland	18,288	13,518	18,915	9,526	(2)	(2)
Portugal	19,738	20,677	23,098	14,854	35,113	66,658
Rumania	1,666,761	1,671,825	1,880,477	2,096,698	2,300,000	(2)
Spain	303,827	(3)	(3)	68,099	204,259	(2)
U. S. S. R.	13,820,000	(3)	(3)	(3)	(2)	(2)
Yugoslavia	4,002,193	4,034,577	4,574,232	5,286,781	5,621,972	(2)
Asia:						
Indochina				4,200	27,000	30,000
Japan	108,526	109,494	(3)	(3)	(2)	(2)
Levant		493	4,658	700	1,000	(2)
Turkey	73,355	95,234	116,397	129,315	151,267	(2)
Oceania:						
Australia (Victoria)	2,257,170	3,093,768	3,448,391	3,734,441	3,709,613	(2)
New Zealand	1,310,660	1,301,895	1,328,805	1,264,208	1,318,863	(2)
	203,341,000	224,434,000	253,953,000	263,624,000	(2)	(2)

[1] Lignite is also mined in Italian East Africa, but complete production figures are not available.
[2] Data not available.
[3] Estimate included in total.

IMPORTS AND EXPORTS [4]

TABLE 45.—*Bituminous coal*[1] *imported for consumption in the United States, 1939–40, by countries and customs districts, in net tons*

	1939	1940
Country		
North America: Canada	296,701	360,975
Europe: United Kingdom	58,414	10,596
	355,115	371,571
Customs district		
Alaska	8,163	6,339
Buffalo	101	22
Chicago	2	2
Dakota	124	272
Duluth and Superior	253	333
Hawaii	--------	1,496
Maine and New Hampshire	127,325	191,429
Maryland	--------	1,792
Michigan	80	--------
Montana and Idaho	103,408	127,274
New Orleans	--------	140
New York	40,365	896
Philadelphia	--------	1,344
Rhode Island	8,238	--------
St. Lawrence	6,796	634
Vermont	11,740	202
Virgin Islands	9,811	--------
Washington	38,709	39,396
	355,115	371,571

[1] Includes slack, culm, and lignite.

TABLE 46.—*Exports of bituminous coal to Canada and Mexico, the West Indies and Central America, and "overseas" destinations, 1936–40, in thousands of net tons*

Year	Canada and Mexico	West Indies and Central America [1]	"Overseas" (all other countries): Newfoundland, Miquelon, Bermuda, and Greenland	South America	Europe	Asia	Africa	Oceania	Total "overseas"	Grand total
1936	9,912	470	44	163	50	(2)	(3)	16	273	10,655
1937	12,052	732	51	265	10	24	11	--------	361	13,145
1938	9,561	619	23	247	11	29	--------	--------	310	10,490
1939	9,976	599	76	681	165	91	2	--------	1,015	11,590
1940	13,537	455	100	1,660	659	29	26	--------	2,474	16,466

[1] Includes Bahamas and Panama.
[2] 1 ton.
[3] 3 tons.

[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. Shipments to Canada and car ferry to Cuba are not considered as exports under the Bituminous Coal Act but are so shown in these tables to continue the statistical series.

TABLE 47.—*Bituminous coal exported from the United States, 1939–40, by countries, in net tons* [1]

Country	1939	1940
North America:		
Bermuda	3,923	11,937
British Honduras	467	70
Canada	9,974,908	13,536,634
Central America:		
Costa Rica	39	88
El Salvador	44	32
Guatemala	217	128
Honduras	327	248
Nicaragua	75	45
Panama:		
Canal Zone	153,278	82,240
Republic of	6	17
Greenland	----------	2,051
Mexico	1,011	708
Miquelon and St. Pierre Islands	4,344	----------
Newfoundland and Labrador	67,869	86,306
West Indies:		
British:		
Barbados	1,284	1,996
Jamaica	77,786	37,531
Trinidad and Tobago	38,581	22,925
Other British	10,630	20,225
Cuba	292,191	257,375
Dominican Republic	310	280
French	20,204	29,206
Haiti	47	28
Netherlands (Curacao)	3,401	2,330
	10,650,942	14,092,400
South America:		
Argentina	232,406	369,830
Bolivia	2,136	12,899
Brazil	425,022	1,040,592
Chile	5,011	198,868
Colombia	46	76
Ecuador	166	----------
Guiana: Surinam	3,379	5,341
South America—Continued.		
Paraguay	----------	24
Peru	3,381	3,166
Uruguay	9,193	29,111
Venezuela	81	15
	680,821	1,659,922
Europe:		
Denmark	3,035	10,690
Greece	----------	16,453
Iceland	----------	6,499
Italy	38,612	119,472
Norway	42,057	132,110
Portugal	4,883	172,012
Spain	25,739	4,592
Sweden	26,516	68,461
Switzerland	24,549	127,198
U. S. S. R.	----------	1,137
	165,391	658,624
Asia:		
China	53,726	----------
Indochina (French)	7,516	----------
Netherlands Indies	12,234	29,195
Philippine Islands	18,089	(2)
Other	----------	7
	91,565	29,202
Africa:		
Canary Islands	1,701	7,840
Egypt	----------	3,135
Liberia	----------	2
Morocco	----------	7,480
Nigeria	----------	2,843
Portuguese	----------	4,480
Union of South Africa	58	----------
	1,759	25,780
Grand total	11,590,478	16,465,928

[1] Amounts stated do not include fuel or bunker coal loaded on vessels engaged in the foreign trade, which aggregated 1,476,556 tons in 1939 and 1,425,836 tons in 1940.
[2] Less than 1 ton.

TABLE 48.—*Bituminous coal exported from the United States, 1939–40, by customs districts, in net tons*

Customs district	1939	1940
North Atlantic:		
Maine and New Hampshire	219	226
Massachusetts	----------	2
New York	1,157	7,003
Philadelphia	13,330	19,504
South Atlantic:		
Maryland	244,444	168,823
South Carolina	82,369	81,966
Virginia	1,243,397	2,603,404
Gulf Coast:		
Florida	3,540	12,326
Mobile	6,687	9,774
New Orleans	1,204	1,418
Sabine	----------	7
Mexican border:		
Arizona	598	391
El Paso	102	92
Laredo	26	28
Pacific Coast:		
Los Angeles	1	2
Oregon	----------	1,137
Pacific Coast—Continued.		
San Diego	84	53
San Francisco	25,535	11
Washington	4,389	2,560
Northern border:		
Buffalo	619,911	774,542
Dakota	7,494	5,049
Duluth and Superior	41,273	34,958
Michigan	1,238,218	1,805,365
Montana-Idaho	466	102
Ohio	6,519,949	8,530,364
Rochester	1,153,914	1,920,361
St. Lawrence	381,796	462,644
Vermont	152	23,010
Wisconsin	101	649
Miscellaneous:		
Alaska	114	28
Puerto Rico	7	129
Virgin Islands	1	----------
	11,590,478	16,465,928

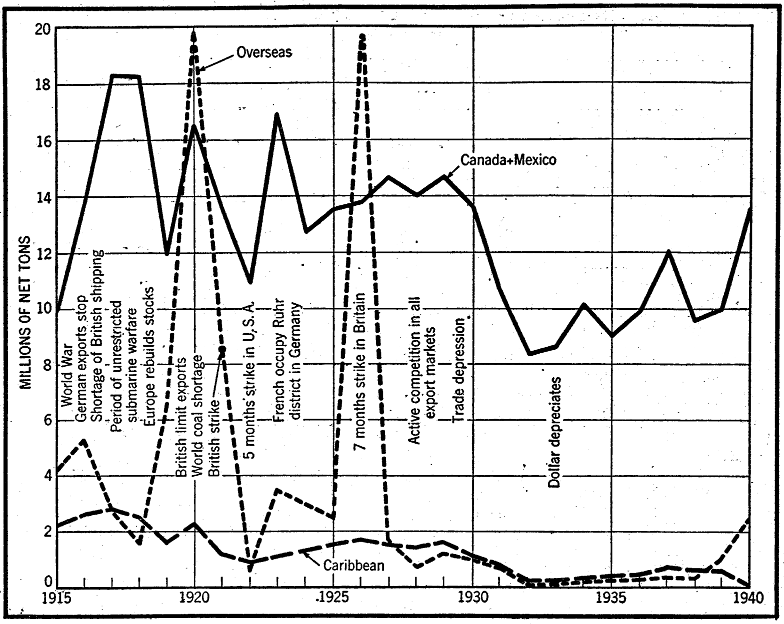

FIGURE 10.—Exports of bituminous coal to Canada and Mexico, the Caribbean, and "overseas" destinations, 1915–40.

Shipments to Alaska, Hawaii, Midway Islands, Puerto Rico, and Virgin Islands.—In addition to export trade proper, the United States supplies a small tonnage of anthracite and bituminous coal to Alaska, Hawaii, the Midway Islands, Puerto Rico, and the Virgin Islands. Shipments of bituminous coal to each of these possessions in 1940 were as follows: Alaska, 14,794 net tons; Hawaii, 1,631; Midway Islands, 106; Puerto Rico, 11,106; and Virgin Islands, 55,579. Comparative shipments for 1939 were: Alaska, 17,587; Hawaii, 1,540; Midway Islands, 81; Puerto Rico, 14,709; and Virgin Islands, 69,751.

WORLD PRODUCTION

TABLE 49.—*World production of coal and lignite, 1936–40, by countries, in thousands of metric tons* [1]

[Compiled by L. P. Lounsbery, Bureau of Mines]

Country [1]	1936	1937	1938	1939	1940
North America:					
Canada:					
Coal	10,308	11,014	9,815	10,985	12,628
Lignite	3,508	3,352	3,153	3,094	3,295
Greenland	5	6	7	(2)	(2)
Mexico	1,072	912	893	628	548
United States:					
Anthracite	49,513	47,043	41,820	46,708	46,706
Bituminous	395,511	401,257	313,473	353,821	(2)
Lignite	2,821	2,920	2,720	2,760	(2)
South America:					
Brazil	648	763	883	1,047	1,336
Chile	1,875	1,988	2,044	1,850	1,937
Colombia	282	330	331	(2)	(2)
Peru	90	99	75	108	107
Venezuela	6	7	6	3	(2)
Europe:					
Albania: Lignite	3	4	4	(2)	(2)
Belgium	27,867	29,859	29,585	29,847	(2)
Bulgaria:					
Coal	102	120	142	164	(2)
Lignite	1,576	1,732	1,855	2,134	(2)
Czechoslovakia:					
Coal	12,233	16,778	15,800	(2)	(2)
Lignite	15,949	17,895	14,717	(2)	(2)
Eire	127	128	120	114	(2)
Faroe Islands: Lignite	------	------	8	8	(2)
France:					
Coal	45,228	44,319	46,498	51,000	(2)
Lignite	943	1,015	1,057		
Germany:					
Coal	158,380	184,513	186,177	200,000	(2)
Lignite	160,276	183,538	195,312	230,000	(2)
Austria:					
Coal	244	230	227	(2)	(2)
Lignite	2,897	3,242	3,342	(2)	(2)
Greece: Lignite	106	131	108	139	(2)
Hungary:					
Coal	827	917	1,042	10,625	(2)
Lignite	7,105	8,055	8,320		
Italy:					
Coal	806	964	1,480	2,025	(2)
Lignite	769	1,059	873	1,058	(2)
Netherlands:					
Coal	12,803	14,321	13,488	12,861	(2)
Lignite	89	143	171	197	(2)
Poland:					
Coal	29,748	36,218	38,104	(2)	(2)
Lignite	14	19	10	(2)	(2)
Portugal:					
Coal	217	259	299	313	310
Lignite	21	23	15	35	67
Rumania:					
Coal	293	303	299	285	(2)
Lignite	1,672	1,880	2,097	2,300	(2)
Spain:					
Coal	(3)	(3)	5,289	6,753	(2)
Lignite	(3)	(3)	68	204	(2)
Svalbard (Spitsbergen)	784	766	627	(2)	(2)
Sweden	456	460	431	444	(2)
Switzerland	3	4	3	3	(2)
United Kingdom:					
Great Britain	232,115	244,268	230,659	236,700	(2)
Northern Ireland	5	1	(4)	(2)	(2)
U. S. S. R.:					
Coal	93,685	94,525	98,627	(2)	(2)
Lignite					
Yugoslavia:					
Coal	441	428	450	444	(2)
Lignite	4,035	4,574	5,287	5,622	(2)

See footnotes at end of table.

TABLE 49.—*World production of coal and lignite, 1936–40, by countries, in thousands of metric tons* [1]—Continued

Country [1]	1936	1937	1938	1939	1940
Asia:					
British Borneo	(4)	(4)	(4)	(4)	(2)
China	[5] 27,116	(3)	(3)	(2)	(2)
Chosen	2,282	2,348	3,200	4,481	(2)
Federated Malay States	511	638	486	448	794
India, British	23,548	26,074	28,798	28,214	(2)
Indochina:					
Coal	2,186	2,308	2,340	2,588	2,456
Lignite	------	------	4	27	30
Japan:					
Japan proper:					
Coal	41,803	(3)	(3)	(2)	(2)
Lignite	109	(3)	(3)	(2)	(2)
Karafuto	2,010	(3)	(3)	(2)	(2)
Taiwan	1,744	(3)	(3)	(2)	(2)
Levant: Lignite	(4)	5	(4)	1	(2)
Netherlands Indies	1,147	1,364	1,457	1,781	(2)
Philippine Islands	25	22	41	47	(2)
Turkey:					
Coal	2,299	2,307	2,589	2,696	(2)
Lignite	95	116	129	151	(2)
U. S. S. R.:					
Coal } Lignite }	32,785	32,616	34,261	(2)	(2)
Africa:					
Algeria	7	14	13	(2)	(2)
Belgian Congo: Coal	14	36	42	(2)	(2)
Morocco, French	49	107	123	116	(2)
Nigeria	296	369	368	311	(2)
Portuguese East Africa	8	19	10	8	(2)
Southern Rhodesia	705	1,029	1,044	1,118	(2)
Union of South Africa	14,842	15,491	16,284	16,890	17,176
Oceania:					
Australia:					
New South Wales	9,347	10,213	9,725	11,376	(2)
Queensland	1,064	1,138	1,131	1,339	(2)
Tasmania	134	93	85	99	(2)
Victoria:					
Coal	434	262	312	371	(2)
Lignite	3,094	3,448	3,734	3,710	(2)
Western Australia	574	562	614	566	(2)
New Zealand:					
Coal	873	986	994	1,061	(2)
Lignite	1,302	1,329	1,264	1,319	(2)
Total, all grades	1,453,000	1,550,000	1,469,000	(2)	(2)
Lignite (total of items shown above)	224,000	254,000	264,000	(2)	(2)
Bituminous and anthracite (by subtraction)	1,229,000	1,296,000	1,205,000	(2)	(2)

[1] Coal is also mined in Argentina, Iran, and Italian East Africa. Production figures for these countries are not available, but estimates are included in the totals.
[2] Data not yet available.
[3] Estimate included in total.
[4] Production less than 1,000 tons.
[5] Production of most important coal mines.

PENNSYLVANIA ANTHRACITE

By F. M. Shore, J. R. Bradley, J. A. Corgan, and A. V. Coleman

SUMMARY OUTLINE

The total production of Pennsylvania anthracite in 1940 was 51,484,640 net tons—a decrease of only 2,737 tons compared with 51,487,377 tons produced in 1939. It should be remembered that these figures include dredge coal, which in many instances is taken from the rivers and creeks some distance from the anthracite regions. In 1940, dredge operations produced 942,944 tons and in 1939, 703,860 tons. Exclusive of dredge coal, the production in 1940 was 50,541,696 tons and is comparable with 50,783,517 tons in 1939.

Despite the slight decrease in anthracite production, several important developments in 1940 are believed to have benefited the industry. Of these, the most important was the voluntary anthracite production control or allocation plan, which was approved by the Governor of Pennsylvania in January and, with the cooperation of the operators and the United Mine Workers of America, doubtless has helped to bring production in closer alinement with current demand.

Moreover, a committee of operators and miners has been working on the problem of "bootleg" or illicit coal, with the hope of formulating a workable plan for its solution. Early in 1941 a plan to end "bootleg" mining was approved by the Anthracite Emergency Committee and adopted by operators representing more than 90 percent of the total anthracite production.

Finally, the price situation in the industry was more stable, and the producers realized higher prices at the mine for the output in 1940 than in 1939.

Research was continued within the industry, and, as provided in the Miller bill passed by the Pennsylvania General Assembly in 1939, the program of research in the Pennsylvania State College School of Mineral Industries is well under way; much valuable information already has been obtained. The program calls for special consideration of the use of anthracite in generating water gas and its utilization as an activated carbon.

There were no major labor disturbances in the anthracite industry during 1940. The wage agreement between the anthracite mine operators and the United Mine Workers of America, which was effected in May 1939, expired April 30, 1941. After a 1-day suspension, a new contract was arranged between the operators and the United Mine Workers of America. The agreement became effective May 1, 1941, and expires April 30, 1943. The miners were given a compensation payment to cover vacation expenses and also received a graduated percentage increase over the old scale.

Freight rates affecting the movement of anthracite were not changed greatly in 1940. The so-called motor-compelled rates, which were inaugurated originally to compete with the trucking of anthracite, were to expire December 20, 1940, but were extended until June 21, 1941, and were again extended to December 20, 1941. A group of large anthracite producers and the Commonwealth of Pennsylvania together petitioned the anthracite-originating railroads that rates on steam sizes be reduced to destinations to which reductions already have been made on domestic sizes and that the area to which reductions apply be made more extensive. The anthracite carriers refused both the reduction in rates and the extension of the area; then early in 1941 the anthracite producers filed freight-rate conplaints with both the Interstate Commerce Commission and the Pennsylvania Utilities Commission.

Definition of Pennsylvania anthracite industry.—Based upon differences in composition and characteristics of the product, trade practice and historical usage recognize two major divisions in the coal industry of the United States—bituminous coal and Pennsylvania anthracite. Anthracite and semianthracite also are mined in parts of Virginia, Arkansas, Colorado, and in New Mexico. Locally these coals represent distinct and important industries, but the tonnages involved are small and for statistical convenience usually are grouped with the totals of the bituminous-coal industry.

The Pennsylvania anthracite industry, as here defined, includes all nonbituminous fields of that State. Trade usage commonly includes the output of the Bernice Basin in Sullivan County with Pennsylvania anthracite, although the coal of this basin is classified officially as semianthracite.

Anthracite program.—Since about 1924 the general trend of production in the Pennsylvania anthracite industry has been downward, due chiefly to the increasing competition of other fuels. The declining output has resulted in keen competition for the anthracite markets within the industry itself.

TABLE 1.—*Statistical trends of Pennsylvania anthracite industry, 1936–40*

	1936	1937	1938	1939	1940
Production:					
Loaded at mines for shipment:					
Breakers ____ net tons __	46,256,132	44,016,915	39,010,935	[1] 43,660,662	[1] 43,800,127
Washeries ____ do ____	2,066,973	1,837,879	1,679,509	1,766,384	1,761,942
Dredges ____ do ____	324,895	348,350	373,425	565,236	613,884
Sold to local trade and used by employees ____ net tons __	3,226,887	2,981,391	2,722,206	3,081,073	3,052,626
Used at collieries for power and heat net tons __	2,704,648	2,671,898	2,312,952	2,414,022	2,256,061
Total production ____ do ____	54,579,535	51,856,433	46,099,027	51,487,377	51,484,640
Value at breaker, washery, or dredge ____	$227,004,000	$197,599,000	$180,600,000	$187,175,000	$205,490,000
Average sales realization per net ton on breaker shipments:					
Lump and Broken ____	$5.05	$5.08	$5.24	$4.63	$5.49
Egg ____	$5.60	$5.06	$5.18	$4.73	$5.32
Stove ____	$6.09	$5.21	$5.33	$4.84	$5.47
Chestnut ____	$5.91	$5.23	$5.36	$4.87	$5.49
Pea ____	$4.30	$4.01	$3.88	$3.65	$4.13
Total domestic ____	$5.67	$5.01	$5.10	$4.64	$5.24
Buckwheat No. 1 ____	$2.91	$2.95	$3.03	$2.90	$3.18
Buckwheat No. 2 (Rice) ____	$2.01	$2.26	$2.35	$2.20	$2.35
Buckwheat No. 3 (Barley) ____	$1.23	$1.45	$1.61	$1.62	$1.68
Boiler ____	----	$.78	----	----	----
Other, including Buckwheat No. 4 ____	$.68	$.79	$.87	$.91	$.92
Total steam ____	$2.10	$2.21	$2.33	$2.25	$2.41
Total, all sizes ____	$4.42	$4.03	$4.16	$3.85	$4.27
Percent by sizes in total breaker shipments:					
Lump and Broken ____ percent __	0.3	0.4	0.3	0.6	0.3
Egg ____ do ____	6.5	5.7	5.4	5.2	4.5
Stove ____ do ____	21.3	22.1	23.7	24.1	24.1
Chestnut ____ do ____	26.4	26.2	26.0	25.8	25.9
Pea ____ do ____	10.4	10.8	10.6	11.0	11.1
Total domestic ____ do ____	64.9	65.2	66.0	66.7	65.9
Buckwheat No. 1 ____ do ____	15.1	14.7	14.8	14.3	14.7
Buckwheat No. 2 (Rice) ____ do ____	8.4	7.9	7.7	7.8	7.8
Buckwheat No. 3 (Barley) ____ do ____	8.8	8.9	8.6	8.5	8.8
Boiler ____ do ____	----	[2]	----	----	----
Other, including Buckwheat No. 4 percent __	2.8	3.3	2.9	2.7	2.8
Total steam ____ do ____	35.1	34.8	34.0	33.3	34.1
Producers' stocks on Dec. 31 [3] ____ net tons __	2,259,000	2,154,000	1,458,000	994,000	939,000
Exports ____ do ____	1,678,000	1,914,000	1,909,000	2,590,000	2,668,000
Imports ____ do ____	615,000	396,000	363,000	298,000	135,000
Consumption (calculated) ____ do ____	53,200,000	50,400,000	45,200,000	49,700,000	49,000,000
Capacity in operation (calculated) __ do ____	87,000,000	83,000,000	82,000,000	85,000,000	84,000,000
Average number of days worked ____	192	189	171	183	186
Man-days lost on account of strikes and lock-outs ____	407,372	580,462	579,457	241,688	176,432
Number of men on strike during year ____	27,574	34,346	27,435	27,795	19,464
Average number of men employed ____	102,081	99,085	96,417	93,138	91,313
Output per man per day ____ net tons __	2.79	2.77	2.79	3.02	3.02
Output per man per year ____ do ____	535	523	478	553	562
Quantity cut by machines ____ do ____	2,162,744	1,984,512	1,588,407	1,881,884	1,816,483
Quantity mined by stripping ____ do ____	6,203,267	5,696,018	5,095,341	5,486,479	6,352,700
Quantity loaded by machines underground ____ net tons __	10,827,946	10,683,837	10,151,669	11,773,833	12,326,000
Distribution:					
Total receipts in New England [4] net tons __	5,287,000	4,761,000	4,468,000	4,902,000	4,937,000
Exports to Canada ____ do ____	1,664,000	1,893,000	1,896,000	2,577,000	2,627,000
Loaded into vessels at Lake Erie [5] net tons __	689,000	674,000	450,000	531,000	430,000
Receipts at Duluth-Superior [6] __ do ____	309,000	296,000	155,000	202,000	138,000

[1] Includes a small quantity of washery coal.
[2] Less than 0.1 percent.
[3] Anthracite Institute. Figures represent prepared coal in ground storage. 1940 figures are through December 28.
[4] Commonwealth of Massachusetts, Division on the Necessaries of Life.
[5] Ore and Coal Exchange.
[6] U. S. Engineer Office, Duluth, Minn.

TABLE 2.—*Statistical summary of monthly developments in Pennsylvania anthracite industry in 1940*

[All tonnage figures represent net tons]

	1940														1939 (total)
	January	February	March	April	May	June	July	August	September	October	November	December	Total	Change from 1939 (percent)	
Production, including mine fuel, local sales, and dredge coal: Monthly total	5,783,000	3,648,000	3,881,000	3,853,000	4,070,000	4,492,000	4,534,000	3,883,000	4,172,000	4,355,000	3,980,000	4,834,000	51,485,000	(1)	51,487,000
Shipments, breakers, and washeries only:[2] Monthly total, all sizes	4,762,423	3,162,602	3,207,973	3,144,127	3,426,004	3,868,879	3,729,214	3,296,260	3,587,206	3,657,876	3,396,388	3,784,798	43,023,750	−1.8	43,809,199
Distribution:															
Lake Erie loadings[3]	-------	-------	-------	16,471	40,499	67,412	97,134	86,556	48,043	54,280	19,675	122	430,192	−19.0	531,335
Receipts at Duluth-Superior[4]	-------	-------	-------	-------	6,263	27,022	27,933	27,918	22,787	19,253	6,512	-------	137,688	−31.7	201,726
Upper Lake dock trade:[5]															
Receipts:															
Lake Superior	-------	-------	-------	-------	9,113	16,891	28,213	27,917	22,785	19,252	6,544	-------	130,715	−39.6	216,440
Lake Michigan	807	787	625	8,674	36,618	46,173	46,756	69,775	25,673	32,128	13,901	558	282,475	+ 4.1	271,432
Deliveries (reloadings):															
Lake Superior	23,794	8,443	4,732	6,133	25,655	17,752	14,580	14,313	16,924	17,229	32,085	21,488	203,128	−4.9	213,554
Lake Michigan	31,263	19,399	20,409	12,296	24,195	27,256	39,116	20,353	26,331	23,718	20,763	18,771	283,870	−1.6	288,444
Retail yards—176 selected dealers:															
Deliveries[5]	441,314	350,100	369,616	255,421	215,599	236,342	253,448	223,434	252,119	281,506	255,658	331,146	3,465,703	-------	(6)
New England receipts:[7]															
By tide (including imports)	51,657	34,713	50,587	56,009	82,086	86,722	87,383	78,816	76,200	59,591	53,623	45,725	763,112	−12.7	874,542
By rail	462,684	320,835	288,991	283,879	336,029	334,101	386,336	298,442	341,571	332,816	365,696	422,917	4,174,297	+ 3.6	4,027,540
Exports[8]	166,751	127,515	135,566	135,653	315,690	406,895	368,251	248,633	247,171	186,622	157,760	171,125	2,667,632	+ 3.0	2,590,000
Imports[8]	13,864	112	10,222	7,503	5,604	13,566	23,041	6,866	9,875	13,698	10,675	20,410	135,436	−54.6	298,153
Industrial consumption by:															
Railroads (class I only)[9]	151,714	137,315	134,540	104,430	93,279	86,730	84,568	84,630	84,540	102,548	197,880	116,901	1,379,075	−18.0	1,681,665
Electric power utilities[10]	233,446	202,253	186,381	166,237	166,245	172,882	197,605	232,896	208,366	234,174	211,303	213,346	2,425,134	+8.1	2,243,984
Other industrial consumers[11]	120,814	119,515	96,744	95,283	73,776	66,027	65,101	64,193	65,553	92,125	101,270	129,847	1,090,248	−7.0	1,172,265
Number of industrial firms reporting[11]	81	85	79	82	82	79	79	69	76	80	84	84	(6)	-------	(6)
Stocks at end of period shown:															
Railroads (class I only)[9]	99,390	83,567	63,212	62,312	68,295	68,283	115,045	143,234	155,305	150,592	142,564	144,149	144,149	+30.7	110,329
Electric power utilities[10]	1,092,989	1,028,831	994,863	981,699	1,029,971	1,033,203	1,144,942	1,147,386	1,189,279	1,197,711	1,195,010	1,216,695	1,216,695	+ 9.2	1,113,839
Other industrial consumers[11]	181,929	172,211	116,669	179,997	171,979	188,803	191,454	171,157	191,319	220,618	227,103	228,583	228,583	+37.8	165,842
Stocks on upper Lake docks:[5]															
Lake Superior	127,678	119,346	114,843	108,528	91,117	90,257	103,894	117,554	123,457	125,643	99,207	77,714	77,714	−48.7	151,475
Lake Michigan	113,144	94,534	74,791	71,194	83,646	102,598	110,274	159,718	159,025	165,592	158,469	140,256	140,256	− 2.3	143,609

Retail stocks—176 selected dealers [5]	358,422	283,438	197,618	227,064	275,280	330,165	405,861	428,483	422,556	415,625	432,587	429,382	429.382	+ 3.5	414,790
Prices at mines, average per net ton: [12]															
Company Stove	$6.25	$6.25	$6.25	$5.88	$5.80	$5.91	$6.03	$6.13	$6.23	$6.25	$6.25	$6.25	$6.12		(6)
Company Buckwheat No. 1	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50		(6)
Wholesale prices: [13]															
On tracks, destination:															
Chestnut	$9.50	$9.58	$9.58	$9.39	$9.28	$9.33	$9.46	$9.56	$9.64	$9.77	$9.78	$9.79	$9.55	+ 4.5	$9.14
Pea	$8.18	$8.23	$8.21	$7.98	$7.89	$7.98	$8.10	$8.19	$8.26	$8.36	$8.37	$8.38	$8.18	+ 3.4	$7.91
Index numbers (1926=100)	78.7	79.2	79.2	77.4	76.5	77.1	78.1	79.0	79.6	80.7	80.7	80.9	78.9	+ 4.1	75.8
Labor conditions: [13]															
Average weekly earnings	$33.46	$20.94	$24.22	$23.31	$25.38	$26.85	$23.79	$21.82	$25.96	$21.48	$24.56	$27.60	$24.95	− 2.2	$25.52
Index of employment (1929 average=100)	51.5	51.6	52.2	51.2	51.8	49.7	50.5	49.9	49.8	49.4	50.4	50.8	50.7	+ 0.2	50.6
Index of pay-roll totals (1929 average=100)	52.5	32.9	38.4	36.3	40.0	40.6	36.5	33.1	39.3	32.3	37.6	42.7	38.5	− 2.5	39.5

1 Less than 0.1 percent.
2 Furnished by Anthracite Institute.
3 Ore and Coal Exchange, Cleveland, Ohio.
4 U. S. Engineer Office, Duluth, Minn.
5 Bituminous Coal Division, U. S. Department of the Interior.
6 Data not available.
7 Commonwealth of Massachusetts, Division on the Necessaries of Life. Figures for 1940 are preliminary.
8 Bureau of Foreign and Domestic Commerce.
9 Association of American Railroads.
10 Federal Power Commission.
11 National Association of Purchasing Agents.
12 Computed from weekly quotations from trade journals. Figures represent circular prices quoted on white ash by leading anthracite-producing companies.
13 Bureau of Labor Statistics.

For several years there has been much discussion of the unsatisfactory situation, and several plans have been under consideration which (it was thought) might bring some measure of relief to the economic ills of the industry. The present voluntary production-control program is the result of conferences between Pennsylvania State officials, representatives of the United Mine Workers of America, and committees of old-line and independent mine operators. It is reported that the voluntary agreement, when submitted to the Governor, was agreed to by producers whose output comprised about 98 percent of the total anthracite production.

The program is supervised and controlled by the Anthracite Emergency Committee, composed of nine members appointed by the Governor. The operators, the United Mine Workers of America, and the public are represented by three members each. The program is administered by an executive committee of three.

A producers' advisory board of 14 members advises and makes recommendations to the executive committee on production requirements, considering stocks, unsold anthracite in cars at mines, and other factors that affect the consumption of anthracite.

Each cooperating producer is to be assigned a certain percentage of the total tonnage allocated for the week. The percentage positions were determined by careful study of the production history of each mine by committees of operators and miners.

A provision is included for amendment by cooperating producers. It is said that elimination of overproduction is the aim of the program and that it does not attempt to regulate marketing or to control prices.

Illicit coal.—One of the most difficult problems with which the industry has had to contend in recent years is the illicit or "bootleg" coal industry. The illicit coal trade first started during the depression years, when unemployed miners dug coal from land owned by the anthracite operating companies to heat their own homes; but it soon grew beyond this phase, and before long trucks were hauling the coal to cities some distance from the anthracite fields, where it was sold in competition with the legitimate product. According to a survey by the Anthracite Emergency Committee, as of March 15, 1941, 10,031 men and boys were working in 2,862 "bootleg" openings. In addition to these workers, 1,697 men and boys were working in 340 breakers and washeries preparing the product for the market. The survey revealed that free-lance miners produced 535,556 tons of anthracite in January 1941. According to the Anthracite Institute, the illicit production for 1940 was more than 4,000,000 net tons.

To find some solution to this problem, a plan was adopted in amendment form to the anthracite emergency program early in 1941 and was agreed to by the State, the operators cooperating under the program, and the United Mine Workers of America. Among other things, the plan provides that the committee will make an immediate survey of all "bootleg" operations; and any cooperating producer may make a lawful arrangement to purchase the output of a "bootleg" hole or holes, in addition to his quota of production under the emergency program, which will not be affected thereby. Moreover, cooperating producers may employ "bootleggers" formerly engaged in illegal mining, and such producers will receive a supplemental allocation equal to 3¼ net tons per man per day of commercial output for each man so employed.

The legitimate operators are reported as hopeful that successful operation of the plan will solve this social and industrial problem.

Distribution.—According to the Pennsylvania State Department of Mines, Pennsylvania anthracite mine shipments to destinations within the United States totaled 44,982,363 net tons in 1940, exclusive of illicit or "bootleg" coal. Of this tonnage, the total truck shipments were 6,192,067 tons, or about 14 percent. This is comparable to a movement of 4,824,537 tons (11 percent) in highway-borne traffic in 1939.

For many years most of the anthracite shipped by rail has been destined to New England, New York, New Jersey, and Pennsylvania, and in 1940 these States received 36,492,328 tons or 94 percent of the total rail shipments within the United States. Three States—Pennsylvania, New York, and New Jersey—received 6,025,310 tons (97 percent) of the total tonnage moved from the mines by truck in 1940.

According to the Commonwealth of Massachusetts, Division on the Necessaries of Life, total receipts of Pennsylvania anthracite in New England in 1940 were 4,802,000 net tons compared with 11,679,000 tons in 1917. Until recent years, tidewater receipts of anthracite in New England comprised a large percentage of the total shipments to these States. For example, in 1917 tidewater receipts amounted to 4,421,000 tons (38 percent) of the total receipts. By 1940, the tonnage had declined to 763,000 tons (16 percent of the total). Table 3 gives details of the anthracite movement into New England.

Loadings at Lake Erie ports dropped from 531,335 net tons in 1939 to 430,192 in 1940—a 19-percent decrease. Receipts at Duluth-Superior fell 32 percent and those on the Upper Lake Docks 15 percent in 1940 compared with 1939.

TABLE 3.—*Receipts of anthracite in New England, 1917, 1920, 1923, and 1927–40, in thousands of net tons*

Year	Receipts by tide [1]						Receipts by rail [1]	Imports [2]	Total receipts of Pennsylvania anthracite [3]
	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total			
1917	432	47	2,222	555	1,165	4,421	7,259	1	11,679
1920	307	6	2,015	450	743	3,521	7,804	1	11,324
1923	437	27	2,216	511	891	4,082	8,102	145	12,039
1927	242	33	1,220	311	615	2,421	6,725	106	9,040
1928	205	35	1,373	301	528	2,442	6,934	369	9,007
1929	237	17	1,227	329	450	2,260	6,781	483	8,558
1930	275	17	1,236	271	422	2,221	6,169	658	7,732
1931	164	18	1,125	282	348	1,937	5,125	611	6,451
1932	148	10	1,014	212	275	1,659	3,980	574	5,065
1933	195	7	1,027	202	259	1,690	3,562	443	4,809
1934	168	20	946	190	266	1,590	4,382	477	5,495
1935	121	7	802	205	237	1,372	4,030	559	4,843
1936	127	14	792	198	267	1,398	3,889	612	4,675
1937	81	11	604	152	200	1,048	3,713	395	4,366
1938	93	2	554	137	191	977	3,491	363	4,105
1939	74	3	488	83	227	875	4,027	298	4,604
1940 [4]	48	4	438	62	211	763	4,174	135	4,802

[1] Commonwealth of Massachusetts, Division on the Necessaries of Life.
[2] Bureau of Foreign and Domestic Commerce.
[3] Total receipts by rail and by tide less imports.
[4] Subject to revision.

Figure 1 gives a graphic presentation of anthracite shipped from the three regions, 1850–1939.

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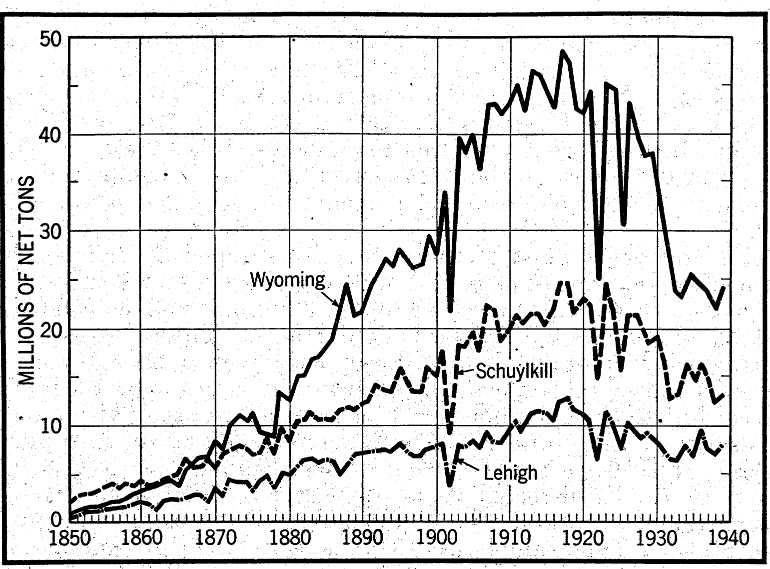

FIGURE 1.—Anthracite shipped from the Lehigh, Schuylkill, and Wyoming regions, 1850–1939.

Competitive fuels in the United States and in principal markets.—The New England States, New York, New Jersey, Delaware, Maryland, Pennsylvania, and the District of Columbia are important, highly competitive markets for domestic fuels. Excluding bituminous coal and liquefied gases (as well as wood fuel for which no data are available), these States in 1939 used solid fuels and heating and range oils equivalent to about 74,774,000 net tons of bituminous coal or 72,025,000 tons of anthracite, largely for heating homes, apartment houses, and public buildings. Based upon reports of the Pennsylvania Department of Mines, rail and truck shipments of Pennsylvania anthracite in 1940 to points within the United States totaled 44,982,363 tons, of which 97 percent went to the States mentioned above. Shipments in 1940 (other than of illicit or "bootleg" coal, the inclusion of which would increase the total by perhaps 10 percent) were slightly higher than in 1939. The consumption of heating and range oils in 1939 in terms of coal was about 27,000,000 tons. Such data as are available indicate that the consumption of oils in 1940 exceeded that in 1939 and set a new high record. The only other fuel of importance in the States mentioned (and again excluding bituminous coal) is coke, use of which for domestic purposes amounted to 4,128,000 tons in 1940, including 76,000 tons imported, some possibly for metallurgical uses. Details are shown in table 4.

For the United States as a whole, the supplies of fuels commonly used for domestic purposes in 1940 show increases over 1939, the outstanding gains being recorded for heating oils for domestic and commercial uses, the sales of which increased from 136,232,000 barrels in 1939 to an estimated 162,000,000 barrels in 1940. Range-oil sales increased from 37,061,000 to 48,600,000 barrels, and liquefied petroleum gases from 2,084,000 to 3,191,000 barrels. Details regarding other fuels used for domestic heating will be found in table 5.

TABLE 4.—*Apparent consumption of anthracite and selected competitive fuels in the principal anthracite markets, 1937–40*

[Thousands of net tons]

Fuel	New England	New York	New Jersey	Delaware	Maryland	Pennsylvania	District of Columbia	Total: Thousands of net tons	Total: Percent of total fuels
Anthracite:									
All users:[1]									
1937	4,129	[2] 16,695	[2] 7,796	238	655	11,777	296	41,586	60.0
1938	3,553	[2] 13,452	[2] 6,421	198	574	9,603	254	34,055	55.0
1939	4,492	[2] 16,716	[2] 9,060	259	634	12,077	264	43,502	58.2
1940	4,539	[2] 16,249	[2] 8,814	304	608	12,915	289	43,718	(3)
Imports:[4]									
1937	395	-------	-------	-------	-------	-------	-------	395	.6
1938	363	-------	-------	-------	-------	-------	-------	363	.6
1939	298	-------	-------	-------	-------	-------	-------	298	.4
1940	135	-------	-------	-------	-------	-------	-------	135	(3)
Briquets:									
Domestic use:									
1937	40	36	2	-------	2	14	1	95	.1
1938	38	27	1	-------	3	11	-------	80	.1
1939	46	23	1	-------	2	11	1	84	.1
1940	52	26	1	(5)	2	10	(5)	91	(3)
Imports:[4]									
1937	7	-------	-------	-------	-------	-------	-------	7	(6)
1938	14	-------	-------	-------	-------	-------	-------	14	(6)
1939	1	-------	-------	-------	-------	-------	-------	1	(6)
1940	-------	-------	-------	-------	-------	-------	-------	-------	-------
Coke:									
Domestic use:									
1937 [7]	1,144	1,800	443	6	7	631	2	4,033	5.8
1938 [7]	1,018	1,604	395	5	7	563	1	3,593	5.8
1939 [7]	1,077	1,696	413	5	7	596	2	3,796	5.0
1940	1,430	1,564	489	2	28	537	2	4,052	(3)
Imports:[4]									
1937	43	77	-------	-------	-------	-------	-------	120	.2
1938	21	7	-------	-------	-------	-------	-------	28	.1
1939	12	19	-------	-------	-------	-------	-------	31	.1
1940	15	58	-------	-------	3	-------	-------	76	(3)
Oil: Heating and range:[8]									
1937	9,358	7,457	3,179	110	578	1,985	390	23,057	33.3
1938	9,649	7,677	3,269	101	591	2,052	406	23,745	38.4
1939	10,787	8,967	3,770	107	694	2,279	458	27,062	36.2
1940	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Total fuel:[9]									
1937	15,116	26,065	11,420	354	1,242	14,407	689	69,293	100.0
1938	14,656	22,767	10,086	304	1,175	12,229	661	61,878	100.0
1939	16,713	27,421	13,244	371	1,337	14,963	725	74,774	100.0
1940	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)

[1] Pennsylvania Department of Mines; illicit coal not included.
[2] An important but undetermined part of anthracite shown as shipped to New Jersey is reshipped to New York City.
[3] Data not yet available.
[4] Bureau of Foreign and Domestic Commerce.
[5] Less than 1,000 tons.
[6] Less than 0.05 percent.
[7] Estimated upon basis of distribution in 1936.
[8] Converted to coal equivalent upon basis of 4 barrels of fuel oil equaling 1 ton of coal.
[9] Does not include bituminous coal.

TABLE 5.—*Total supplies of fuels commonly used for domestic purposes in the United States, 1924 and 1937–40*

[Wherever available, figures represent 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, total production (or imports) is shown to indicate trend of growth]

	1924	1937	1938	1939	1940
SOLID FUELS (NET TONS)					
Anthracite:					
Production:					
Shipments of domestic sizes	56,576,296	29,092,974	26,206,508	29,504,632	29,076,573
Shipments of Buckwheat No. 1 [1]	9,510,508	6,859,707	6,159,006	6,569,902	6,771,387
Shipments of smaller steam sizes [1]	11,160,695	10,250,463	8,698,355	9,917,748	10,327,993
Local sales	3,043,939	2,981,391	2,722,206	3,081,073	3,052,626
Total commercial production	80,291,438	49,184,535	43,786,075	49,073,355	49,228,579
Exports	4,017,785	1,914,173	1,908,911	2,590,000	2,667,632
Imports for consumption (chiefly from United Kingdom and U. S. S. R.)	117,951	395,737	362,895	298,153	135,436
Fuel briquets [2]	580,508	977,254	868,382	880,981	1,027,585
Packaged-fuel production		146,037	160,952	215,507	284,513
Coke:					
Byproduct sales for domestic use	2,812,771	7,807,792	7,129,384	7,549,937	8,131,947
Beehive sales for domestic use	139,886	299,726	93,306	88,204	99,066
Imports for consumption	82,833	286,364	135,240	141,911	112,550
Gas-house-coke sales [3]	1,400,000	350,700	342,300	362,000	(4)
Petroleum-coke production	761,100	1,306,600	1,602,200	1,666,400	[5] 1,526,600
Anthracite and semianthracite production outside of Pennsylvania	704,513	468,852	370,665	(4)	(4)
Lignite production [6]	2,255,385	3,218,419	2,997,921	3,042,537	(4)
Bituminous-coal sales for domestic use	(7)	(7)	(7)	(7)	(7)
OIL (BARRELS OF 42 GALLONS)					
Oil sales for heating buildings:					
Range oil [8]	(4)	[9] 32,259,000	33,707,000	[9] 37,061,000	[5] 48,600,000
Heating oils: [10]					
Domestic	5,021,000	} [9] 116,617,000	} 118,323,000	} [9] 136,232,000	} [5] 162,000,000
Commercial	(4)				
Liquefied petroleum gases, domestic	(4)	972,000	1,377,000	2,084,000	3,191,000
GAS (MILLION CUBIC FEET)					
Natural-gas consumption for domestic and commercial use [11]	285,152	489,234	482,068	[9] 509,487	[5] 574,000
Manufactured-gas sales for: [12]					
Domestic use	(4)	193,325	195,887	192,338	197,360
House heating	(4)	45,200	47,634	55,561	68,038

[1] A considerable part of Buckwheat No. 1 and smaller steam sizes is used by industries, railroads, and public utilities.
[2] Production plus imports less exports.
[3] Partly estimated.
[4] Data not available.
[5] Subject to revision.
[6] An estimated one-half is used for domestic purposes.
[7] Exact data not available; estimated between 55 and 77 million tons a year, including lignite and anthracite and semianthracite outside of Pennsylvania, which is shown separately.
[8] Range oil is a light distillate used for house heating, hot-water heating, and cooking.
[9] Revised figures.
[10] Includes all grades of fuel oil used for heating buildings.
[11] Includes gas used for heating offices, hotels, apartments, schools, hospitals, and stores and other large buildings, as well as houses.
[12] American Gas Association.

Transportation of anthracite to principal markets.—Data compiled from reports issued by the Pennsylvania State Department of Mines indicate that of the total anthracite mine shipments by rail and truck to destinations in the United States, 86 percent moved by rail and 14 percent by truck in 1940; of the rail shipments, 62 percent was domestic and 38 percent steam sizes. In 1939, 89 percent of the total shipments was carried by the railroads and 11 percent by truck.

It is interesting to note (table 7) that in 1940, 2,911,316 tons or 47 percent of the total tonnage trucked were sold to local trade within the anthracite region and that 1,433,939 tons or 23.2 percent of the total trucked coal were sold within Pennsyvlania but outside the anthracite region. New York and New Jersey received 27.2 percent of the total truck shipments. Taken as a whole, these three States—Pennsylvania, New York, and New Jersey—received 97 percent of the coal shipped by truck. It is also of interest to note that the largest percentage of the trucked coal is transported to market during January, February, March, October, November, and December.

TABLE 6.—*Shipments of Pennsylvania anthracite, 1938–40, by States of destination, in net tons* [1]

[Truck shipments excluded]

	1938	1939	1940
New England States	3, 551, 572	4, 489, 970	4, 539, 026
New York	13, 214, 996	16, 251, 195	15, 477, 318
New Jersey	6, 180, 129	8, 494, 964	7, 906, 071
Pennsylvania	6, 827, 437	8, 407, 564	8, 569, 913
Delaware	168, 316	194, 759	197, 456
Maryland	545, 454	592, 627	570, 771
District of Columbia	248, 577	256, 936	280, 415
Virginia	103, 580	108, 418	106, 713
Ohio	91, 017	112, 833	113, 553
Indiana	80, 153	98, 090	83, 539
Illinois	254, 193	277, 166	265, 424
Wisconsin	345, 445	355, 291	347, 223
Minnesota	77, 461	93, 367	61, 203
Michigan	214, 768	245, 519	203, 299
Other States	65, 873	66, 217	68, 372
Total United States	31, 968, 971	40, 044, 916	38, 790, 296
Canada	1, 631, 489	2, 441, 070	2, 312, 531
Other foreign countries	4, 476	4, 456	2, 525
Grand total	33, 604, 936	42, 490, 442	41, 105, 352

[1] Pennsylvania Department of Mines.

TABLE 7.—*Truck shipments of Pennsylvania anthracite by months, in 1940, by States of destination in net tons* [1]

State	January	February	March	April	May	June	July
Pennsylvania:							
Within region	387, 033	308, 431	314, 571	249, 319	180, 171	123, 744	117, 411
Outside region	152, 924	122, 500	141, 375	124, 629	120, 083	79, 388	70, 511
New York	68, 011	52, 973	62, 831	45, 537	36, 047	40, 579	54, 208
New Jersey	115, 560	73, 273	89, 639	73, 556	42, 184	44, 182	45, 463
Maryland	9, 437	5, 054	1, 887	2, 306	1, 441	1, 274	1, 180
Delaware	14, 956	12, 029	11, 215	6, 407	3, 427	3, 861	3, 573
District of Columbia	954	936	886	642	724	523	474
Other States	1, 378	877	1, 563	880	852	664	597
Total	750, 253	576, 073	623, 967	503, 276	384, 929	294, 215	293, 417

State	August	September	October	November	December	Total	Percent of total trucked
Pennsylvania:							
Within region	156, 761	199, 198	248, 977	271, 509	354, 191	2, 911, 316	47. 0
Outside region	79, 353	115, 820	136, 709	132, 884	157, 763	1, 433, 939	23. 2
New York	54, 894	75, 108	97, 006	85, 872	98, 634	771, 700	12. 5
New Jersey	52, 419	84, 626	99, 436	84, 901	103, 116	908, 355	14. 7
Maryland	1, 484	1, 892	4, 277	2, 719	4, 144	37, 095	. 6
Delaware	4, 696	9, 222	12, 289	11, 412	13, 674	106, 761	1. 7
District of Columbia	568	725	805	757	984	8, 978	. 1
Other States	1, 369	1, 090	1, 786	1, 513	1, 354	13, 923	. 2
Total	351, 544	487, 681	601, 285	591, 567	733, 860	6, 192, 067	100. 0

[1] Compiled from reports of Pennsylvania Department of Mines.

In view of the rise from 3,177,656 tons in 1936 to 6,192,067 in 1940, it is apparent that the trucking of coal is increasing and that the railroads, therefore, are not transporting as high a percentage of shipments as they formerly did.

The distribution of rail shipments of anthracite, by States of destination, for 1938–40 is shown in table 6 and truck movement of Pennsylvania anthracite by months, in 1940, by States of destination, in table 7.

Consumption.—Considering changes in producers' stocks and making allowances for foreign trade, the total consumption of anthracite in 1940 was 49,000,000 net tons compared with 49,700,000 in 1939. The consumption for 1940 is not exactly comparable with that for 1939, because the producers' stock figure for 1940 was as of December 28 and the stock for 1939 was as of December 31. Class I railroads and electric power utilities consumed 3,804,209 net tons of anthracite in 1940; in 1939, this group consumed 3,925,649 tons. Illicit coal is not included in the figures of either year.

According to the Census of Manufactures, 1939, the consumption of anthracite, as well as of other solid fuels, in manufacturing establishments declined in 1939 compared with 1937. The consumption of anthracite decreased from 6,562,000 net tons in 1937 to 5,016,000 in 1939.

Consumption by principal industry groups in 1937 and 1939, respectively, was as follows: Paper and allied products, 1,280,000 and 1,039,000 net tons; food and kindred groups, 1,021,000 and 738,000 net tons; nonferrous metals and their products, 966,000 and 598,000 net tons; textile-mill products and other fiber manufactures, 681,000 and 507,000 net tons; chemicals and allied products, 605,000 and 641,000 net tons; iron and steel and their products, except machinery, 486,000 and 511,000 net tons; and stone, clay, and glass products, 449,000 and 239,000 net tons.

Changes in stocks.—On December 31, 1940, stocks of anthracite held by railroads (class I), electric power utilities, and other industrial consumers totaled 1,589,427 net tons. On the corresponding date in 1939, stocks held by the same group of consumers amounted to 1,390,010 tons.

The stocks of anthracite on the upper Lake docks on December 31, 1940, were 217,970 net tons—a slight decrease from the 295,084 tons on this date in 1939.

Producers' stocks amounted to 939,227 net tons on December 28, 1940. On December 31, 1939, stocks in producers' yards were 993,848 net tons.

Stocks held by 176 selected retail dealers totaled 358,422 net tons in January, reached a low point of 197,618 tons in March and a high of 432,587 tons in November, and were 429,382 tons or slightly above the 1939 figure in December.

Trend of employment.—The peak year for employment in the Pennsylvania anthracite industry was 1914, when 179,679 men were employed. In 1926 the figure had fallen to 165,386 and declined steadily until 1939, when 93,138 men were on the pay rolls. In 1940 the number employed had fallen to 91,313.

The decrease in the number of men employed in the anthracite industry is due to several developments, principally the decline in production, the increased mechanization of the mines, and the extended mining in strip pits. The first has caused a natural decline in the men employed, and the latter two have resulted in a higher output per man per day, reducing the labor required for a given tonnage.

Trend of prices.—According to trade-journal quotations, the circular prices, f. o. b. mine, quoted by leading anthracite-producing companies, effective January 1940, were as follows: For Broken, Egg, Stove, and Chestnut sizes, $6.25 a net ton; for Pea, $4.75 a ton. To stimulate spring fill-up and summer business the prices were decreased 50 cents a ton in April and then gradually increased until September, when they equaled those at the beginning of the year. Buckwheat. Rice, and Barley sizes were firm throughout the year at $3.50, $2.75, and $2.00 a net ton, respectively. Comparable quotations were not published by the trade journals for each month in 1939. However, trade reports indicate that in 1939 the price structure was unstable throughout the year and that the price situation was more favorable to the industry in 1940.

According to the Bureau of Labor Statistics, United States Department of Labor, the retail prices for Stove size on December 15, 1939, in Boston, New York City, and Washington, D. C., were $13.00, $10.69, and $12.65, respectively. On the same date in 1940, comparable prices were $13.75, $11.72, and $12.95. At the same periods, the prices for Buckwheat No. 1 in these three cities were $9.75, $7.59, and $9.55 in 1939 compared with $10.00, $8.38, and $9.60 in 1940. The prices are for a net ton of 2,000 pounds in Boston and New York and a gross ton of 2,240 pounds in Washington, D. C. The New York prices also include a 2-percent sales tax.

Sales realization.—The average sales realization on breaker shipments in 1940 was $4.27 a net ton compared with $3.85 in 1939—an 11-percent increase. However, the realization was low in 1939 because of the chaotic price situation in that year. The average sales realization was $4.16 a net ton in 1938 and $5.63 in 1929.

The value at the mines of all anthracite production in 1939 was $187,175,000, while in 1940 (with prices more favorable to the producers) it reached $205,490,000—a 9.8 percent increase.

Imports and exports.—Imports of anthracite decreased from 298,153 net tons in 1939 to 135,436 in 1940—a 55-percent reduction. The United Kingdom and Canada supplied all of the imported coal in 1940, 98 percent coming from the former. Imports from Canada doubtless represent reexports of coal. Exports, on the other hand, increased approximately 3 percent in 1940 compared with 1939, as the tonnage rose from 2,590,000 tons to 2,667,632. Canada received about 98 percent of the total exports in 1940 (see tables 33–35).

Mechanical stokers and oil burners.—According to the Bureau of the Census, United States Department of Commerce, factory sales of mechanical stokers for burning anthracite have shown little change in the last 3 years. Sales of class 1 stokers (capacity under 61 pounds of coal an hour) were 12,651, 11,776, and 11,917 units, respectively in 1938, 1939, and 1940. Sales of class 2 stokers (capacity 61 to 100 pounds of coal an hour) were 970 units in 1940. Data on class 2 stokers for 1938–39 are not available.

Shipments of oil burners in 1940 (for purposes other than ranges, stoves, water heaters, and space heaters) within the United States increased from 210,120 burners in 1939 to 260,991 in 1940.

Research and technologic developments.—The fourth annual anthracite conference of Lehigh University was held at Bethlehem, Pa., May 8–9, 1941. A paper presented by Carl A. Fraser, Albany, on Practical Merchandising of Anthracite from the Dealer Viewpoint, stressed the needs of the ultimate consumer, service, budget selling, and automatic heating equipment. In Market Opportunities for Anthracite, J. D. Jillson, Anthracite Industries, Inc., discussed competitive fuels in the primary anthracite markets, including Canada, with special reference to the influence of war-time economy on the demand for anthracite. J. F. K. Brown, Hudson Coal Co., in a paper Observations on the Use of Anthracite in Foundry Cupolas, added to the information presented on this subject in his paper read at the 1940 conference. Other papers included:

Future Research in the Anthracite Industry, by Frank C. Wright, Jr., vice president, The Philadelphia & Reading Coal & Iron Co.

Anthracite Fuel Beds in Water-gas Generators, by C. C. Wright, associate professor of fuel technology, and L. L. Newman, assistant professor of fuel technology, Pennsylvania State College.

Advanced Developments in the Control of the Combustion of Anthracite, by Allen J. Johnson, director, Anthracite Industries Laboratory.

Preparation of Activated Carbon from Pennsylvania Anthracite, by Eric Sinkinson, associate professor of fuel technology, Lehigh University, Bethlehem, Pa.

Practical Pointers in Domestic Stoker Installations, by Joseph K. Goundie, Fritch Coal Co., Bethlehem, Pa.

Nonfuel applications of anthracite and anthracite refuse, including the use of anthracite ashes for soil improvement, the production of mineral wool from anthracite culm and ashes, and the production of lightweight aggregate from anthracite ashes for use in various concrete products, among other subjects, were discussed in the paper, Anthracite Research at Mellon Institute, by H. J. Rose.

According to the Anthracite Institute, anthrafilt expanded into new markets and is now a widely used filtering material in municipal and industrial water plants. Oil refineries and the paper-mill industry are employing it more extensively, and the War Department has found it of value in water softening and filtering problems.

Anthracite Institute.—The Anthracite Institute carried on its usual functions and information services. It opposed actively the reduction of freight rates on oil commodities, the extension of natural-gas pipe lines into eastern markets, and hydroelectric projects in competition with anthracite. The institute, with other interested parties, successfully opposed railroads that had filed reduced rates for crude petroleum from the St. Louis-Chicago area to the eastern seaboard.

SOURCES AND ACKNOWLEDGMENTS

Final statistics of the Pennsylvania anthracite-mining industry are prepared from an annual canvass, by mail, of all known anthracite operations, including over 400 mines, large and small, that are active producers. About 95 percent of the tonnage is reported direct, and the remaining 5 percent is collected by personal visits or from reliable collateral evidence. The data on individual operations furnished by the producers are voluntary and confidental, as is customary in the statistical services of the Bureau of Mines.

In assembling available detailed information, free use has been made of the pertinent figures prepared by the Anthracite Institute, the Anthracite Emergency Committee, the American Association of Railroads, and the Pennsylvania Department of Mines; to all of these, thanks are extended for their cordial and continued cooperation. Thanks are also due especially to the producers for reporting so promptly and, in general, so fully upon their 1940 operations.

PRODUCTION

The production of Pennsylvania anthracite in 1940 was 51,484,640 net tons—a slight decrease compared with the output of 51,487,377 tons in 1939. These figures include a small tonnage of semianthracite produced in Sullivan County (50,844 tons in 1940) and also the output of dredge coal (which amounted to 942,944 tons in 1940 and 703,860 tons in 1939), but they do not consider the production of "bootleg" or illicit coal, which has been increasing since its beginning during the depression years and has been estimated as amounting to at least 4,000,000 tons in 1940.

The peak year in production was reached in 1917, when the output was 99,611,811 net tons. Since 1924 the general trend has been downward, and in 1940 the output was a little more than one-half of that in 1917.

Weeks and months.—Tables 8 and 9 summarize the statistics of weekly and monthly production of anthracite. Statistics of current output are estimated from records of car loadings and from tonnage reports from trade sources. The weekly and monthly figures in tables 8 and 9 have been adjusted to the annual total ascertained by direct canvass of the operators.

TABLE 8.—*Estimated weekly production of Pennsylvania anthracite in 1940, in net tons*

Week ended—	Production	Week ended—	Production
Jan. 6	1,131,000	July 20	1,133,000
13	1,410,000	27	987,000
20	1,175,000	Aug. 3	787,000
27	1,425,000	10	834,000
Feb. 3	1,078,000	17	952,000
10	654,000	24	977,000
17	832,000	31	864,000
24	967,000	Sept. 7	837,000
Mar. 2	891,000	14	1,057,000
9	1,064,000	21	1,115,000
16	886,000	28	952,000
23	874,000	Oct. 5	735,000
30	927,000	12	912,000
Apr. 6	709,000	19	850,000
13	878,000	26	1,295,000
20	903,000	Nov. 2	947,000
27	902,000	9	1,069,000
May 4	1,058,000	16	919,000
11	935,000	23	905,000
18	855,000	30	918,000
25	868,000	Dec. 7	1,032,000
June 1	849,000	14	1,259,000
8	1,006,000	21	1,187,000
15	1,220,000	28	890,000
22	1,159,000	Jan. 4	[1] 466,000
29	1,065,000		
July 6	696,000	Calendar year	51,485,000
13	1,189,000		

[1] Figures represent the output of working days in that part of the week included in the calendar year 1940. Total production for the week of January 4, 1941, was 817,000 tons.

TABLE 9.—*Estimated monthly production of Pennsylvania anthracite, 1933–40* [1]

[Production figures represent thousands of net tons]

Month	1933	1934	1935	1936	1937	1938	1939	1940
January	3,818	6,102	5,790	5,315	4,236	4,978	5,019	5,783
February	4,287	5,930	4,652	6,952	3,671	3,646	4,169	3,648
March	4,532	6,394	3,228	3,051	4,795	4,257	3,652	3,881
April	2,899	4,819	4,763	4,757	6,779	3,149	5,367	3,853
May	2,975	5,230	5,118	5,104	4,361	4,400	5,141	4,070
June	3,939	4,168	5,724	4,292	4,635	4,450	3,577	4,492
July	3,688	3,430	3,502	3,912	2,748	2,580	2,951	4,534
August	4,409	3,570	3,073	3,492	2,903	2,735	3,883	3,883
September	5,007	3,962	4,113	3,861	3,682	3,388	4,840	4,172
October	4,725	4,711	4,132	4,593	4,848	4,180	4,985	4,355
November	4,825	4,165	3,432	4,320	4,439	3,803	3,989	3,980
December	4,437	4,687	4,632	4,931	4,759	4,533	3,914	4,834
	49,541	57,168	52,159	54,580	51,856	46,099	51,487	51,485

[1] Production is estimated from weekly carloadings as reported by the Association of American Railroads and includes mine fuel, coal sold locally, and dredge coal. Does not include an unknown amount of "bootleg" production. Monthly statistics from 1905 to 1925 will be found in Mineral Resources, 1925, pt. II, pp. 427–428, and from 1925 to 1930 in Mineral Resources, 1930, pt. II, p. 741.

Small mines and intercompany sales.—All known legitimate operations are included in the statistics. In recent years, conditions have favored the development of numerous small mines operating on lease or subcontract and producing run-of-mine coal, which is sold to larger companies for preparation at a breaker. At the same time, there has developed an increasing transfer of coal from one operation to another, and some of the companies have built central breakers to which coal from numerous mines is shipped by rail or truck for preparation. These tendencies have increased the complexity of the task of collecting and compiling statistics of the industry, but great care has been exercised to avoid double counting of tonnages produced by one operator and prepared for market by another, and the figures herein represent the net quantity of merchantable coal plus the fuel used by the collieries themselves. The employees of operators producing run-of-mine only have been included in the employment statistics, as they have received wages from the industry and have contributed to the final product.

Regions, fields, and counties.—The anthracite fields are divided into three trade regions— Lehigh, Schuylkill, and Wyoming. This classification is generally used by the trade, and it is also followed in the district organization of the United Mine Workers of America, in which District 1 corresponds to the Wyoming region, District 7 to the Lehigh region, and District 9 to the Schuylkill region. Geologically the anthracite area is classified by fields—the Northern, Eastern Middle, Western Middle, and Southern. This classification is used in technical operating studies because it follows more closely the geologic conditions that largely influence the methods and cost of mining. The Northern field is the same as the Wyoming region. The Lehigh field and that part of the Southern field lying east of Tamaqua (known as the Panther Creek Valley) make up the Lehigh region. The Schuylkill region comprises that part of the Southern field lying west of Tamaqua and the Western Middle field. For historical comparison, the tonnage of the small Bernice Basin is often included with the statistics of the Northern field, although the coal is classified officially as semianthracite. The total area of the four fields is about 484 square miles—the Northern covers 176 square miles, the Eastern Middle 33, the Western Middle 94, and the Southern 181.

TABLE 10.—*Pennsylvania anthracite shipped, sold locally, and used as colliery fuel in 1940, by regions*

Region	Shipments		Local sales		Colliery fuel		Total	
	Net tons	Value [1]	Net tons	Value	Net tons	Value	Net tons	Value [1]
Lehigh:								
Breakers [2]	7,546,242	$31,540,000	309,428	$1,474,000	377,009	$691,000	8,232,679	$33,705,000
Dredges	50,860	58,000					50,860	58,000
Total Lehigh	7,597,102	31,598,000	309,428	1,474,000	377,009	691,000	8,283,539	33,763,000
Schuykill:								
Breakers	12,781,630	50,970,000	567,329	1,607,000	306,559	472,000	13,655,518	53,049,000
Washeries	1,502,834	2,959,000	16,414	57,000	27,455	41,000	1,546,703	3,057,000
Dredges	561,884	620,000	323,863	411,000	3,837	4,000	889,584	1,035,000
Total Schuykill	14,846,348	54,549,000	907,606	2,075,000	337,851	517,000	16,091,805	57,141,000
Wyoming:								
Breakers	23,443,576	104,427,000	1,701,043	7,384,000	1,426,764	1,565,000	26,571,383	113,376,000
Washeries	259,108	687,000	112,834	328,000	112,627	69,000	484,569	1,084,000
Dredges	1,140	2,000	1,360	2,000			2,500	4,000
Total Wyoming	23,703,824	105,116,000	1,815,237	7,714,000	1,539,391	1,634,000	27,058,452	114,464,000
Total, excluding Sullivan County:								
Breakers [2]	43,771,448	186,937,000	2,577,800	10,465,000	2,110,332	2,728,000	48,459,580	200,130,000
Washeries [2]	1,761,942	3,646,000	129,248	385,000	140,082	110,000	2,031,272	4,141,000
Dredges	613,884	680,000	325,223	413,000	3,837	4,000	942,944	1,097,000
Total	46,147,274	191,263,000	3,032,271	11,263,000	2,254,251	2,842,000	51,433,796	205,368,000
Sullivan County: [3] Breakers	28,679	69,000	20,355	51,000	1,810	2,000	50,844	122,000
Grand total: 1940	46,175,953	191,332,000	3,052,626	11,314,000	2,256,061	2,844,000	51,484,640	205,490,000
1939	45,992,282	172,445,000	3,081,073	11,726,000	2,414,022	3,004,000	51,487,377	187,175,000
Change, 1940 ... percent	+0.4	+11.0	−0.9	−3.5	−6.5	−5.3	(4)	+9.8

1 Value given is value at which coal left possession of producing company and does not include margins of separately incorporated sales companies.
2 Small quantity of washery coal included with breaker.
3 For purposes of historical comparison and statistical convenience, the mines of Sullivan County are grouped with the Pennsylvania anthracite region, although the product is classified as semianthracite according to the American Society for Testing Materials Tentative Standard.
4 Less than 0.1 percent.

Based upon minable reserves, the Southern field is first, followed by the Western Middle, Northern, and Eastern Middle.

Tables 10–12 present production data by regions, fields, and counties.

TABLE 11.—*Pennsylvania anthracite produced, by fields, 1936–40, in net tons*

[The figures of breaker product include a certain quantity of culm-bank coal, which amounted to 763,648 tons in 1940. Data for 1913–25 will be found in Mineral Resources, 1925, pt. II, p. 517, and for 1919–30 in Mineral Resources 1930, pt. II, p. 747]

Field	1936	1937	1938	1939	1940
Eastern Middle: Breakers	6,102,979	6,045,813	5,217,169	[1] 5,444,335	[1] 5,104,708
Western Middle:					
Breakers	11,469,078	10,381,521	8,877,485	9,242,223	10,168,142
Washeries	1,510,913	1,456,505	940,938	906,992	734,541
Dredges	221,800	264,588	223,961	253,819	447,760
Total Western Middle	13,201,791	12,102,614	10,042,384	10,403,034	11,350,443
Southern:					
Breakers	6,439,213	5,849,381	5,447,804	6,196,051	6,615,347
Washeries	438,465	218,541	625,335	855,659	812,162
Dredges	303,984	468,386	317,572	432,974	492,684
Total Southern	7,181,662	6,536,308	6,390,711	7,484,684	7,920,193
Northern:					
Breakers	27,448,035	26,707,743	24,059,598	27,806,467	26,571,383
Washeries	405,615	347,959	310,491	295,103	484,569
Dredges	20,900	27,500	29,491	17,067	2,500
Total Northern	27,874,550	27,083,202	24,399,580	28,118,637	27,058,452
Total, excluding Sullivan County:					
Breakers	51,459,305	48,984,458	43,602,056	[1] 48,689,076	[1] 48,459,580
Washeries	2,354,993	2,023,005	1,876,764	[1] 2,057,754	[1] 2,031,272
Dredges	546,684	760,474	571,024	703,860	942,944
	54,360,982	51,767,937	46,049,844	51,450,690	51,433,796
Sullivan County: Breakers	218,553	88,496	49,183	36,687	50,844
Grand total	54,579,535	51,856,433	46,099,027	51,487,377	51,484,640

[1] Small amount of washery coal included with breaker.

TABLE 12.—*Pennsylvania anthracite produced in 1940, by counties*

County	Shipments		Local sales		Colliery fuel		Total	
	Net tons	Value [1]	Net tons	Value	Net tons	Value	Net tons	Value [1]
Carbon	2,326,157	$9,422,000	82,614	$400,000	105,142	$181,000	2,513,913	$10,003,000
Columbia	256,587	1,109,000	42,551	75,000	6,674	11,000	305,812	1,195,000
Dauphin and Lebanon	432,261	1,843,000	277,523	401,000	7,565	11,000	717,349	2,255,000
Lackawanna	7,465,421	32,473,000	663,164	2,916,000	538,334	677,000	8,666,919	36,066,000
Luzerne	19,612,282	87,416,000	1,329,900	5,652,000	1,215,217	1,357,000	22,157,399	94,425,000
Northumberland	4,872,738	17,866,000	247,740	509,000	78,968	118,000	5,199,446	18,493,000
Schuylkill	10,974,639	40,508,000	357,733	1,228,000	286,973	480,000	11,619,345	42,216,000
Sullivan	28,679	69,000	20,355	51,000	1,810	2,000	50,844	122,000
Susquehanna and Wayne	128,242	535,000	11,222	60,000	15,378	8,000	154,842	603,000
Berks, Northampton, and York [2]	78,947	90,000	19,824	22,000			98,771	112,000
	46,175,953	191,331,000	3,052,626	11,314,000	2,256,061	2,845,000	51,484,640	205,490,000

[1] Value given for shipments is value at which coal left possession of producing company; does not include margins of separately incorporated sales companies.

[2] Counties producing dredge coal only.

Culm-bank coal.—The culm banks in the anthracite region have been a source of coal for many years. In the early days of anthracite mining, the smaller sizes of anthracite, especially Pea and smaller, were not used as they are today, and these sizes and larger pieces of refuse containing much good coal were piled in large banks throughout the region. In recent years, with the increased demand for the smaller sizes and more efficient preparation methods, the product of these banks is run through the washery or breaker, and a prepared coal is obtained.

In 1939, this source supplied 2,583,814 net tons of coal. Prepared coal from culm banks in 1940 amounted to 2,783,038 tons. Tables 13 and 14 give a detailed break-down of culm-bank product by regions and fields.

Dredge coal.—Dredging anthracite from the stream beds is an important industry to many operators along the banks of the rivers and creeks that drain the region. From 1915 to 1940, inclusive, 16,946,557 net tons of anthracite, with a reported value of $16,455,313, have been produced in this manner. The industry reached a peak in 1925, when 1,015,708 net tons of anthracite with a value of $929,292 were taken from the river and creek bottoms. In 1940, this source supplied 942,944 net tons of anthracite valued at $1,096,926.

TABLE 13.—*Pennsylvania anthracite produced in 1940, classified as fresh-mined, culm-bank, and river coal and as breaker, washery, and dredge product, by regions, in net tons*

[Exclusive of change in stock]

Region and type of plant	From mines			From culm banks	From river dredging	Total
	Underground		Strip pits			
	Mechanically loaded	Hand-loaded				
Lehigh:						
Breakers [1]	867,762	5,110,714	2,057,690	192,878		8,229,044
Dredges					50,860	50,860
Total Lehigh	867,762	5,110,714	2,057,690	192,878	50,860	8,279,904
Schuylkill:						
Breakers	1,634,555	8,188,780	3,306,235	558,044		13,687,614
Washeries				1,551,513		1,551,513
Dredges					889,584	889,584
Total Schuylkill	1,634,555	8,188,780	3,306,235	2,109,557	889,584	16,128,711
Wyoming:						
Breakers	9,823,683	15,840,499	982,127	12,726		26,659,035
Washeries			6,648	467,877		474,525
Dredges					2,500	2,500
Total Wyoming	9,823,683	15,840,499	988,775	480,603	2,500	27,136,060
Total, excluding Sullivan County:						
Breakers [1]	12,326,000	29,139,993	6,346,052	763,648		48,575,693
Washeries			6,648	2,019,390		2,026,038
Dredges					942,944	942,944
Total	12,326,000	29,139,993	6,352,700	2,783,038	942,944	51,544,675
Sullivan County: Breakers		50,844				50,844
Grand total: 1940	12,326,000	29,190,837	6,352,700	2,783,038	942,944	51,595,519
1939	11,773,833	30,797,715	5,486,479	2,583,814	703,860	51,345,701
Change, 1940 percent	+4.7	−5.2	+15.8	+7.7	+34.0	+.5

[1] Includes a small amount of washery coal.

Reconciliation of fresh-mined, culm-bank, and breaker product.—Anthracite is now produced from three sources—from mines, from old culm banks, and from the rivers that drain the anthracite region. As all three sources contribute to the country's supply, it is important to consider them all to ascertain the total production. No difficulty is experienced in separating the figures of production by dredges, as this is a distinct industry. It is difficult, however, to differentiate sharply between fresh-mined and culm-bank coal that can be maintained throughout the statistics of the industry.

As the best solution of this problem, the individual breaker, washery, or dredge is taken as the unit in compiling the statistics, and the producing companies are asked to supply separate statements for each. These are totaled to form the primary tables of this report to show the total quantity of breaker product, washery product, and dredge product, with related figures of value and number of employees.

The figures for breaker and washery product, however, are not exactly equivalent to the fresh-mined and culm-back coal because of the practice, sometimes adopted, of putting culm-bank coal through a breaker, either directly from the bank or after preliminary treatment in a washery. The tonnage of culm-bank coal prepared at the breakers is broken down by fields and shown in table 15.

TABLE 14.—*Pennsylvania anthracite produced in 1940, classified as fresh-mined, culm-bank, and river coal and as breaker, washery, and dredge product, by fields, in net tons*

[Exclusive of change in stock]

Field and type of plant	From mines			From culm banks	From river dredging	Total
	Underground		Strip pits			
	Mechanically loaded	Hand-loaded				
Eastern Middle: Breakers [1]	867,762	2,785,901	1,307,969	139,441		5,101,073
Western Middle:						
Breakers	1,592,302	6,179,417	2,175,325	250,065		10,197,109
Washeries				734,541		734,541
Dredges					447,760	447,760
Total Western Middle	1,592,302	6,179,417	2,175,325	984,606	447,760	11,379,410
Southern:						
Breakers	42,253	4,334,176	1,880,631	361,416		6,618,476
Washeries				816,972		816,972
Dredges					492,684	492,684
Total Southern	42,253	4,334,176	1,880,631	1,178,388	492,684	7,928,132
Northern:						
Breakers	9,823,683	15,840,499	982,127	12,726		26,659,035
Washeries			6,648	467,877		474,525
Dredges					2,500	2,500
Total Northern	9,823,683	15,840,499	988,775	480,603	2,500	27,136,060
Total, excluding Sullivan County:						
Breakers [1]	12,326,000	29,139,993	6,346,052	763,648		48,575,693
Washeries			6,648	2,019,390		2,026,038
Dredges					942,944	942,944
Total	12,326,000	29,139,993	6,352,700	2,783,038	942,944	51,544,675
Sullivan County: Breakers		50,844				50,844
Grand total	12,326,000	29,190,837	6,352,700	2,783,038	942,944	51,595,519

[1] Includes a small quantity of washery coal.

TABLE 15.—*Culm-bank coal put through breakers, 1936–40, by fields, in net tons*

Year	Northern	Eastern Middle	Western Middle	Southern	Total [1]
1936	122,000	84,000	148,000	633,000	987,000
1937	95,000	67,000	102,000	606,000	870,000
1938	52,000	11,000	44,000	455,000	562,000
1939	70,000	17,000	204,000	295,000	586,000
1940	13,000	[2] 139,000	250,000	362,000	764,000

[1] No culm-bank coal is put through breakers in Sullivan County.
[2] Includes some washery coal.

Interregional variation in sizes.—Geologic conditions affect the percentages of domestic and steam sizes produced and consequently the value of the product as a whole. In the Wyoming and Lehigh regions, the percentage yield of the higher-priced domestic sizes is relatively high; in the Schuylkill region, it is less because of the crushing of the coal by faulting and folding of the beds. In 1940, the breaker output of the Wyoming region comprised 70.4 percent domestic sizes and 29.6 percent steam sizes; the Lehigh region—63.8 percent domestic and 36.2 percent steam sizes; the Schuylkill region—58.5 percent domestic and 41.5 percent steam sizes. Table 16 shows shipments of anthracite by regions and sizes. Table 17 shows by regions the percentages of various sizes in relation to total breaker product.

TABLE 16.—*Pennsylvania anthracite shipped in 1940, by regions and sizes* [1]

Size	Breaker shipments [2]						Washery shipments	Dredge shipments	Grand total
	Lehigh region	Schuylkill region	Wyoming region	Sullivan County	Total: Excluding Sullivan County	Total: Including Sullivan County			
Net tons									
Lump [3] and Broken	34, 652	51, 695	41, 619		127, 966	127, 966			127, 966
Egg	279, 833	498, 873	1, 183, 806		1, 962, 512	1, 962, 512	1, 442		1, 963, 954
Stove	1, 739, 003	2, 435, 574	6, 331, 455	3, 940	10, 506, 032	10, 509, 972	27, 828		10, 537, 800
Chestnut	1, 857, 598	2, 980, 825	6, 475, 141	5, 366	11, 313, 564	11, 318, 930	177, 125		11, 496, 055
Pea	864, 844	1, 505, 441	2, 480, 454	3, 614	4, 850, 739	4, 854, 353	96, 445		4, 950, 798
Total domestic sizes	4, 775, 930	7, 472, 408	16, 512, 475	12, 920	28, 760, 813	28, 773, 733	302, 840		29, 076, 573
Buckwheat No. 1	1, 176, 840	2, 069, 298	3, 192, 220	2, 786	6, 438, 358	6, 441, 144	288, 740	41, 503	6, 771, 387
Buckwheat No. 2 (Rice) [4]	633, 264	1, 190, 937	1, 611, 822	4, 535	3, 436, 023	3, 440, 558	316, 563	60, 403	3, 817, 524
Buckwheat No. 3 (Barley)	644, 932	1, 456, 997	1, 779, 462		3, 881, 391	3, 881, 391	457, 521	182, 345	4, 521, 257
Buckwheat No. 4	315, 276	591, 990	347, 597	8, 438	1, 254, 863	1, 263, 301	396, 278	329, 633	1, 989, 212
Boiler [5]									
Other [5]									
Total steam sizes	2, 770, 312	5, 309, 222	6, 931, 101	15, 759	15, 010, 635	15, 026, 394	1, 459, 102	613, 884	17, 099, 380
Grand total	7, 546, 242	12, 781, 630	23, 443, 576	28, 679	43, 771, 448	43, 800, 127	1, 761, 942	613, 884	46, 175, 953
Value									
Lump [3] and Broken	$184, 000	$301, 000	$217, 000		$702, 000	$702, 000			$702, 000
Egg	1, 475, 000	2, 686, 000	6, 279, 000		10, 440, 000	10, 440, 000	$6, 000		10, 446, 000
Stove	9, 473, 000	13, 402, 000	34, 580, 000	$17, 000	57, 455, 000	57, 472, 000	124, 000		57, 596, 000
Chestnut	10, 244, 000	16, 264, 000	35, 598, 000	23, 000	62, 106, 000	62, 129, 000	735, 000		62, 864, 000
Pea	3, 590, 000	6, 160, 000	10, 291, 000	12, 000	20, 041, 000	20, 053, 000	337, 000		20, 390, 000
Total domestic	24, 966, 000	38, 813, 000	86, 965, 000	52, 000	150, 744, 000	150, 796, 000	1, 202, 000		151, 998, 000
Buckwheat No. 1	3, 719, 000	6, 539, 000	10, 189, 000	7, 000	20, 447, 000	20, 454, 000	840, 000	$121, 000	21, 415, 000
Buckwheat No. 2 (Rice) [4]	1, 472, 000	2, 751, 000	3, 848, 000	5, 000	8, 071, 000	8, 076, 000	627, 000	107, 000	8, 810, 000
Buckwheat No. 3 (Barley)	1, 094, 000	2, 312, 000	3, 115, 000		6, 521, 000	6, 521, 000	635, 000	192, 000	7, 348, 000
Buckwheat No. 4	289, 000	555, 000	310, 000	5, 000	1, 154, 000	1, 159, 000	342, 000	260, 000	1, 761, 000
Boiler [5]									
Other [5]									
Total steam	6, 574, 000	12, 157, 000	17, 462, 000	17, 000	36, 193, 000	36, 210, 000	2, 444, 000	680, 000	39, 334, 000

Grand total	31,540,000	50,970,000	104,427,000	69,000	186,937,000	187,006,000	3,646,000	680,000	191,332,000
Average value per ton									
Lump [3] and Broken	$5.31	$5.82	$5.21	----------	$5.49	$5.49	----------	----------	$5.49
Egg	5.27	5.38	5.30	----------	5.32	5.32	$4.16	----------	5.32
Stove	5.45	5.50	5.46	$4.31	5.47	5.47	4.46	----------	5.47
Chestnut	5.51	5.46	5.50	4.29	5.49	5.49	4.15	----------	5.47
Pea	4.15	4.09	4.15	3.32	4.13	4.13	3.49	----------	4.12
Total domestic	5.23	5.19	5.27	4.02	5.24	5.24	3.97	----------	5.23
Buckwheat No. 1	3.16	3.16	3.19	2.51	3.18	3.18	2.91	$2.92	3.16
Buckwheat No. 2 (Rice) [4]	2.32	2.31	2.39	1.10	2.35	2.35	1.98	1.77	2.31
Buckwheat No. 3 (Barley)	1.70	1.59	1.75	----------	1.68	1.68	1.39	1.05	1.63
Buckwheat No. 4	.92	.94	.89	.59	.92	.92	.86	.79	.89
Boiler [5]	----------	----------	----------	----------	----------	----------	----------	----------	----------
Other [5]	----------	----------	----------	----------	----------	----------	----------	----------	----------
Total steam	2.37	2.29	2.52	1.08	2.41	2.41	1.68	1.11	2.30
Grand total	4.18	3.99	4.45	2.41	4.27	4.27	2.07	1.11	4.14

[1] Figures of shipments from breakers include 763,648 tons of culm-bank coal handled in the breakers.
[2] Small amount of washery coal is included.
[3] Quantity of Lump included is insignificant.
[4] Includes Birdseye.
[5] Included in Buckwheat No. 4.

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TABLE 17.—*Sizes of Pennsylvania anthracite shipped from breakers, 1938–40, by regions, in percent of total*

[Note that shipments of dredge and washery coal are not included]

Size of coal	Percent of total shipments								
	Lehigh region			Schuylkill region			Wyoming region		
	1938	1939	1940	1938	1939	1940	1938	1939	1940
Lump [1] and Broken	0.4	0.5	0.5	0.4	0.4	0.4	0.2	0.7	0.2
Egg	4.5	4.0	3.8	4.2	3.9	3.9	6.3	6.2	5.0
Stove	23.0	23.1	23.3	19.3	19.0	19.1	26.2	26.8	27.0
Chestnut	24.7	24.9	24.7	23.6	23.9	23.3	27.6	27.1	27.6
Pea	12.0	11.8	11.5	11.0	11.6	11.8	10.0	10.5	10.6
Total domestic	64.6	64.3	63.8	58.5	58.8	58.5	70.3	71.3	70.4
Buckwheat No. 1	15.6	15.5	15.6	16.3	15.8	16.2	13.7	13.2	13.6
Buckwheat No. 2 (Rice) [2]	8.3	8.3	8.3	8.8	8.9	9.3	7.1	7.1	6.9
Buckwheat No. 3 (Barley)	8.5	8.4	8.4	10.7	11.7	11.4	7.5	7.0	7.6
Boiler	------	------	------	------	------	------	------	------	------
Other, including Buckwheat No. 4	3.0	3.5	3.9	5.7	4.8	4.6	1.4	1.4	1.5
Total steam [3]	35.4	35.7	36.2	41.5	41.2	41.5	29.7	28.7	29.6

Size of coal	Sullivan County			Total					
				Excluding Sullivan County			Including Sullivan County		
Lump [1] and Broken	11.3	------	------	0.3	0.6	0.3	0.3	0.6	0.3
Egg	------	------	------	5.4	5.2	4.5	5.4	5.2	4.5
Stove	10.8	14.1	13.8	23.7	24.1	24.1	23.7	24.1	24.1
Chestnut	26.4	19.3	18.7	26.0	25.8	25.9	26.0	25.8	25.9
Pea	16.6	13.5	12.6	10.6	11.0	11.1	10.6	11.0	11.1
Total domestic	65.1	46.9	45.1	66.0	66.7	65.9	66.0	66.7	65.9
Buckwheat No. 1	10.6	9.1	9.7	14.8	14.3	14.7	14.8	14.3	14.7
Buckwheat No. 2 (Rice) [2]	14.7	14.8	15.8	7.7	7.8	7.8	7.7	7.8	7.8
Buckwheat No. 3 (Barley)	------	------	------	8.6	8.5	8.8	8.6	8.5	8.8
Boiler	------	------	------	------	------	------	------	------	------
Other, including Buckwheat No. 4	9.6	29.2	29.4	2.9	2.7	2.8	2.9	2.7	2.8
Total steam [3]	34.9	53.1	54.9	34.0	33.3	34.1	34.0	33.3	34.1

[1] Quantity of Lump included is insignificant.
[2] Includes Birdseye.
[3] Includes all steam sizes.

Anthracite sizing specifications.—Table 18 gives the new sizing specifications for the anthracite industry, adopted by the Anthracite Emergency Committee January 8, 1941, which became effective April 1, 1941. These specifications replace those adopted by the Anthracite Institute in 1931. The test mesh is round.

TABLE 18.—*Standard anthracite sizing specifications approved and adopted by the Anthracite Emergency Committee*

	Test mesh, inches	Percent				
		Oversize maximum	Undersize		Maximum impurities	
			Maximum	Minimum	Slate [1]	Bone
Broken	Through 4 3/8				1 1/2	2
	Over 3 1/4		15	7 1/2		
Egg	Through 3 1/4	5			1 1/2	2
	Over 2 7/16		15	7 1/2		
Stove	Through 2 7/16	7 1/2			2	3
	Over 1 5/8		12 1/2	7 1/2		
Nut	Through 1 5/8	7 1/2			3	4
	Over 13/16		10	5		
Pea	Through 13/16	10			4	5
	Over 9/16		15	7 1/2		
Buck	Through 9/16	10			Ash, 12	
	Over 5/16		15	7 1/2		
Rice	Through 5/16	10			Ash, 13	
	Over 3/16		15	7 1/2		
Barley	Through 3/16	10				
	Over 3/32		20	10		

[1] When slate content on Broken to Pea, inclusive, is less than the above standards, bone content may be correspondingly increased, but slate content specified above shall not be exceeded in any event and the total maximum impurities shall not exceed those above specified.

AVERAGE SALES REALIZATION

The valuation figures in this study represent value at the breaker or washery reported by the operating companies. The company is requested to "estimate value of the product not sold" and to "exclude selling expenses" in making its report.

From this it will be seen that when a producing concern sells its output to a separately organized sales company, the value reported will exclude the margin of the sales company and may therefore be somewhat less than the circular price at which the coal is placed on the general market. This fact should be borne in mind in considering the variations in value among different regions, shown in the tables, for the same sizes of coal.

The average sales realization per net ton on breaker shipments was $4.27 in 1940 compared with $3.85 in 1939—an 11-percent increase (see table 19).

If local sales, colliery fuel, and washery and dredge coal are included, the average value per net ton of the total 1940 production was $3.99 compared with $3.64 in 1939 (see table 20).

TABLE 19.—*Average sales realization per net ton on Pennsylvania anthracite shipments from breakers, 1938–40, by regions and sizes*

[Value does not include margins of separately incorporated sales companies]

Size	Lehigh region			Schuylkill region			Wyoming region		
	1938	1939	1940	1938	1939	1940	1938	1939	1940
Lump [1] and Broken	$5.17	$4.92	$5.31	$5.50	$5.26	$5.82	$5.16	$4.38	$5.21
Egg	5.11	4.73	5.27	5.27	4.95	5.38	5.16	4.67	5.30
Stove	5.36	4.87	5.45	5.39	4.98	5.50	5.31	4.79	5.46
Chestnut	5.43	4.95	5.51	5.41	4.98	5.46	5.32	4.79	5.50
Pea	3.93	3.73	4.15	3.80	3.69	4.09	3.91	3.60	4.15
Total domestic	5.10	4.69	5.23	5.09	4.73	5.19	5.10	4.60	5.27
Buckwheat No. 1	3.06	2.93	3.16	2.93	2.84	3.16	3.08	2.92	3.19
Buckwheat No. 2 (Rice) [2]	2.36	2.17	2.32	2.27	2.21	2.31	2.39	2.21	2.39
Buckwheat No. 3 (Barley)	1.61	1.65	1.70	1.50	1.51	1.59	1.69	1.70	1.75
Total steam [3]	2.35	2.25	2.37	2.13	2.10	2.29	2.47	2.35	2.52
Total all sizes	4.13	3.81	4.18	3.86	3.64	3.99	4.32	3.95	4.45

Size	Sullivan County			Total: Excluding Sullivan County			Total: Including Sullivan County		
Lump [1] and Broken	$3.00			$5.28	$4.63	$5.49	$5.24	$4.63	$5.49
Egg				5.18	4.73	5.32	5.18	4.73	5.32
Stove	3.00	$4.03	$4.31	5.33	4.84	5.47	5.33	4.84	5.47
Chestnut	3.00	4.40	4.29	5.36	4.87	5.49	5.36	4.87	5.49
Pea	2.52	3.15	3.32	3.88	3.65	4.13	3.88	3.65	4.13
Total domestic	2.88	3.93	4.02	5.10	4.64	5.24	5.10	4.64	5.24
Buckwheat No. 1	1.50	3.13	2.51	3.03	2.90	3.18	3.03	2.90	3.18
Buckwheat No. 2 (Rice) [2]	.50	.96	1.10	2.35	2.20	2.35	2.35	2.20	2.35
Buckwheat No. 3 (Barley)				1.61	1.62	1.68	1.61	1.62	1.68
Total steam [3]	.73	1.07	1.08	2.33	2.25	2.41	2.33	2.25	2.41
Total all sizes	2.13	2.41	2.41	4.16	3.85	4.27	4.16	3.85	4.27

[1] The quantity of lump included is insignificant.
[2] Includes Birdseye.
[3] Includes all steam sizes.

TABLE 20.—*Average value per net ton of Pennsylvania anthracite shipped, local sales, colliery fuel, and total production, 1939–40, by regions* [1]

[Note that values in this table include washery and dredge coal]

Region	1939				1940			
	Shipments	Local sales	Colliery fuel	Total production	Shipments	Local sales	Colliery fuel	Total production
Lehigh	$3.80	$4.43	$1.74	$3.73	$4.16	$4.76	$1.83	$4.08
Schuylkill	3.36	2.69	1.50	3.29	3.67	2.29	1.53	3.55
Wyoming	3.95	4.10	1.08	3.79	4.43	4.25	1.06	4.23
Total, excluding Sullivan County	3.75	3.81	1.24	3.64	4.14	3.71	1.26	3.99
Sullivan County	2.41	2.84	1.04	2.62	2.41	2.51	1.10	2.40
Grand total	3.75	3.81	1.24	3.64	4.14	3.71	1.26	3.99

[1] Value given for shipments is value at which coal left possession of producing company and does not include margins of separately incorporated sales companies.

LABOR STATISTICS

The average number of men employed in the Pennsylvania anthracite industry in 1940 was 91,313—a decrease of 1,825 from the 93,138 employees in 1939 (see tables 21 and 22). The number employed is based upon reports direct from the operators and includes the workers from strip and dredge operations.

Although there were no major labor distrubances in either 1940 or 1939, the number of man-days lost because of strikes amounted to 241,688 and 176,432, and the average days lost per man employed in the industry was 2.6 and 1.9 in these years, respectively (see table 23).

According to the Bureau of Labor Statistics, average weekly earnings ranged from a low of $21.48 in October to a high of $33.46 in January and averaged $24.95 compared with $25.52 in 1939. The index of employment (1929 average=100) fluctuated between 49.4 percent in October and 52.2 percent in March and for the year as a whole averaged 0.2 percent above 1939. The index of pay rolls reached a low of 32.3 in October and a high of 52.5 in January and averaged 2.5 percent below 1939.

TABLE 21.—*Men Employed and Days Worked at Operations Producing Pennsylvania Anthracite, 1939–40*

[Includes operations of strip contractors]

Region	Average number of men employed								Average number of days plant operated	Man-days of labor	Average tons per man per day
	Underground			Surface				Grand total			
	Miners and their laborers	Other	Total underground	In strip pits	In preparation plant	Other	Total surface				
1939											
Lehigh:											
Breaker [1]	6,560	4,237	10,797	1,693	1,336	2,719	5,748	16,545	175	2,901,194	2.99
Dredge	------	------	------	------	8	15	23	23	155	3,563	17.44
Total Lehigh	6,560	4,237	10,797	1,693	1,344	2,734	5,771	16,568	175	2,904,757	3.01
Schuylkill:											
Breaker	9,583	5,653	15,236	1,522	1,776	3,284	6,582	21,818	186	4,053,025	3.01
Washery	------	------	------	31	220	734	985	985	138	135,965	[2] 12.96
Dredge	------	------	------	------	109	142	251	251	179	44,814	13.94
Total Schuylkill	9,583	5,653	15,236	1,553	2,105	4,160	7,818	23,054	184	4,233,804	3.45
Wyoming:											
Breaker	29,802	13,949	43,751	670	2,477	6,122	9,269	53,020	186	9,856,207	2.82
Washery	------	------	------	8	7	248	263	263	77	20,236	[2] 14.58
Dredge	------	------	------	------	21	4	25	25	154	3,850	4.43
Total Wyoming	29,802	13,949	43,751	678	2,505	6,374	9,557	53,308	185	9,880,293	2.85
Total, excluding Sullivan County:											
Breaker [1]	45,945	23,839	69,784	3,885	5,589	12,125	21,599	91,383	184	16,810,426	2.90
Washery	------	------	------	39	227	982	1,248	1,248	125	156,201	[2] 13.17
Dredge	------	------	------	------	138	161	299	299	175	52,227	13.48
Total	45,945	23,839	69,784	3,924	5,954	13,268	23,146	92,930	183	17,018,854	3.02
Sullivan County: Breaker	135	33	168	------	21	19	40	208	94	19,506	1.88
Grand total	46,080	23,872	69,952	3,924	5,975	13,287	23,186	93,138	183	17,038,360	3.02
1940											
Lehigh:											
Breaker [1]	6,481	3,589	10,070	1,369	1,059	2,604	5,032	15,102	183	2,766,234	2.98
Dredge	------	------	------	------	5	11	16	16	171	2,741	18.56
Total Lehigh	6,481	3,589	10,070	1,369	1,064	2,615	5,048	15,118	183	2,768,975	2.99
Schuylkill:											
Breaker	9,185	5,481	14,666	1,971	1,688	3,031	6,690	21,356	193	4,130,234	3.31
Washery	------	------	------	------	151	595	746	746	175	130,240	[2] 11.88
Dredge	------	------	------	------	141	169	310	310	230	71,235	12.49
Total Schuylkill	9,185	5,481	14,666	1,971	1,980	3,795	7,746	22,412	193	4,331,709	3.71
Wyoming:											
Breaker	29,683	14,068	43,751	770	2,545	6,272	9,587	53,338	185	9,857,730	2.70
Washery	------	------	------	4	50	201	255	255	178	45,328	[2] 10.69
Dredge	------	------	------	------	7	1	8	8	105	840	2.98
Total Wyoming	29,683	14,068	43,751	774	2,602	6,474	9,850	53,601	185	9,903,898	2.73
Total, excluding Sullivan County:											
Breaker [1]	45,349	23,138	68,487	4,110	5,292	11,907	21,309	89,796	187	16,754,198	2.89
Washery	------	------	------	4	201	796	1,001	1,001	175	175,568	[2] 11.57
Dredge	------	------	------	------	153	181	334	334	224	74,816	12.60
Total	45,349	23,138	68,487	4,114	5,646	12,884	22,644	91,131	187	17,004,582	3.02
Sullivan County: Breaker	106	26	132	------	16	34	50	182	131	23,889	2.13
Grand total	45,455	23,164	68,619	4,114	5,662	12,918	22,694	91,313	186	17,028,471	3.02

[1] Includes a small number of washery employees.
[2] Represents washeries for which both production and employment were separately reported.

TABLE 22.—*Men employed at operations producing Pennsylvania anthracite in 1939–40, by counties*

[Includes operations of strip contractors]

County	Men 1939	Men 1940	County	Men 1939	Men 1940
Carbon	4,177	4,906	Schuylkill	18,246	16,308
Columbia	444	500	Sullivan	208	182
Dauphin and Lebanon	1,032	1,045	Susquehanna and Wayne	383	302
Lackawanna	16,852	17,381	Berks, Northampton, and York [1]	51	47
Luzerne	43,992	43,086			
Northumberland	7,753	7,556		93,138	91,313

TABLE 23.—*Strikes, suspensions, and lock-outs in the Pennsylvania anthracite region, 1939–40*

	Lehigh	Schuylkill	Wyoming	Total, excluding Sullivan County	Sullivan County	Grand total
1939						
Total number employed	16,568	23,054	53,308	92,930	208	93,138
Men on strike	8,612	10,990	8,193	27,795		27,795
Man-days lost on account of strike	43,057	148,000	50,631	241,688		241,688
Average days lost:						
Per man employed	2.6	6.4	0.9	2.6		2.6
Per man on strike	5.0	13.5	6.2	8.7		8.7
1940						
Total number employed	15,118	22,412	53,601	91,131	182	91,313
Men on strike	4,011	6,665	8,788	19,464		19,464
Man-days lost on account of strike	80,654	60,878	34,900	176,432		176,432
Average days lost:						
Per man employed	5.3	2.7	0.7	1.9		1.9
Per man on strike	20.1	9.1	4.0	9.1		9.1

EQUIPMENT AND METHODS OF MINING

Mechanical loading.—The percentage of total deep-mined production of anthracite loaded mechanically continued to increase. In 1940, the 12,326,000 tons so loaded comprised 29.7 percent of the total underground output compared with 27.7 percent (11,773,883 tons) in 1939 and 26.6 percent (10,151,669 tons) in 1938 (see tables 24–26). The total tonnage loaded mechanically underground increased 5 percent from 1939 to 1940; hand-loading declined 5 percent.

Mechanical loading has increased more rapidly in the Northern field than in the other three anthracite-producing districts. The reason for this is that the coal measures in the Northern field are flatter than those in the Lehigh and Schuylkill regions. In 1940, the tonnage loaded mechanically in the Northern field was nearly four times that so loaded in the Western Middle, Eastern Middle, and Southern fields combined.

TABLE 24.—*Relative growth of mechanical loading, hand loading, and stripping in Pennsylvania anthracite mines, 1936–40*

[Mechanical loading includes coal handled on pit-car loaders and hand-loaded face conveyors]

Year	Net tons			Index numbers: 1927=100		
	Mechanical loading underground	Stripping	Hand loading	Mechanical loading underground	Stripping	Hand loading
1936	10,828,000	6,203,000	33,899,000	487	288	47
1937	10,684,000	5,696,000	31,883,000	481	265	45
1938	10,152,000	5,095,000	27,990,000	457	237	39
1939	11,774,000	5,486,000	30,798,000	530	255	43
1940	12,326,000	6,353,000	29,191,000	554	295	41

TABLE 25.—*Pennsylvania anthracite loaded mechanically underground, 1936–40*

Year	Scrapers		Conveyors and pit-car loaders [1]		Total loaded mechanically	
	Number of units	Net tons loaded	Number of units	Net tons handled	Number of units	Net tons handled
1936	[2] 504	[2] 2,966,407	1,790	7,861,539	2,294	10,827,946
1937	539	2,873,289	[2] 1,855	[2] 7,810,548	2,394	10,683,837
1938	545	2,589,954	[2] 1,831	[2] 7,561,715	2,376	10,151,669
1939	535	3,088,956	1,997	8,684,877	2,532	11,773,833
1940	547	2,983,792	2,189	9,342,208	2,736	12,326,000

[1] Includes duckbills and other self-loading conveyors, which account for only a small part of the total.
[2] Includes mobile loaders.

TABLE 26.—*Pennsylvania anthracite handled by mobile loaders and scrapers and by all types of conveyors in 1940 by fields, in net tons*

Field	Scraper loaders	Pit-car loaders	Hand-loaded face conveyors, all types [1]	Total mechanically loaded underground
Northern	2,422,861	62,037	7,338,785	9,823,683
Eastern Middle	174,366		693,396	867,762
Western Middle	374,965	25,845	1,191,492	1,592,302
Southern	11,600		30,653	42,253
	2,983,792	87,882	9,254,326	12,326,000

[1] Shaker chutes, etc., including those equipped with duckbills.

Cutting machines.—The number of cutting machines in use in 1940 was greater than in 1939, but a smaller tonnage was cut by machines (see table 27).

TABLE 27.—*Pennsylvania anthracite cut by machines, 1939–40*

Region	1939			1940		
	Cutting machines		Net tons cut by machines	Cutting machines		Net tons cut by machines
	Permissible	All other types		Permissible	All other types	
Lehigh						
Schuylkill }	145	80	1,881,884	185	65	1,816,483
Wyoming						
Total, excluding Sullivan County	145	80	1,881,884	185	65	1,816,483
Sullivan County						
Grand total	145	80	1,881,884	185	65	1,816,483

Strip-pit operations.—The quantity of coal mined by stripping increased from 5,486,479 tons in 1939 to 6,352,700 in 1940 (see table 28); this type of mining comprised 12 percent of the total 1940 production.

TABLE 28.—*Relative growth of Pennsylvania anthractie mined from strip pits, 1915, 1920, 1925, 1930, and 1938–40, in net tons*

Year	Number of power shovels in use[1]	Quantity mined by stripping		Percent of fresh-mined total that was stripped	Number of men employed	Average number of days worked
		Total	Average per shovel			
1915	57	1,121,603	19,677	(2)	(2)	(2)
1920	96	2,054,441	21,400	2.5	(2)	(2)
1925	97	1,578,478	16,273	2.7	(2)	(2)
1930	108	2,526,288	23,484	3.7	(2)	(2)
1938	331	5,095,341	15,394	11.8	3,642	186
1939	346	5,486,479	15,857	11.4	3,924	156
1940:						
Lehigh region	113	2,057,690	18,210	25.6	1,369	214
Schuylkill region	143	3,306,235	23,121	25.2	1,971	190
Wyoming region	92	988,775	10,748	3.7	774	146
Total, 1940[3]	348	6,352,700	18,255	13.3	4,114	190

[1] Certain equipment reported by stripping contractors may have been counted twice when moved from one small job to another during the year. The amount of such double counting is unknown but presumably is not great.
[2] Data not available. [3] There was no strip-pit mining in Sullivan County during 1940.

Dredge operations.—Both the tonnage and average value of anthracite produced by dredges increased in 1940 compared with 1939 (see tables 29 and 30).

TABLE 29.—*Pennsylvania anthracite produced by dredges, 1939–40, by rivers*

River (including tributaries)	1939			1940		
	Dredges	Net tons	Value	Dredges	Net tons	Value
Lehigh	3	62,134	$73,000	4	78,947	$90,000
Schuylkill	3	67,539	62,000			
Susquehanna	25	574,187	611,000	31	863,997	1,007,000
	31	703,860	746,000	35	942,944	1,097,000

TABLE 30.—*Average receipts per net ton on all dredge coal sold, 1935–40*

Year	Average receipts	Year	Average receipts
1935	$0.88	1938	$1.00
1936	1.06	1939	1.06
1937	1.11	1940	1.16

FOREIGN TRADE [1]

Anthracite imported into the United States in 1940 declined to 135,436 net tons, which was less than one-half the quantity imported in 1939 (tables 31 and 32). Pennsylvania anthracite exported from the United States increased slightly over 1939, and practically all of the exports were sent to Canada (tables 33 and 34).

TABLE 31.—*Anthracite imported for consumption in the United States, 1939–40, by countries, in net tons*

Country	1939	1940	Country	1939	1940
Canada	7,111	3,026	U. S. S. R.	212,444	
China	20		United Kingdom	66,784	132,410
Indochina (French)	11,794			298,153	135,436

TABLE 32.—*Anthracite imported for consumption in the United States, 1939–40, by customs districts, in net tons*

Customs district	1939	1940	Customs district	1939	1940
Connecticut	6,655	2,914	New York	20	
Dakota		16	Rhode Island	48,240	28,280
Maine and New Hampshire	21,354	3,026	Vermont	1	
Massachusetts	221,883	101,200		298,153	135,436

[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.

TABLE 33.—*Anthracite exported from the United States, 1939–40, by customs districts and ports of export, in net tons*

Customs district	1939	1940
North Atlantic:		
Maine and New Hampshire	703	487
Massachusetts	86	76
New York	44,846	28,741
Philadelphia	48,000	32,980
South Atlantic:		
Maryland		9,690
Virginia	353	53
Gulf coast:		
Florida	47	105
Mobile		804
New Orleans	371	354
Mexican border:		
Arizona	37	87
El Paso	33	38
Laredo	22	1
Pacific coast:		
Alaska	270	37
Los Angeles	2	
San Diego	20	17
San Francisco	11	
Northern border:		
Buffalo	1,564,952	1,546,032
Dakota	117	174
Duluth and Superior	4,556	3,916
Michigan		55
Ohio	14,501	8,863
Rochester	283,465	413,641
St. Lawrence	625,239	619,116
Vermont	2,369	2,365
	2,590,000	2,667,632

TABLE 34.—*Anthracite exported from the United States, 1939–40, by countries, in net tons*

Country	1939	1940
North America:		
Bermuda	1,541	42
Canada	2,577,157	2,626,692
Central America:		
British Honduras	259	
Guatemala	90	202
Honduras	1	110
Nicaragua	8	4
Panama		3
Mexico	150	143
Miquelon and St. Pierre Islands	62	
Newfoundland and Labrador	9,349	7,606
West Indies:		
British:		
Trinidad and Tobago		41
Other British	221	297
Cuba		295
Donimican Republic	242	22
North America—Continued.		
West Indies—Continued.		
Haiti	1	2
Netherlands (Curacao)	7	
Other North America		30
South America:		
Bolivia		118
Brazil	59	6,019
Colombia	2	33
Surinam		804
Venezuela		6
Other South America	2	29
Europe:		
Italy		9,370
Switzerland		15,011
United Kingdom	49	12
Asia:		
China		717
Netherlands Indies	778	
Other Asia	22	
Africa		24
	2,590,000	2,667,632

Canadian market.—Coal and lignite production in Canada in 1940 totaled 17,551,000 net tons (12-percent increase over 1939); it was about the same as output in 1927, 1928, and 1929 and nearly 2,500,000 tons greater than in the war year 1918. Coal available for consumption in Canada (production, plus imports, minus exports) totaled nearly 35,000,000 tons and closely approached the record of 1918; about half was imported, mainly from the United States, whereas in 1918 Canada imported about 21,000,000 tons of coal from the United States. Imports of bituminous coal from the United States in 1940 increased 36 percent over 1939. The quantity of anthracite imported was almost identical with the 1939 tonnage, and Pennsylvania anthracite retained its relative position in the market at about 60 percent of the total; Great Britain supplied the remainder. That country typically produces about 6,000,000 long tons of anthracite annually, of which two-thirds is exported; Canada and the United States together take roughly 1,000,000 tons, and practically all of the remainder is exported to Europe. With the loss of the European market, for the time being at least, British exporters may be expected to endeavor to increase their exports to Canada. British anthracite has always entered the Canadian market duty free; however, the duty on bituminous coal from Great Britain was removed late in 1940.

Details of the coal and coke industry and foreign trade of Canada in 1939 and 1940 are shown in table 35.

TABLE 35.—*Coal and coke industry and foreign trade of Canada, 1939–40* [1]

[Thousands of net tons]

	Anthracite		Bituminous and subbituminous		Lignite		Total coal		Coke from coal	
	1939	1940	1939	1940	1939	1940	1939	1940	1939	1940
Production			12,281	13,919	3,411	3,632	15,692	17,551	2,410	3,016
Imports:										
United States	2,606	2,644	9,836	13,382	3	3	12,445	16,029	434	709
Great Britain	1,035	1,321	68	196			1,103	1,517	2	9
Germany	294						294			
French Indochina	43						43			
Total imports	3,978	3,965	9,904	13,578	3	3	13,885	17,546	436	718
Exports			368	498	8	7	376	505	48	36
Available for consumption	3,978	3,965	21,817	26,999	3,406	3,628	29,201	34,592	2,798	3,698

[1] Quarterly Coal and Coke Statistics for Canada, October–December 1939 and October–December 1940 preliminary.

World anthracite production.—On account of unsettled conditions in many of the producing countries, detailed statistics on the output of anthracite in those countries are not available (see table 36).

TABLE 36.—*World production of anthracite, 1935–40, in metric tons*

[Compiled by L. P. Lounsbery]

Country	1935	1936	1937	1938	1939	1940
Belgium	5,241,026	6,077,907	6,694,049	6,874,520	(1)	(1)
Bulgaria	2,223	2,323	2,542	4,000	6,038	(1)
China	(2)	(2)	(1)	(1)	(1)	(1)
Chosen	1,079,330	1,051,853	1,101,500	1,664,000	2,064,000	(1)
France	5,000,000	8,227,000	(1)	(1)	(1)	(1)
Germany	4,886,000	5,511,000	5,627,000	(1)	(1)	(1)
Indochina	1,740,606	2,150,654	2,264,978	2,289,832	2,534,000	2,400,000
Irish Free State	87,114	96,742	106,651	92,157	90,455	(1)
Italy	70,150	79,972	95,060	132,197	100,000	(1)
Japan [3]	(2)	(2)	(1)	(1)	(1)	(1)
Morocco, French	52,696	49,388	107,150	123,200	115,600	(1)
Peru	2,461	3,535	2,918	1,500	3,514	9,240
Portugal	205,373	207,890	241,163	281,740	294,081	286,854
Rumania	17,207	3,708	3,646	3,266	(1)	(1)
Spain	701,789	(2)	(1)	493,539	663,593	(1)
Switzerland	3,500	3,000	4,000	3,000	2,500	(1)
U. S. S. R.:						
Asiatic	350,000	410,000	(1)	(1)	(1)	(1)
European	25,200,000	28,100,000	(1)	(1)	(1)	(1)
United Kingdom	6,907,530	6,629,955	6,437,465	6,378,904	(1)	(1)
United States	47,317,405	49,513,463	47,043,119	41,820,115	46,708,319	46,705,836
World total	104,089,405	113,843,463	(1)	(1)	(1)	(1)
Total, exclusive of United States	56,772,000	64,330,000	(1)	(1)	(1)	(1)

[1] Data not available.
[2] Estimate included in total.
[3] Anthracite output of Japan is said to average about 225,000 tons a year. Production figures are not available.

COKE AND BYPRODUCTS

By F. M. Shore, M. M. Otero, and M. F. Cooke

SUMMARY OUTLINE

More coke was produced during 1940 than in any year since 1929. The production from byproduct ovens—54,014,309 net tons (see table 1)—was the highest on record, and coke from beehive ovens totaled 3,057,825 tons.

Compared with the output of 42,882,313 tons in 1939 (see table 2), byproduct-coke production increased 26 percent. Production from beehive ovens increased 112 percent over 1939, as the large demand for metallurgical coke stimulated activity within the industry and led to the rehabilitation of ovens that had been out of service for many years. Of the total production in 1940, byproduct ovens contributed 95 percent and beehive ovens 5 percent. The 29-percent increase in the output of all coke compares favorably with the 33-percent rise in the production of pig iron but is substantially greater than the improvement in industry generally, which was only 13 percent, according to the Federal Reserve Board index of the physical volume of industrial production.

The survey of employment and accidents in coke-oven plants in 1940 revealed that, in the byproduct-coke industry, 17,469 men were employed and worked a total of 50,350,927 man-hours, compared with 14,852 men working 42,196,654 man-hours during 1939; in the beehive industry 2,493 men were employed during 1940, contributing 3,272,729 man-hours of work. This compares with 1,757 men working 1,540,540 man-hours during 1939.

The total value of coke, breeze, and tar produced and of other byproducts sold in 1940 was $442,282,951—an increase of $87,170,042 (25 percent) over 1939.

Coke used in blast furnaces (used by producers, sold to financially affiliated corporations, or sold to other companies) totaled 42,483,624 tons (nearly 75 percent of the total coke production) and exceeded the figure for 1939 by 10,985,067 tons. Coke used for other purposes (in foundries, for manufacturing water gas, and for other industrial

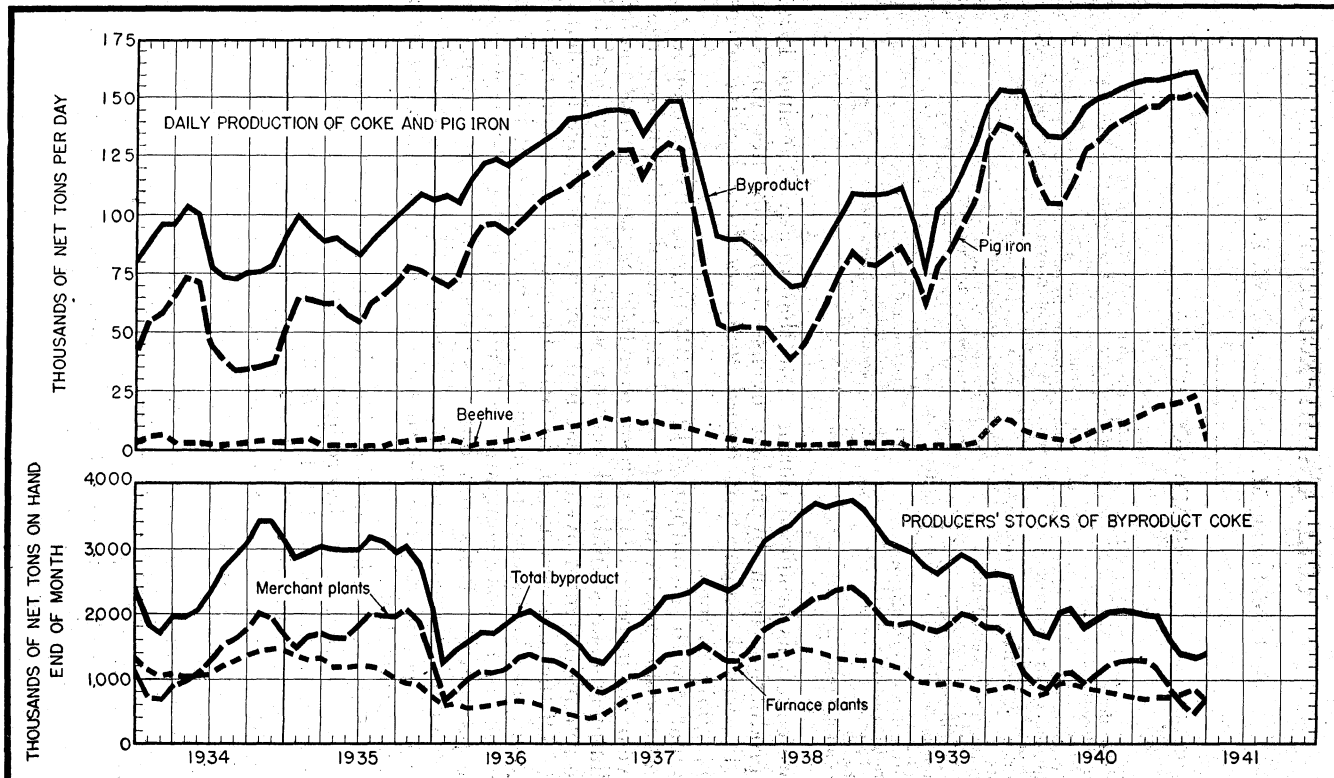

Figure 1.—Average daily production of beehive and byproduct coke and pig iron; and producers' stocks of byproduct coke, 1934–41, by months.

uses), totaled 7,130,073 tons compared with 6,186,827 tons in 1939. Coke sold for domestic use was reported at 8,231,013 tons in 1940 compared with 7,638,141 in 1939.

The average receipts per ton of coke sold by the producers in 1940 were as follows: Furnace coke, $4.40, an increase of 4 cents over 1939; foundry coke, $8.28, which was 53 cents higher than in 1939; coke used in the manufacture of water gas, $5.99, which exceeded the price in 1939 by 12 cents; other industrial coke, $5.42, which dropped 52 cents below the cost in 1939; and domestic coke, $6.00, an increase of 86 cents.

The production of screenings or breeze was 4,165,453 tons in 1940 and exceeded that in 1939 by 759,536 tons; the average receipts from sales dropped from $2.42 a ton to $2.24.

Producers' stocks of coke at the end of 1940 totaled 1,956,442 tons—a reduction of 645,657 tons from the quantity on hand at the end of 1939. Stocks of furnace coke decreased 72,132 tons; foundry coke, 39,987 tons; and domestic coke, 533,538 tons.

Coke exported in 1940 amounted to 804,095 tons—an increase of 214,170 tons (36 percent) over 1939. Imports of coke were 112,550 tons—21 percent less than in 1939.

Consumption of coke during 1940 is calculated at 57,026,246 tons—an increase of 12,073,164 tons over 1939.

Accompanying the increased activity of the byproduct industry in 1940, production of the four principal byproducts of the coking process was substantially augmented. The value realized through their sale (including tar used by the producer) during the year was $153,416,975. The output of gas increased 158,618,519 M cubic feet (23 percent); tar, 118,880,301 gallons (21 percent); ammonium sulfate or equivalent, 310,612,823 pounds (23 percent); and crude light oil, 44,250,468 gallons (26 percent). The role of byproducts is becoming increasingly important for national defense requirements.

TABLE 1.—*Salient statistics of the coke industry in 1940*

	Byproduct	Beehive	Total
Coke produced:			
At merchant plants:			
Quantity ..... net tons	12,549,132		12,549,132
Value	$78,554,814		$78,554,814
At furnace plants:			
Quantity ..... net tons	41,465,177		41,465,177
Value	$181,801,752		$181,801,752
Total:			
Quantity ..... net tons	54,014,309	3,057,825	57,072,134
Value	$260,356,566	$13,475,844	$273,832,410
Screenings or breeze produced:			
Quantity ..... net tons	4,078,037	87,416	4,165,453
Value	$8,472,114	$111,524	$8,583,638
Coal charged into ovens:			
Quantity ..... net tons	76,582,780	4,802,996	81,385,776
Value	$282,144,477	$9,568,854	$291,713,331
Average value per ton	$3.68	$1.99	$3.58
Average yield in percent of coal charged:			
Coke	70.53	63.66	70.13
Breeze (at plants actually recovering)	5.37	2.79	5.27
Ovens:			
In existence January 1	[1] 12,732	10,934	23,666
In existence December 31	12,734	[2] 15,150	27,884
Dismantled during year	1	709	710
In course of construction December 31	492	1,350	1,842
Daily capacity of ovens December 31	170,467	(3)	(3)
Coke used by producer:			
In blast furnaces:			
Quantity ..... net tons	35,895,934	667,431	36,563,365
Value	$155,886,637	$3,184,617	$159,071,254

See footnotes at end of table.

TABLE 1.—*Salient statistics of the coke industry in 1940*—Continued

	Byproduct	Beehive	Total
Coke used by producer—Continued.			
To make producer or water gas:			
Quantity net tons	1,529,239		1,529,239
Value	$7,953,324		$7,953,324
For other purposes:			
Quantity net tons	440,067	4,940	445,007
Value	$2,290,494	$22,153	$2,312,647
Disposal of coke:			
Sold to financially affiliated corporations:			
For blast-furnace use:			
Quantity net tons	2,686,737	207,282	2,894,019
Value	$11,407,387	$931,555	$12,338,942
For all other purposes:			
Quantity net tons	973,004	40,424	1,013,428
Value	$5,606,034	$197,265	$5,803,299
Sold to other consumers:			
For blast-furnace use:			
Quantity net tons	1,474,654	1,551,586	3,026,240
Value	$6,707,038	$6,607,660	$13,314,698
For foundry use:			
Quantity net tons	1,858,664	231,298	2,089,962
Value	$16,116,048	$1,182,808	$17,298,856
For manufacture of water gas:			
Quantity net tons	569,150	108,935	678,085
Value	$3,673,636	$385,354	$4,058,990
For other industrial use:			
Quantity net tons	1,185,767	188,585	1,374,352
Value	$6,607,862	$845,600	$7,453,462
For domestic use:			
Quantity net tons	8,131,947	99,066	8,231,013
Value	$49,014,276	$385,365	$49,399,641
Disposal of screenings or breeze:			
Used by producer:			
For raising steam:			
Quantity net tons	3,013,070	9,154	3,022,224
Value	$6,139,014	$10,581	$6,149,595
To make producer or water gas:			
Quantity net tons	47,791		47,791
Value	$149,989		$149,989
For all other purposes:			
Quantity net tons	418,080	268	418,348
Value	$808,194	$747	$808,941
Sold:			
Quantity net tons	603,657	24,171	627,828
Value	$1,377,970	$27,117	$1,405,087
Average receipts per ton sold:			
Furnace coke (merchant sales)	$4.55	$4.26	$4.40
Foundry coke	$8.67	$5.11	$8.28
For manufacture of water gas	$6.45	$3.54	$5.99
Other industrial coke	$5.57	$4.48	$5.42
Domestic coke	$6.03	$3.89	$6.00
Screenings or breeze	$2.28	$1.12	$2.24
Stocks on hand Januray 1, 1941:			
Furnace net tons	525,798	16,022	541,820
Foundry do	14,123	3,973	18,096
Domestic and other do	1,373,213	23,313	1,396,526
Breeze do	419,867	5,608	425,475
Exports do			804,095
Imports do			112,550
Calculated consumption do			57,026,246
Byproducts produced:			
Gas M cubic feet	833,761,720		833,761,720
Wasted percent	1.51		1.51
Burned in coking process do	35.69		35.69
Surplus sold or used do	62.80		62.80
Tar gallons	673,286,517		673,286,517
Ammonium sulfate or equivalent pounds	1,664,217,195		1,664,217,195
Crude light oil gallons	215,213,667		215,213,667
Yield of byproducts per ton of coal:			
Gas M cubic feet	10.89		10.89
Tar gallons	8.79		8.79
Ammonium sulfate or equivalent pounds	22.00		22.00
Crude light oil gallons	2.93		2.93
Value of byproducts sold:			
Gas (surplus)	$81,402,047		$81,402,047
Tar:			
Sold	$16,051,496		$16,051,496
Used by producer	$14,785,026		$14,785,026
Ammonium sulfate or equivalent	$19,674,277		$19,674,277
Crude light oil and derivatives	$21,504,129		$21,504,129
Other byproducts [4]	$6,449,928		$6,449,928
Total value of coke and breeze produced and byproducts sold [5]	$428,695,583	$13,587,368	$442,282,951

[1] Revised figure.
[2] Increase in ovens in existence is due to number of old ovens previously reported as abandoned that were rehabilitated in 1940.
[3] Data not available.
[4] Includes naphthalene and tar derivatives.
[5] Includes value of tar used by producer.

TABLE 2.—*Statistical trends of the coke industry in the United States 1923 and 1937–40*

	1923	1937	1938	1939	1940
Coke produced:					
Beehive net tons	19,379,870	3,164,721	837,412	1,444,328	3,057,825
Byproduct do	37,597,664	49,210,748	31,658,403	42,882,313	54,014,309
Total do	56,977,534	52,375,469	32,495,815	44,326,641	57,072,134
Percent of total from byproduct ovens	66.0	94.0	97.4	96.7	94.6
Stocks of producers, end of year, all coke net tons	[1] 1,221,737	2,595,287	3,676,554	2,602,099	1,956,442
Exports, all coke do	1,237,342	526,683	486,571	589,925	804,095
Imports, all coke [2] do	85,002	286,364	135,240	141,911	112,550
Consumption, calculated, all coke do	55,173,457	51,271,929	31,063,217	44,953,082	57,026,246
Disposal of coke, all coke sold or used:					
Furnace coke net tons	47,774,408	36,751,969	19,070,186	31,498,557	42,483,624
Foundry coke do	3,600,719	2,038,822	1,215,780	1,682,200	2,089,962
Other industrial (including water gas) net tons	2,283,888	3,329,105	2,786,710	3,193,068	3,581,676
Domestic coke do	2,733,414	8,107,518	7,222,690	7,638,141	8,231,013
For all other purposes do	(3)	1,268,789	1,175,346	1,311,559	1,458,435
Ovens:					
Beehive, in existence, end of year	62,349	12,194	10,816	10,934	15,150
Byproduct, in existence, end of year	11,156	12,718	12,724	[4] 12,732	12,734
Byproduct under construction, end of year	629	259	146	----------	492
Cost of coal charged, byproduct ovens, average per ton	$4.76	$3.74	$3.92	$3.75	$3.68
Prices of coke:					
Average spot price of Connellsville furnace coke, f. o. b. ovens	$5.33	$4.29	$3.86	$4.09	$4.42
Average realization on byproduct coke sold:					
Furnace coke (merchant sales)	$6.74	$4.34	$4.41	$4.38	$4.55
Foundry coke	$10.54	$8.47	$8.39	$8.15	$8.67
Other industrial (including water gas)	$9.06	$6.08	$5.68	$5.64	$5.86
Domestic	$9.05	$6.53	$6.17	$5.90	$6.03
Yield of byproducts per ton of coal charged:					
Tar gallons	8.1	8.67	9.27	9.06	8.79
Ammonium sulfate or equivalent pounds	21.2	21.84	23.36	22.33	22.00
Light oil gallons	2.7	2.86	2.99	2.99	2.93
Surplus gas sold or used M cubic feet	5.9	6.66	7.14	7.08	6.84
Average gross receipts for byproducts, per ton of coke produced:					
Tar sold and used	$0.51	$0.588	$0.654	$0.622	$0.571
Ammonia and its compounds	$0.84	$0.326	$0.380	$0.341	$0.364
Light oil and its derivatives (including naphthalene)	$0.51	$0.443	$0.423	$0.414	$0.421
Surplus gas sold or used	$1.37	$1.483	$1.907	$1.676	$1.507
Total byproducts, including breeze	$3.48	$3.068	$3.647	$3.315	$3.117

[1] Furnace and foundry coke only.
[2] Before 1934, the figures represented general imports; beginning with 1934, they represent imports for consumption only.
[3] Included in "Other industrial (including water gas)."
[4] Revised figure.

SCOPE OF REPORT

This report contains final statistics of the production of both byproduct and beehive coke (tables 3 to 48), coke breeze (table 28), coke byproducts (tables 49 to 56), and city-gas company statistics (table 57) for 1940. In addition to the customary annual report, there are included a survey of the coke-producing capacity of the United States; a table showing the precentage of low-, medium-, and high-volatile coals used in each State for making coke; and a summary of the distribution of coke shipments, by uses.

Those industries in the United States engaged in the production of coke include the byproduct and beehive coke ovens, petroleum and tar refineries, and coal-gas retorts. There is also a fuel obtained from low-temperature carbonization, which has been established commercially in recent years.

In 1940, 1,526,600 tons of petroleum coke and 90,906 tons of coal-tar pitch coke were produced compared with 1,666,400 and 90,124 tons, respectively, in 1939. The quantity of coke produced in the manufacture of coal-gas in retorts is relatively small and the figure is not now available.

Only coke from byproduct and beehive ovens is suitable for blast furnaces and foundries, which consume the bulk of all coke produced. Therefore, as the coke trade is concerned only with these two types of coke, the statistics of this report are confined thereto.

COKE AND COKE BREEZE

MONTHLY AND WEEKLY PRODUCTION

TABLE 3.—*Byproduct, beehive, and total coke produced in the United States, 1937–40 by months, and average per day, in net tons*

Month	1937		1938		1939		1940	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
Byproduct:								
January	4, 360, 700	140, 700	2, 749, 100	88, 700	3, 355, 200	108, 200	4, 720, 600	152, 300
February	3, 992, 900	142, 600	2, 481, 600	88, 600	3, 066, 800	109, 500	4, 028, 300	138, 900
March	4, 495, 500	145, 000	2, 661, 700	85, 900	3, 425, 700	110, 500	4, 136, 600	133, 400
April	4, 350, 900	145, 000	2, 424, 100	80, 800	2, 903, 800	96, 800	3, 995, 800	133, 200
May	4, 479, 700	144, 500	2, 272, 100	73, 300	2, 387, 100	77, 000	4, 256, 000	137, 300
June	4, 024, 800	134, 200	2, 056, 300	68, 500	3, 078, 500	102, 600	4, 387, 200	146, 200
July	4, 423, 900	142, 700	2, 166, 100	69, 900	3, 354, 100	108, 200	4, 632, 400	149, 400
August	4, 573, 400	147, 500	2, 484, 000	80, 100	3, 652, 900	117, 800	4, 695, 500	151, 500
September	4, 427, 800	147, 600	2, 665, 100	88, 800	3, 890, 600	129, 700	4, 640, 700	154, 700
October	4, 035, 100	130, 200	3, 081, 200	99, 400	4, 512, 300	145, 600	4, 853, 600	156, 600
November	3, 222, 300	107, 400	3, 266, 300	108, 900	4, 551, 900	151, 700	4, 763, 500	158, 800
December	2, 823, 800	91, 100	3, 350, 800	108, 100	4, 703, 400	151, 700	4, 904, 100	158, 200
	49, 210, 800	134, 800	31, 658, 400	86, 700	42, 882, 300	117, 500	54, 014, 300	147, 600
Beehive:								
January	274, 300	10, 600	114, 100	4, 400	78, 400	3, 000	252, 300	9, 300
February	294, 600	12, 300	102, 200	4, 300	72, 000	3, 000	164, 400	6, 600
March	357, 300	13, 200	95, 200	3, 500	69, 600	2, 600	143, 100	5, 500
April	309, 700	11, 900	73, 100	2, 800	20, 000	800	108, 400	4, 200
May	326, 500	12, 600	56, 700	2, 200	24, 700	900	112, 300	4, 200
June	274, 800	10, 600	49, 800	1, 900	52, 300	2, 000	159, 800	6, 400
July	285, 100	11, 000	42, 000	1, 700	47, 100	1, 900	244, 400	9, 400
August	259, 000	10, 000	47, 700	1, 800	44, 900	1, 700	294, 200	10, 900
September	253, 900	9, 800	53, 600	2, 100	77, 000	3, 000	287, 800	11, 500
October	225, 500	8, 700	60, 700	2, 300	266, 800	10, 300	384, 200	14, 200
November	168, 800	6, 500	66, 700	2, 600	362, 700	14, 000	416, 800	16, 000
December	135, 200	5, 200	75, 600	2, 900	328, 800	13, 200	490, 100	19, 600
	3, 164, 700	10, 200	837, 400	2, 700	1, 444, 300	4, 700	3, 057, 800	9, 800
Total coke:								
January	4, 635, 000	151, 300	2, 863, 200	93, 100	3, 433, 600	111, 200	4, 972, 900	161, 600
February	4, 287, 500	154, 900	2, 583, 800	92, 900	3, 138, 800	112, 500	4, 192, 700	145, 500
March	4, 852, 800	158, 200	2, 756, 900	89, 400	3, 495, 300	113, 100	4, 279, 700	138, 900
April	4, 660, 600	156, 900	2, 497, 200	83, 600	2, 923, 800	97, 600	4, 104, 200	137, 400
May	4, 806, 200	157, 100	2, 328, 800	75, 500	2, 411, 800	77, 900	4, 368, 300	141, 500
June	4, 299, 600	144, 800	2, 106, 100	70, 400	3, 130, 800	104, 600	4, 547, 000	152, 600
July	4, 709, 000	153, 700	2, 208, 100	71, 600	3, 401, 200	110, 100	4, 876, 800	158, 800
August	4, 832, 400	157, 500	2, 531, 700	81, 900	3, 697, 800	119, 500	4, 989, 700	162, 400
September	4, 681, 700	157, 400	2, 718, 700	90, 900	3, 967, 600	132, 700	4, 928, 500	166, 200
October	4, 260, 600	138, 900	3, 141, 900	101, 700	4, 779, 100	155, 900	5, 237, 800	170, 800
November	3, 391, 100	113, 900	3, 333, 000	111, 500	4, 914, 600	165, 700	5, 180, 300	174, 800
December	2, 959, 000	96, 300	3, 426, 400	111, 000	5, 032, 200	164, 900	5, 394, 200	177, 800
	52, 375, 500	145, 000	32, 495, 800	89, 400	44, 326, 600	122, 200	57, 072, 100	157, 400

TABLE 4.—*Beehive coke produced in the United States in 1940, by weeks*

[Estimated from railroad shipments]

Week ended—	Net tons	Week ended—	Net tons	Week ended—	Net tons
January 6	53,500	May 18	23,600	September 28	68,500
13	60,900	25	26,700	October 5	76,900
20	55,600	June 1	25,600	12	81,100
27	57,400	8	28,900	19	88,600
February 3	49,900	15	33,700	26	86,000
10	42,600	22	42,400	November 2	96,700
17	38,300	29	50,500	9	96,900
24	35,800	July 6	44,400	16	89,900
March 2	34,200	13	51,900	23	98,700
9	33,200	20	58,500	30	99,100
16	33,300	27	59,400	December 7	120,100
23	31,200	August 3	60,300	14	106,100
30	33,900	10	64,400	21	98,700
April 6	26,700	17	61,300	28	113,300
13	27,300	24	66,400	30–31 [1]	51,900
20	23,400	31	72,000		
27	21,700	September 7	59,800		3,057,800
May 4	27,600	14	69,100		
11	22,300	21	77,600		

[1] 2 days only.

TABLE 5.—*Byproduct coke produced in the United States in 1940, by months and States, in net tons*

[Based upon reports from all producers]

State	January	February	March	April	May	June	July
Alabama	394,800	384,800	403,500	380,400	396,200	384,400	397,300
Colorado	49,700	39,200	40,500	47,000	47,900	41,400	48,700
Illinois	267,900	221,000	192,500	168,200	152,000	209,900	280,000
Indiana	579,200	452,300	449,900	432,600	504,700	540,800	564,100
Maryland	147,600	139,100	148,500	125,200	140,500	143,300	135,700
Massachusetts	102,700	92,600	101,600	96,600	98,000	88,400	84,300
Michigan	234,400	222,200	241,100	224,800	237,100	237,000	246,500
Minnesota	47,100	41,700	42,500	41,800	44,500	41,800	40,800
New Jersey	88,100	83,600	88,000	85,200	72,500	84,800	86,700
New York	434,500	400,100	416,600	404,200	416,200	411,200	430,300
Ohio	690,700	526,300	524,000	555,000	585,000	628,100	672,600
Pennsylvania	1,321,800	1,090,100	1,131,700	1,099,500	1,214,900	1,236,900	1,287,600
Tennessee	7,600	7,600	7,600	7,400	7,500	7,500	8,100
Utah	16,000	16,400	18,700	17,300	17,600	18,200	18,900
West Virginia	161,800	146,000	156,800	149,400	156,300	153,700	161,200
Conn., Ky., Mo., R. I., and Wis.	176,700	165,300	173,100	161,200	165,100	159,800	169,600
	4,720,600	4,028,300	4,136,600	3,995,800	4,256,000	4,387,200	4,632,400
At merchant plants	1,076,300	990,100	1,053,900	1,010,100	1,007,800	991,400	1,032,600
At furnace plants	3,644,300	3,038,200	3,082,700	2,985,700	3,248,200	3,395,800	3,599,800

State	August	September	October	November	December	Total
Alabama	398,300	386,700	402,000	391,600	407,400	4,727,400
Colorado	40,400	41,400	45,900	49,600	51,800	543,500
Illinois	287,700	298,100	317,200	312,900	307,400	3,014,800
Indiana	574,000	560,400	583,700	575,700	595,300	6,412,700
Maryland	135,300	132,500	142,800	144,500	147,700	1,682,700
Massachusetts	85,300	94,100	99,500	95,500	91,700	1,130,300
Michigan	246,900	242,100	247,900	240,600	251,400	2,872,000
Minnesota	42,900	43,400	45,200	46,000	46,700	524,400
New Jersey	85,200	81,800	85,800	86,000	88,800	1,016,500
New York	428,700	420,300	441,900	432,600	443,800	5,080,400
Ohio	706,500	721,000	759,100	748,000	781,600	7,897,900
Pennsylvania	1,304,200	1,262,400	1,312,300	1,279,400	1,320,900	14,861,700
Tennessee	7,700	7,400	8,200	8,700	9,200	94,500
Utah	19,600	19,200	19,500	18,400	19,100	218,900
West Virginia	163,700	160,600	165,200	160,300	164,900	1,899,900
Conn., Ky., Mo., R. I., and Wis.	169,100	169,300	177,400	173,700	176,400	2,036,700
	4,695,500	4,640,700	4,853,600	4,763,500	4,904,100	54,014,300
At merchant plants	1,036,700	1,043,800	1,102,800	1,088,800	1,114,800	12,549,100
At furnace plants	3,658,800	3,596,900	3,750,800	3,674,700	3,789,300	41,465,200

TABLE 6.—*Beehive coke produced in the United States in 1940, by months and States, in net tons*

[Based upon railroad shipments]

State	January	February	March	April	May	June
Colorado	6,000	5,100	6,900	5,000	6,600	7,100
Pennsylvania	207,700	124,400	103,900	73,700	75,000	121,800
Tennessee and Kentucky	100	100	100	200	200	200
Utah and Washington	300	800	300	500	500	300
Virginia	21,600	18,400	16,200	14,200	15,000	14,500
West Virginia	16,600	15,600	15,700	14,800	15,000	15,900
	252,300	164,400	143,100	108,400	112,300	159,800

State	July	August	September	October	November	December	Total
Colorado	4,200	4,300	3,300	4,200	5,000	4,700	62,400
Pennsylvania	205,500	256,500	250,000	335,400	363,100	433,400	2,550,400
Tennessee and Kentucky	200	500	500	800	1,400	1,700	6,000
Utah and Washington	700	1,100	800	300	800	1,100	7,500
Virginia	14,900	11,000	10,100	18,300	20,700	23,500	198,400
West Virginia	18,900	20,800	23,100	25,200	25,800	25,700	233,100
	244,400	294,200	287,800	384,200	416,800	490,100	3,057,800

GROWTH OF THE INDUSTRY

The record of developments in the coke industry follows the pattern of growth in the iron and steel industry, because the principal use of beehive and byproduct coke is for metallurgical fuel. As activity in the iron and steel industry is a primary indicator of general industrial development, the growth of the coke industry affords a fairly accurate picture of the industrial growth of the country. Table 7 shows the course of developments in the coke industry from 1880 (the earliest record) to 1940, inclusive.

From 1880, when coke production in the United States was 3,338,300 net tons, until 1919, when it was 44,180,557 tons, beehive plants dominated the coke industry. The first byproduct ovens in this country were 12 Semet-Solvay ovens constructed in 1893 for use in connection with the chemical works of the Solvay Process Co. at Syracuse, N. Y. Compared with the wasteful beehive method, the advantages and economies realized by the use of coal-carbonizing equipment (designed for the recovery of valuable byproducts), were responsible for the steady growth of the byproduct method as an efficient means of producing coke.

The growth of the byproduct industry was at first slow. However, from 1900 to 1907—a period of rapid industrial expansion, particularly in the iron and steel industry—the number of byproduct ovens, as well as the number of beehive ovens, increased rapidly to meet the demand for coke during that period. At the close of 1910, 4,078 byproduct ovens had been built, and the number of beehive ovens in existence had reached a maximum of 100,362. Beehive plants produced 83 percent of the total coke production that year. Since 1910. however, the number of beehive ovens reported in existence has steadily declined at a rate that has varied with the demand for coke; meanwhile, byproduct ovens steadily increased in number. Not until 1939 did the number of beehive ovens reported increase over the preceding year, and during 1940 over 4,000 additional beehive ovens were added to the existing ovens, as the iron and steel industry made increasing demands for coke.

Coke production from byproduct ovens exceeded that from beehive ovens for the first time in 1919, as the 5 year period ended that year (during which 4,111 ovens were built) represented the era of greatest construction activity in the history of the byproduct industry, owing largely to war-time demands for coke from the steel industry and for such byproducts as ammonia, benzol, and toluol from war industries. At the end of 1921, when national production dropped to 25 million tons, that portion supplied by byproduct plants amounted to 78 percent—a 22-percent increase during the 2 years. The sudden increased demand for coke in 1922 and 1923 slowed the rate of decline of beehive ovens during this period, and byproduct ovens produced only 66 percent of the 57-million ton output for 1923. By 1929, however, byproduct ovens in existence totaled 12,649 and supplied 89.2 percent of the record coke production attained during that year. Beehive ovens in 1929 made some recovery, producing 2 million tons more than the preceding year; but in the following year, with slackening demand for coke, they produced only 6 percent of the national output. During the depression years, there was little change in the productive facilities of the byproduct-coke industry, and in the ensuing years up to 1940 but slight variation was noted in the number of ovens reported in existence. Only 83 more byproduct ovens were in existence at the end of 1939 than at the end of 1929. Beehive ovens, however, being less efficient, declined from 30,082 in 1929 to 10,934 at the end of 1939, and their annual output followed the same trend. Many new byproduct ovens were under construction during 1940 and ordered for completion during 1941; and altogether, 565 new and replacement ovens were scheduled to begin operation during 1941. The list of beehive ovens reported in existence increased by 4,216 in 1940, and there are indications that the number may be increased further during 1941.

The economic significance of the growth of the coke industry is broadly indicated by the value of its products. Thus, from the earliest record, when the total value at the plant of the products of the industry was only $6,631,267, this figure had grown to $581,594,972 in 1920 but was $442,282,951 in 1940. With the advent of byproduct ovens, byproducts of the coking process constituted an important and growing addition to the total value of the industry, reaching the maximum of $192,231,520 in 1929 and amounting to $168,450,541 in 1940.

TABLE 7.—*Statistical summary illustrating growth of coke industry in the United States, 1880–1940*

Year	Production (million net tons)			Percent of total production from byproduct ovens	Number of ovens in existence		Number of byproduct ovens under construction at end of year	Coal charged (million net tons)	Yield of coke from coal (percent)	Average value of coke per ton at plant	Total value at plant (million dollars)			
	Byproduct	Beehive	Total		Byproduct	Beehive					Beehive coke	Byproduct coke	All byproducts[1]	Total coke and byproducts
1880	------	3.3	3.3	------	------	12,372	------	5.2	63.7	$1.99	7	------	------	7
1881	------	4.1	4.1	------	------	14,119	------	6.5	62.8	1.88	8	------	------	8
1882	------	4.8	4.8	------	------	16,356	------	7.6	63.3	1.77	8	------	------	8
1883	------	5.5	5.5	------	------	18,304	------	8.5	64.2	1.49	8	------	------	8
1884	------	4.9	4.9	------	------	19,557	------	8.0	61.3	1.49	7	------	------	7
1885	------	5.1	5.1	------	------	20,116	------	8.1	63.3	1.49	8	------	------	8
1886	------	6.8	6.8	------	------	22,597	------	10.7	64.0	1.63	11	------	------	11
1887	------	7.6	7.6	------	------	26,001	------	11.9	64.2	2.01	15	------	------	15
1888	------	8.5	8.5	------	------	30,059	------	12.9	66.0	1.46	12	------	------	12
1889	------	10.3	10.3	------	------	34,165	------	16.0	64.3	1.62	17	------	------	17
1890	------	11.5	11.5	------	------	37,158	------	18.0	63.9	2.02	23	------	------	23
1891	------	10.4	10.4	------	------	40,057	------	16.3	63.3	1.97	20	------	------	20
1892	------	12.0	12.0	------	------	42,002	------	18.8	63.8	1.96	24	------	------	24
1893	0.01	9.5	9.5	0.1	12	44,189	------	14.9	63.5	1.74	17	------	(2)	(2)
1894	.02	9.2	9.2	.2	12	44,760	60	14.4	64.0	1.34	12	------	(2)	(2)
1895	.02	13.3	13.3	.1	72	45,493	60	20.8	64.0	1.44	19		(2)	(2)
1896	.1	11.7	11.8	.7	160	46,784	120	18.7	63.1	1.84	22		(2)	(2)
1897	.3	13.0	13.3	2.0	280	47,388	240	20.9	63.6	1.66	22		(2)	(2)
1898	.3	15.7	16.0	1.8	520	47,863	500	25.2	63.6	1.59	26		(2)	(2)
1899	.9	18.8	19.7	4.6	1,020	48,583	65	30.2	65.1	1.76	35		(2)	(2)
1900	1.1	19.4	20.5	5.2	1,085	57,399	1,096	32.1	63.9	2.31	47		(2)	(2)
1901	1.2	20.6	21.8	5.4	1,165	62,786	1,533	34.2	63.7	2.04	44		------	------
1902	1.4	24.0	25.4	5.5	1,663	67,406	1,346	39.6	64.1	2.49	63		(2)	(2)
1903	1.9	23.4	25.3	7.4	1,956	77,378	1,335	39.4	64.1	2.63	66		(2)	(2)
1904	2.6	21.1	23.7	11.0	2,910	80,689	832	36.5	64.8	1.95	46		(2)	(2)
1905	3.4	28.8	32.2	10.7	3,103	84,405	417	49.5	65.1	2.25	72		(2)	(2)
1906	4.6	31.8	36.4	12.5	3,547	90,354	112	55.7	65.3	2.52	92		(2)	(2)
1907	5.6	35.2	40.8	13.8	3,684	95,996	330	61.9	65.8	2.74	90	22	8	120
1908	4.2	21.8	26.0	16.1	3,799	97,419	240	39.4	66.0	2.40	48	14	7	69
1909	6.2	33.1	39.3	15.9	3,989	99,993	949	59.4	66.2	2.29	70	20	8	98
1910	7.1	34.6	41.7	17.1	4,078	100,362	1,200	63.1	66.1	2.39	75	25	8	108
1911	7.9	27.7	35.6	22.1	4,624	99,255	698	53.3	66.7	2.37	57	27	10	94
1912	11.1	32.9	44.0	25.3	5,211	97,019	793	65.6	67.1	2.54	69	43	14	126
1913	12.7	33.6	46.3	27.5	5,688	96,962	504	69.2	66.9	2.78	80	49	17	146
1914	11.2	23.4	34.6	32.5	5,809	93,946	644	51.6	66.9	2.56	50	38	18	106
1915	14.1	27.5	41.6	33.8	6,268	93,110	1,191	61.8	67.2	2.54	57	49	30	136
1916	19.1	35.4	54.5	35.0	7,283	91,581	2,084	81.6	66.8	3.13	96	75	62	233
1917	22.4	33.2	55.6	40.4	7,869	88,027	2,260	83.8	66.4	5.36	159	139	68	366
1918	26.0	30.5	56.5	46.0	9,279	84,635	1,815	85.0	66.4	6.77	189	193	77	459
1919	25.1	19.1	44.2	56.9	10,379	82,560	877	65.6	67.4	5.85	98	160	68	326
1920	30.8	20.5	51.3	60.0	10,881	75,298	396	76.2	67.4	9.27	163	313	105	581
1921	19.8	5.5	25.3	78.1	11,142	66,014	85	37.2	68.0	5.84	30	118	68	216
1922	28.5	8.6	37.1	76.9	11,212	63,958	403	54.3	68.3	6.42	50	188	95	333
1923	37.6	19.4	57.0	66.0	11,156	62,349	629	84.4	67.5	6.56	116	257	131	504
1924	34.0	10.3	44.3	76.8	11,413	60,432	247	65.0	68.1	5.51	48	196	120	364
1925	39.9	11.4	51.3	77.9	11,290	57,587	429	74.5	68.8	5.12	52	211	143	406
1926	44.4	12.5	56.9	78.0	11,716	52,558	978	82.9	68.6	5.41	57	251	157	465
1927	43.9	7.2	51.1	85.9	12,475	49,795	289	74.4	68.6	5.13	30	232	160	422
1928	48.3	4.5	52.8	91.5	12,544	41,288	145	77.2	68.4	4.79	16	237	177	430
1929	53.4	6.5	59.9	89.2	12,649	30,082	408	86.8	69.0	4.66	23	256	192	471
1930	45.2	2.8	48.0	94.2	12,831	23,907	276	69.8	68.7	4.36	10	200	168	378
1931	32.4	1.1	33.5	96.6	13,108	21,588	------	48.6	68.9	4.83	4	158	125	287
1932	21.1	.7	21.8	97.0	13,053	19,440	------	31.9	68.3	4.79	2	103	88	193
1933	26.7	.9	27.6	96.7	13,053	16,857	------	40.1	68.7	4.46	3	120	95	218
1934	30.8	1.0	31.8	96.8	12,963	14,206	------	46.0	69.2	5.01	4	155	104	263
1935	34.2	.9	35.1	97.4	12,860	13,674	122	50.5	69.6	5.03	4	173	113	290
1936	44.6	1.7	46.3	96.3	12,849	13,012	305	65.9	70.2	5.02	7	226	136	369
1937	49.2	3.2	52.4	94.0	12,718	12,194	259	74.5	70.3	4.98	14	247	151	412
1938	31.7	.8	32.5	97.4	12,724	10,816	146	46.6	69.7	5.14	4	163	116	283
1939	42.9	1.4	44.3	96.7	[3] 12,732	10,934	------	63.5	69.8	4.80	6	207	142	355
1940	54.0	3.1	57.1	94.6	12,734	15,150	492	81.4	70.1	4.80	14	260	168	442

[1] Value for tar up to and including 1917 represented that of tar "obtained and sold," which did not always include value of tar used by producer. Beginning with 1918, tar used by producer is specifically included. Value of breeze produced at byproduct plants is included for those years for which it was reported, namely, 1916, 1917, and 1919–40. For other byproducts, only value of those sold is included. Value of breeze produced at beehive plants is not included, as it has usually been much less than a million dollars.

[2] No accurate data on value of the byproducts available.

[3] Revised figure.

PRODUCTION BY FURNACE AND NONFURNACE PLANTS

The terms "furnace" and "merchant" plants originated in the Connellsville beehive-coke trade, although in this report the distinction is applied to byproduct-coke plants only. Furnace plants are those affiliated with the iron and steel industry, with an output that does not ordinarily enter the open market. Merchant plants include some that are affiliated with local iron furnaces but produce more coke than the furnaces can consume and therefore depend on foundry, domestic, or other markets. The term also includes producers of coke who sell their entire output on the competitive market; the plants affiliated with alkali works; low-temperature carbonization plants; and, in addition, a number of plants that, although not public utilities, were constructed primarily to supply city gas and which sell their coke for domestic, industrial, and metallurgical use.

TABLE 8.—*Number and production of byproduct-coke plants connected with iron furnaces and of other byproduct plants in the United States, 1913, 1918, and 1938–40*

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
1938	44	40	20,668,878	10,989,525	65.3	34.7
1939	45	39	31,811,807	11,070,506	74.2	25.8
1940	45	40	41,465,177	12,549,132	76.8	23.2

TABLE 9.—*Monthly and average daily production of byproduct coke by plants associated with iron furnaces and by all other plants in the United States, 1938–40, in net tons*

Month	1938		1939		1940	
	Furnace plants	Other plants	Furnace plants	Other plants	Furnace plants	Other plants
Monthly production:						
January	1,710,500	1,038,600	2,388,000	967,200	3,644,300	1,076,300
February	1,544,100	937,500	2,199,000	867,800	3,038,200	990,100
March	1,672,200	989,500	2,495,000	930,700	3,082,700	1,053,900
April	1,493,800	930,300	2,045,700	858,100	2,985,700	1,010,100
May	1,374,900	897,200	1,625,900	761,200	3,248,200	1,007,800
June	1,224,100	832,200	2,230,200	848,300	3,395,800	991,400
July	1,350,200	815,900	2,480,600	873,500	3,599,800	1,032,600
August	1,645,300	838,700	2,759,900	893,000	3,658,800	1,036,700
September	1,798,300	866,800	2,960,400	930,200	3,596,900	1,043,800
October	2,138,100	943,100	3,463,300	1,049,000	3,750,800	1,102,800
November	2,338,600	927,700	3,526,400	1,025,500	3,674,700	1,088,800
December	2,378,800	972,000	3,637,400	1,066,000	3,789,300	1,114,800
	20,668,900	10,989,500	31,811,800	11,070,500	41,465,200	12,549,100
Average daily production:						
January	55,200	33,500	77,000	31,200	117,600	34,700
February	55,100	33,500	78,500	31,000	104,800	34,100
March	54,000	31,900	80,500	30,000	99,400	34,000
April	49,800	31,000	68,200	28,600	99,500	33,700
May	44,400	28,900	52,400	24,600	104,800	32,500
June	40,800	27,700	74,300	28,300	113,200	33,000
July	43,600	26,300	80,000	28,200	116,100	33,300
August	53,100	27,000	89,000	28,800	118,000	33,500
September	59,900	28,900	98,700	31,000	119,900	34,800
October	69,000	30,400	111,700	33,900	121,000	35,600
November	78,000	30,900	117,500	34,200	122,500	36,300
December	76,700	31,400	117,300	34,400	122,200	36,000
Average	56,600	30,100	87,200	30,300	113,300	34,300

In 1940, 45 furnace plants produced 41,465,177 tons, (77 percent of all byproduct coke); and 40 "other", or merchant, plants produced 12,549,132 tons (23 percent). The proportion of coke from furnace plants has remained fairly constant, except in years of depression or exceptional activity in the iron and steel industry. In 1932, furnace plants furnished only 54 percent and in 1938 only 65 percent of the total byproduct coke.

PRODUCTION BY STATES AND DISTRICTS

All 20 States in which the byproduct-coke industry operates shared the increased output in 1940. Illinois led with the highest percentage of increase—60 percent—followed by Colorado, with an advance of 37 percent; Pennsylvania, 35 percent; Indiana, 31 percent; Ohio, 29 percent; and Alabama, 23 percent. Increases in the other States ranged from 19 percent in Tennessee and West Virginia to 1 percent in New Jersey.

Pennsylvania retained its lead in the tonnage produced and in 1940 contributed 28 percent of all byproduct coke and 83 percent of all beehive coke produced in the United States. Not only is Pennsylvania the principal coke-producing State, but it also leads in the shipment of coking coal to ovens in other States.

TABLE 10.—*Byproduct and beehive coke produced in the United States, 1918 and 1937–40, by States, in net tons*

[Exclusive of screenings or breeze]

State	1918	1937	1938	1939	1940
Byproduct:					
Alabama	2, 634, 451	4, 259, 771	3, 378, 044	3, 854, 505	4, 727, 378
Colorado	230, 663	486, 945	186, 805	398, 033	543, 548
Connecticut		(1)	(1)	(1)	(1)
Illinois	2, 285, 610	2, 998, 663	1, 734, 511	1, 884, 240	3, 014, 840
Indiana	3, 898, 215	5, 467, 061	2, 904, 779	4, 878, 033	6, 412, 716
Kentucky	517, 749	(1)	(1)	(1)	(1)
Maryland	474, 368	1, 513, 651	1, 105, 262	1, 578, 973	1, 682, 701
Massachusetts	556, 397	1, 130, 620	1, 019, 302	1, 057, 158	1, 130, 311
Michigan	(1)	2, 283, 518	1, 742, 787	2, 430, 688	2, 872, 026
Minnesota	784, 065	704, 631	540, 447	497, 079	524, 360
Missouri	(1)	(1)	(1)	(1)	(1)
New Jersey	682, 148	1, 015, 073	1, 007, 394	1, 003, 197	1, 016, 481
New York	1, 069, 587	4, 946, 964	3, 945, 358	4, 468, 437	5, 080, 403
Ohio	5, 226, 334	6, 737, 881	3, 699, 995	6, 135, 949	7, 897, 929
Pennsylvania	4, 586, 981	13, 701, 262	7, 119, 328	10, 994, 254	14, 861, 657
Rhode Island		(1)	(1)	(1)	(1)
Tennessee	124, 469	89, 451	76, 123	79, 448	94, 454
Utah		149, 659	132, 513	189, 194	218, 949
Washington	30, 129	14, 656			
West Virginia	603, 393	1, 817, 993	1, 346, 734	1, 598, 198	1, 899, 849
Wisconsin	(1)	(1)	(1)	(1)	(1)
Combined States	2, 293, 021	1, 892, 949	1, 719, 021	1, 834, 927	2, 036, 707
	25, 997, 580	49, 210, 748	31, 658, 403	42, 882, 313	54, 014, 309
Beehive:					
Alabama	1, 717, 721				
Colorado	758, 784	64, 222	54, 721	56, 836	62, 417
Georgia	22, 048				
Kentucky	301, 036				(1)
New Mexico	597, 072				
Ohio	138, 909				
Oklahoma	(1)				
Pennsylvania	22, 136, 664	2, 559, 048	482, 105	1, 125, 971	2, 550, 367
Tennessee	302, 637	14, 982	5, 500		5, 251
Utah	(1)	6, 657	7, 668	8, 332	7, 398
Virginia	1, 234, 256	240, 425	133, 905	165, 317	198, 379
Washington	93, 659				(1)
West Virginia	2, 716, 613	279, 387	153, 513	87, 872	233, 154
Combined States	461, 393				859
	30, 480, 792	3, 164, 721	837, 412	1, 444, 328	3, 057, 825
Grand total	56, 478, 372	52, 375, 469	32, 495, 815	44, 326, 641	57, 072, 134

1 Included under "Combined States."

TABLE 11.—*Coke produced, value, number of ovens, coal charged, and average yield in 1940, by States*

[Exclusive of screenings or breeze]

State	Byproduct							Beehive						Total	
	Plants	Ovens	Coal used (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens: Total	Value of coke at ovens: Per ton	Ovens	Coal used (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens: Total	Value of coke at ovens: Per ton	Coke produced (net tons)	Value of coke at ovens
Alabama	8	1, 254	6, 655, 710	71. 03	4, 727, 378	$13, 748, 837	$2. 91	380						4, 727, 378	$13, 748, 837
Colorado	1	188	849, 977	63. 95	543, 548	(1)	(1)	255	95, 735	65. 20	62, 417	(1)	(1)	605, 965	(1)
Connecticut	1	61	(2)	(2)	(2)	(2)	(2)							(2)	(2)
Illinois	9	916	4, 272, 553	70. 56	3, 014, 840	18, 217, 939	6. 04							3, 014, 840	18, 217, 939
Indiana	5	1, 450	8, 756, 244	73. 24	6, 412, 716	37, 308, 469	5. 82							6, 412, 716	37, 308, 469
Kentucky	1	120	(2)	(2)	(2)	(2)	(2)	14	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Maryland	1	361	2, 326, 483	72. 33	1, 682, 701	(1)	(1)							1, 682, 701	(1)
Massachusetts	2	215	1, 589, 587	71. 11	1, 130, 311	(1)	(1)							1, 130, 311	(1)
Michigan	10	747	4, 099, 657	70. 06	2, 872, 026	15, 445, 452	5. 38							2, 872, 026	15, 445, 452
Minnesota	3	196	743, 722	70. 50	524, 360	3, 662, 908	6. 99							524, 360	3, 662, 908
Missouri	1	64	(2)	(2)	(2)	(2)	(2)							(2)	(2)
New Jersey	2	244	1, 418, 226	71. 67	1, 016, 481	(1)	(1)							1, 016, 481	(1)
New York	8	978	7, 121, 369	71. 34	5, 080, 403	29, 519, 871	5. 81							5, 080, 403	29, 519, 871
Ohio	15	1, 862	11, 049, 203	71. 48	7, 897, 929	38, 568, 313	4. 88							7, 897, 929	38, 568, 313
Pennsylvania	13	3, 351	21, 718, 501	68. 43	14, 861, 657	58, 619, 692	3. 94	11, 067	3, 997, 312	63. 80	2, 550, 367	$10, 979, 384	$4. 31	17, 412, 024	69, 599, 076
Rhode Island	1	65	(2)	(2)	(2)	(2)	(2)							(2)	(2)
Tennessee	1	24	133, 966	70. 51	94, 454	588, 448	6. 23	250	8, 818	59. 55	5, 251	30, 298	5. 77	99, 705	618, 746
Utah	1	56	369, 145	59. 31	218, 949	(1)	(1)	814	14, 537	50. 89	7, 398	(1)	(1)	226, 347	(1)
Virginia								1, 284	330, 818	59. 97	198, 379	943, 753	4. 76	198, 379	943, 753
Washington								160	(2)	(2)	(2)	(2)	(2)	(2)	(2)
West Virginia	4	387	2, 751, 565	69. 05	1, 899, 849	5, 135, 184	2. 70	926	354, 405	65. 79	233, 154	1, 035, 665	4. 44	2, 133, 003	6, 170, 849
Wisconsin	2	195	(2)	(2)	(2)	(2)	(2)							(2)	(2)
Combined States			2, 726, 872	74. 69	2, 036, 707	13, 197, 673	6. 48		1, 371	62. 65	859	3, 720	4. 33	2, 037, 566	13, 201, 393
Undistributed						26, 343, 780	5. 74					483, 024	6. 92		26, 826, 804
Total: 1940	89	12, 734	76, 582, 780	70. 53	54, 014, 309	260, 356, 566	4. 82	15, 150	4, 802, 996	63. 66	3, 057, 825	13, 475, 844	4. 41	57, 072, 134	273, 832, 410
1939	88	[3] 12, 732	61, 215, 899	70. 05	42, 882, 313	206, 457, 873	4. 81	10, 934	2, 297, 785	62. 86	1, 444, 328	6, 426, 177	4. 45	44, 326, 641	212, 884, 050

1 Included under "Undistributed."
2 Included under "Combined States."
3 Revised figure.

TABLE 12.—*Byproduct and beehive coke produced in Pennsylvania in 1940, by districts*

[Number of plants and ovens includes those idle during the year; 16 plants were under construction or reconstruction in 1940]

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
Byproduct:							
Eastern Pennsylvania [1]	5	734	3, 299, 929	70. 36	2, 321, 909	$14, 011, 112	$6. 03
Western Pennsylvania [2]	8	2, 617	18, 418, 572	68. 08	12, 539, 748	44, 608, 580	3. 56
	13	3, 351	21, 718, 501	68. 43	14, 861, 657	58, 619, 692	3. 94
Beehive:							
Allegheny Mountain and Allegheny Valley	2	242	37, 829	62. 16	23, 516	117, 580	5. 00
Connellsville	37	5, 899	1, 557, 775	64. 65	1, 007, 161	4, 147, 941	4. 12
Lower Connellsville	16	2, 931	1, 619, 619	63. 52	1, 028, 760	4, 446, 702	4. 32
Upper Connellsville	5	676	118, 484	66. 67	78, 999	317, 213	4. 02
Pittsburgh and other districts [3]	8	1, 319	663, 605	62. 07	411, 931	1, 949, 948	4. 73
	68	11, 067	3, 997, 312	63. 80	2, 550, 367	10, 979, 384	4. 31
Grand total	81	14, 418	25, 715, 813	67. 71	17, 412, 024	69, 599, 076	4. 00

[1] Includes plants at Bethlehem, Chester, Philadelphia, Steelton, and Swedeland.
[2] Includes plants at Aliquippa, Champion, 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 1940, 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	3, 304, 344	71. 88	2, 375, 161	$11, 812, 872	$4. 97
Youngstown	3	602	3, 473, 041	70. 61	2, 452, 251	11, 814, 059	4. 82
Other districts [1]	7	665	4, 271, 818	71. 88	3, 070, 517	14, 941, 382	4. 87
	15	1, 862	11, 049, 203	71. 48	7, 897, 929	38, 568, 313	4. 88

[1] Includes plants at Hamilton, Ironton, Lorain, Painesville, Portsmouth, Toledo, and Warren.

NUMBER AND TYPE OF OVENS

In the byproduct industry at the end of 1940, the number of ovens in existence totaled 12,734, only 3 were added to the record of existing capacity, and only 1 was abandoned during the year. However, in view of the growing demand from the iron and steel industry, 492 ovens were under construction or reconstruction at the end of the year. In addition, there were 73 ovens which, though not under actual construction on December 31, 1940, will come into operation during 1941. The ovens to be completed in 1941 will add about 3,000,000 tons to the present annual capacity of the byproduct-coke industry.

In the face of an impending heavy demand for furnace coke, the beehive-coke industry restored to the list of existing ovens many whose use had long been abandoned and began a program of repairing and rebuilding old ovens that apparently continues. Nearly 5,000 ovens were restored to the "in existence" list during the year 1940. Of the total 15,150 beehive ovens reported as in existence at the end of

1940, 1,350 were under construction or reconstruction at that time. During January, an average of 5,000 beehive ovens was active, but the number gradually declined to 2,634 in May. From then on, the average number of active ovens increased steadily, reaching a peak of 8,895 in December; evidence pointed toward further expansion in 1941.

TABLE 14.—*Coke ovens completed and abandoned in the United States in 1940 and total number in existence at end of year, by States*

State	Plants in existence Dec. 31	Ovens						
		In existence Dec. 31		New		Abandoned during year	Under construction Dec. 31	
		Number	Capacity per day (net tons of coke)	Number	Capacity per day (net tons of coke)		Number	Capacity per day (net tons of coke)
Byproduct:								
Alabama	8	1,254	14,540				25	(1)
Colorado	1	188	2,907			1		
Connecticut	1	61	(2)				9	(1)
Illinois	9	916	12,410					
Indiana	5	1,450	19,322				183	(1)
Kentucky	1	120	(2)					
Maryland	1	361	5,088				61	(1)
Massachusetts	2	215	3,553					
Michigan	10	747	9,194					
Minnesota	3	196	2,572					
Missouri	1	64	(2)					
New Jersey	2	244	2,833					
New York	8	978	15,048				76	(1)
Ohio	15	1,862	24,569				101	(1)
Pennsylvania	13	3,351	45,501	3	(1)			
Rhode Island	1	65	(2)					
Tennessee	1	24	330					
Utah	1	56	705					
West Virginia	4	387	5,550				37	(1)
Wisconsin	2	195	(2)					
Undistributed			6,345					
	89	12,734	170,467	3	(1)	1	492	7,543
At merchant plants	43	3,440	41,926	3	(1)		188	2,733
At furnace plants	46	9,294	128,541			1	304	4,810
Beehive:								
Alabama	2	380						
Colorado	1	255				28		
Kentucky	1	14		14	(3)			
Pennsylvania	68	11,067				184	1,350	(3)
Tennessee	3	250	(3)			40		
Utah	1	814						
Virginia	8	1,284						
Washington	1	160						
West Virginia	8	926				457		
	93	[4] 15,150	(3)	14	(3)	709	1,350	(3)

1 Concealed to avoid disclosure of individual operations.
2 Included under "Undistributed."
3 Data not available.
4 Increase in number of ovens is due chiefly to number previously reported abandoned that were returned by operators to "in existence" list.

TABLE 15.—*Average number of beehive ovens active in the United States in 1940, by months*

Month	Number	Month	Number	Month	Number
January	5,000	May	2,634	September	6,603
February	4,440	June	4,207	October	7,477
March	3,117	July	4,900	November	8,189
April	2,772	August	5,445	December	8,895

TABLE 16.—*Byproduct ovens of each type in the United States at end of 1940, by States*

State	Koppers[1]	Semet-Solvay	Wilputte	Cambria	Roberts Morrissey	American Foundation	All others[2]	Total
Alabama	774	420	60					1,254
Colorado	188							188
Connecticut	61							61
Illinois	662	120	88				46	916
Indiana	889	161	400					1,450
Kentucky		120						120
Maryland	361							361
Massachusetts	160		55					215
Michigan	314	346					87	747
Minnesota	196							196
Missouri	56						8	64
New Jersey	244							244
New York	743	180				55		978
Ohio	1,569	293						1,862
Pennsylvania	3,018	88	97	120	25		3	3,351
Rhode Island	65							65
Tennessee		24						24
Utah	56							56
West Virginia	316		71					387
Wisconsin	115	80						195
	9,787	1,832	771	120	25	55	144	12,734
At merchant plants	1,924	1,046	246		25	55	144	3,440
At furnace plants	7,863	786	525	120				9,294

[1] Includes Koppers-Becker type.
[2] Includes 46 Curran-Knowles, 27 Parker-Russell, 60 Improved Equipment Co., 8 Piette, and 3 Disco ovens in 1940.

CAPACITY OF BYPRODUCT PLANTS

The fundamental basis upon which the maximum capacity (see table 17) of a byproduct plant is established is the minimum coking time at which the ovens in that plant can be operated to produce coke of characteristics suitable for the use for which it is intended. This theoretical capacity is seldom attained in practice for reasons that may be due to operating, economic, or labor conditions. For many years the Bureau of Mines has been obtaining annually from the operators of byproduct-coke plants data showing the daily coke-producing capacity of the ovens in existence at the end of the calendar year. The operators are requested to state daily capacity in the terms of the total quantity of coke, of grades they aim to produce that can be obtained with all conditions favorable and all ovens active.

The potential maximum daily capacity of the 89 byproduct-coke plants in existence December 31, 1940, both active and idle, was 170,467 tons. The daily capacity of the 43 merchant plants was 41,926 tons and that of the 46 furnace plants 128,541 tons.

It should be noted that the estimated maximum daily capacity is not necessarily a true guide for calculating annual capacity, as in the latter allowance may be included for possible interruptions to full running time in the course of a normal year. The estimated maximum capacity of byproduct ovens on December 31, 1940, was obtained through a special survey of the industry, the results of which are shown in succeeding pages.

During 1940 the byproduct-coke industry was busily engaged in gearing its productive facilities to higher limits to meet the steadily growing demand from the steel industry for metallurgical coke. To supplement existing facilities, construction of new ovens and rehabilitation of old ones were under way at the end of the year.

TABLE 17.—*Relationship of production to potential maximum capacity*[1] *at byproduct-coke plants in the United States, 1929 and 1937–40, by months, in percent*

Month	1929	1937	1938	1939	1940	Month	1929	1937	1938	1939	1940
January	88.6	83.0	52.4	62.8	89.2	August	93.6	86.0	47.3	70.2	87.3
February	91.3	83.5	52.3	63.5	81.3	September	91.9	86.1	52.4	77.2	89.2
March	93.0	84.9	50.7	64.1	78.1	October	92.3	76.0	57.9	86.6	90.2
April	92.8	84.9	47.7	56.2	78.0	November	89.0	62.8	63.3	90.3	91.5
May	94.0	84.6	43.2	44.4	80.4	December	83.1	53.1	62.8	89.7	91.2
June	93.9	78.6	40.4	59.2	85.6						
July	93.0	83.2	41.3	64.4	86.1	The year	91.4	78.8	51.0	68.9	85.7

[1] Capacity of all ovens in existence, whether active or idle, based upon maximum daily capacity times days in month.

COKE-PRODUCING CAPACITY OF THE UNITED STATES

The potential annual coke-producing capacity of the byproduct and beehive ovens, active and idle, in existence on December 31, 1940, as reported by the operators, was 69,035,730 net tons, according to a special survey made by the Bureau of Mines, United States Department of the Interior, at the request of the Advisory Commission to the Council of National Defense, now part of the Office of Production Management.[1] Of this capacity, 59,394,070 tons represented that of byproduct ovens and 9,641,660 tons that of beehive ovens. In reporting these capacities to the Bureau of Mines, the operators were asked to give the capacity of ovens in existence on December 31, 1940, and that which would be added during 1941 through the building of new ovens or the reconstruction of old ones; they were also asked to state the estimated maximum annual coke capacity of their ovens "of grades you aim to produce, that can be obtained with all conditions favorable and all ovens active." Of the total capacity reported, the part that is considered potential represents only ovens in need of repairs, rebuilding, or replacement. This category comprises a relatively small percentage of the byproduct ovens but a much larger percentage of the beehive ovens. Additional beehive ovens are being reconditioned from time to time, progressively converting potential into active capacity. For comparison, it is noted that during December 1940 byproduct ovens produced at the rate of 57,576,195 tons and beehive ovens at the rate of 5,758,476 tons a year. In March 1941 byproduct coke was produced at the rate of 58,862,820 net tons a year and beehive coke at the rate of 7,004,653 net tons a year.

Byproduct ovens in existence at the end of 1940 totaled 12,734, of which 12,175 were active. To the estimated maximum annual capacity of ovens in existence December 31, 1940 (amounting to 59,394,070 tons), 492 new and replacement ovens in course of construction at the end of 1940 and ordered for completion during 1941, plus 73 ovens whose construction was begun after December 31, 1940, will add 2,994,563 tons—a total of 62,388,633 tons of potential annual capacity of ovens in existence at the end of 1941. In addition, operators reported that they contemplated building additional capacity amounting to 847,700 tons. Of course, plans for this additional tonnage may not be consummated. Of the 89 byproduct plants in existence at the end of 1940, 4 containing 164 ovens with an estimated capacity of 298,200 tons were idle. The 85 active plants contained 12,570 ovens with an estimated maximum annual capacity of 59,095,-

[1] Special acknowledgment is due Carl D. Ulmer, then of the Koppers Co., for his valuable assistance in making the capacity survey.

870 tons. Not all of the ovens at active plants were in operation at the end of 1940; but it is probably safe to assume, for the idle ovens at these plants, that if repairs are needed they will be reconditioned and placed in operation should the demand for coke continue to grow. In fact, one of the 4 plants that were idle on December 31, 1940, has already been reconditioned. Press reports indicate also that contracts have been made for building 2 new plants in the Pittsburgh area and additional capacity in the Philadelphia area that would add about 877,000 net tons of coke per year to existing capacity, but it was not expected that these plants would be completed during 1941.

Of the capacity represented by byproduct ovens in existence at the end of 1940, Pennsylvania had 28 percent, followed in order by Ohio with 15 percent, Indiana, 12 percent, and New York and Alabama with 9 percent each.

In addition to the byproduct ovens needing repairs or reconditioning on December 31, 1940, a number of operators reported that auxiliary equipment would need to be repaired, replaced, or enlarged to obtain the estimated potential maximum output reported. Reports indicating the need of new auxiliary equipment or the repair of old equipment came from plants having a total annual capacity of 2,276,938 tons. Repairs that "might" be needed represented 664,425 additional tons of capacity. These figures represent the capacity of plants that doubtless include ovens whose capacity was not limited by the needs reported. It should be kept in mind that the reported needs do not necessarily mean that the ovens to which they relate were not capable of producing coke. On the contrary, much of this capacity probably was being operated but perhaps at a somewhat reduced rate.

Reports as to the year of first operation of byproduct coke ovens when new or after rebuilding or major repairs throw an interesting light upon the durability of this type of equipment. For example, 556 of the existing byproduct ovens first operated prior to 1910, and 5,334 ovens first operated prior to 1920. Almost half of the existing ovens are 20 years old or more upon the basis stated.

Beehive ovens reported in existence on December 31, 1940, totaled 15,150 with an estimated maximum potential annual capacity of 9,641,660 tons. This number is an increase of 4,216 ovens over those reported in existence at the end of 1939 and represents chiefly restoration to the record by the operators of existing ovens, many of which previously had been considered and reported as abandoned. Of the ovens in existence, 9,148 were reported as active at the end of 1940. New and replacement beehive ovens in course of construction December 31, 1940, and ordered for completion during 1941 numbered 1,350 and would add 43,320 tons of capacity to that reported for ovens in existence at the end of 1940, making an estimated annual capacity of 9,684,980 net tons available at the end of 1941. Of the total capacity of beehive ovens in existence at the end of 1940, 79 percent was represented by ovens in Pennsylvania; Virginia was next with 7 percent.

The estimated potential annual capacity of 9,684,980 net tons of beehive coke at the end of 1941 is based upon reports covering plants known to be in existence December 31, 1940. The canvass of plants begun in January 1941 was continued into April. This capacity figure must necessarily be subject to periodic revision in the event of an increasing demand for coke that would induce the building of new ovens or the restoration and rehabilitation of old ones.

The operators of beehive plants representing an annual capacity of 2,663,000 tons indicated that, to obtain the maximum coke-producing capacity reported, it would be necessary to replace, repair, or rebuild 4,439 ovens. It is to be noted further that the repair, replacement, or enlargement of auxiliary equipment was also reported as essential for maximum capacity operation of some of the existing ovens.

Official and trade press reports indicate that, until recently, at least, rehabilitation of old ovens was still in progress in the beehive industry and that the number of active ovens was increasing. Whether this trend will continue depends on future demand. For the beehive industry, therefore, the statistical picture is subject to short-time change in line with changes in the demand for coke.

Byproduct-coke output, which surpassed that of beehive coke for the first time in 1919, has gradually relegated operation of beehive ovens to the status of a standby industry to take up the excess load during periods of large demand. Thus, since the loss of its primary importance as a source of metallurgical fuel, the output of the beehive ovens has fluctuated widely with variations in the activity of the heavy industries. It is worth noting, however, that although beehive ovens waste valuable byproducts in the production of coke, they afford a relatively rapid means for speedy expansion in coke capacity when needed to meet sudden abnormal demand. Old beehive ovens can be repaired or rebuilt or new ovens constructed in less time than would be required to build byproduct ovens.

TABLE 18.—*Estimated capacity of byproduct coke ovens in the United States, December 31, 1940–41, by States*

[Exclusive of screenings or breeze]

State	No. of ovens active Dec. 31, 1940	No. of ovens in existence Dec. 31, 1940	Estimated maximum annual capacity of existing ovens Dec. 31, 1940 (net tons)	Additional capacity available in 1941 [1]: No. of ovens under construction Dec. 31, 1940	Additional capacity available in 1941 [1]: Estimated capacity secured by new and replacement ovens (net tons)	Estimated maximum annual capacity available at end of 1941 (net tons)	Additional capacity contemplated during 1941 (net tons)
Alabama	1,066	1,254	5,075,836	25	(2)	(2)	----------
Colorado	188	188	645,300	----------	----------	645,300	----------
Illinois	915	916	3,844,840	----------	----------	3,844,840	----------
Indiana	1,407	1,450	7,123,019	183	(2)	(2)	----------
Maryland	359	361	1,780,000	61	(2)	(2)	----------
Massachusetts	215	215	1,186,050	----------	----------	1,186,050	----------
Michigan	655	747	3,073,649	----------	----------	3,073,649	----------
Minnesota	145	196	805,000	----------	----------	805,000	----------
New Jersey	244	244	1,041,550	----------	----------	1,041,550	----------
New York	974	978	5,194,072	76	(2)	(2)	(2)
Ohio	1,862	1,862	8,749,100	101	(2)	(2)	----------
Pennsylvania	3,173	3,351	16,477,700	----------	----------	16,477,700	----------
Tennessee	24	24	120,450	----------	----------	120,450	(2)
Utah	56	56	216,200	----------	----------	216,200	----------
West Virginia	387	387	2,002,680	37	(2)	(2)	(2)
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	505	505	2,058,624	9	(2)	(2)	----------
	12,175	12,734	59,394,070	492	[3] 2,994,563	62,388,633	847,700
At merchant plants	3,160	3,440	13,760,065	188	841,880	14,601,945	(2)
At furnace plants	9,015	9,294	45,634,005	304	[3] 2,152,683	47,786,688	(2)

[1] Includes new and replacement ovens in course of construction or reconstruction December 31, 1940, and ordered for completion during 1941.
[2] Bureau of Mines not at liberty to publish figures.
[3] Includes capacity of 73 ovens whose construction was begun after December 31, 1940, but is scheduled for completion during 1941.

TABLE 19.—*Estimated capacity of beehive coke ovens in the United States, December 31, 1940–41, by States*

[Exclusive of screenings or breeze]

State	No. of ovens active, Dec. 31, 1940	No. of ovens in existence Dec. 31, 1940	Estimated maximum annual capacity of existing ovens, Dec. 31, 1940: Reported by operators: No. of ovens	Reported by operators: Capacity (net tons)	Existing ovens for which no capacity was reported: No. of ovens	Existing ovens for which no capacity was reported: Estimated capacity (net tons)	Total capacity at end of 1940 (net tons)	Additional capacity available in 1941[1]: No. of ovens under construction Dec. 31, 1940	Additional capacity available in 1941[1]: Estimated capacity secured by new and replacement ovens (net tons)	Estimated maximum annual capacity available at end of 1941 (net tons)
Pennsylvania	7, 609	11, 067	10, 647	7, 341, 936	420	244, 220	7, 586, 156	1, 350	43, 320	7,629,476
West Virginia	749	926	926	385, 720	------	--------	385, 720	--------	--------	385, 720
Alabama, Kentucky, Tennessee, and Virginia	619	1, 928	1, 327	704, 400	601	354, 200	1, 058, 600	--------	--------	1,058,600
Colorado, Utah, and Washington	171	1, 229	1, 229	611, 184	------	--------	611, 184	--------	--------	611, 184
	9, 148	15, 150	14, 129	9, 043, 240	1, 021	598, 420	9, 641, 660	1, 350	43, 320	9,684,980

[1] Includes new and replacement ovens in course of construction or reconstruction December 31, 1940, and ordered for completion during 1941.

QUANTITY AND COST OF COAL CHARGED

In 1940, byproduct and beehive coke ovens together consumed 81,385,800 tons of coal—18 percent of the total estimated production of bituminous coal for the year—compared with 16 percent in 1939. Of this quantity, byproduct ovens consumed 76,582,800 tons of coal and beehive ovens 4,803,000 tons. Table 20 gives a further indication of the increased activity of the beehive industry in supplementing byproduct production in supplying a rising demand for metallurgical coke by the quantity of coal it has consumed monthly over the 3-year period. The consumption of coal by beehive ovens reached a maximum of 773,600 tons in December 1940, and indications in early 1941 pointed toward even greater requirements.

TABLE 20.—*Coal consumed in coke ovens in the United States, 1938–40, by months, in net tons*

Month	1938			1939			1940		
	Byproduct	Beehive	Total	Byproduct	Beehive	Total	Byproduct	Beehive	Total
January	3, 946. 400	184, 400	4, 130, 800	4, 785, 200	127, 400	4, 912, 600	6, 648, 600	390, 700	7, 039, 300
February	3, 560, 700	164, 700	3, 725, 400	4, 377, 200	116, 800	4, 494, 000	5, 671, 400	254, 700	5, 926, 100
March	3, 818, 100	153, 200	3, 971, 300	4, 890, 000	113, 200	5, 003, 200	5, 824, 900	221, 600	6, 046, 500
April	3, 477, 500	117, 600	3, 595, 100	4, 143, 400	32, 700	4, 176, 100	5, 627, 800	167, 800	5, 795, 600
May	3, 255, 500	92, 000	3, 347, 500	3. 407, 500	40, 900	3, 448, 400	5, 995, 000	173, 900	6, 168, 900
June	2, 948, 600	81, 500	3, 030, 100	4, 392, 300	85, 400	4, 477, 700	6, 179, 500	252, 100	6, 431, 600
July	3, 104, 000	68, 700	3, 172, 700	4. 782, 900	76, 300	4, 859, 200	6, 608, 300	385, 700	6, 994, 000
August	3, 555, 600	78, 900	3, 634, 500	5, 214, 200	72, 700	5, 286, 900	6, 697, 900	464, 500	7, 162, 400
September	3, 792, 600	87, 700	3, 880, 300	5, 556, 700	123, 900	5, 680, 600	6, 619, 200	454, 300	7, 073, 500
October	4, 386, 700	99, 700	4, 486, 400	6, 446, 900	421, 200	6, 868, 100	6, 922. 500	606, 400	7, 528, 900
November	4, 650, 100	109, 100	4, 759, 200	6, 503, 500	570, 500	7, 074, 000	6, 793, 800	657, 700	7, 451, 500
December	4, 770, 500	122, 400	4, 892, 900	6, 716, 100	516, 800	7, 232, 900	6, 993, 900	773, 600	7, 767, 500
	45, 266. 300	1, 359, 900	46, 626, 200	61, 215, 900	2, 297. 800	63, 513, 700	76, 582, 800	4, 803, 000	81, 385, 800

The average cost of coal for byproduct ovens in 1940 was $3.68 a ton as compared with $3.75 in 1939. Coal used for producing beehive coke averaged $1.99 a ton, which was the same as in 1939.

The cost of coal charged into byproduct ovens in 1940 ranged from $2.39 in West Virginia to $5.16 in Minnesota, where it includes freight charges from distant mines. The average cost of coal for beehive ovens is much less than that for byproduct ovens, as the former usually are built at or near the producing mines and therefore benefit from the saving in transportation charges. On the basis of average costs of coal for beehive ovens by States, Virginia was low with $1.78 a ton, while the average cost in the Western States—Colorado, Utah, and Washington combined—was high with $3.61 a ton.

TABLE 21.—*Total quantity and value at ovens of coal used in manufacture of coke in the United States in 1940, by States*

State	Coal used (net tons)	Cost of coal		Coal per ton of coke	
		Total	Average	Net tons	Cost
Byproduct plants:					
Alabama	6,655,710	$16,050,704	$2.41	1.41	$3.40
Colorado	849,977	(1)	(1)	1.56	(1)
Illinois	4,272,553	19,509,125	4.57	1.42	6.49
Indiana	8,756,244	41,362,375	4.72	1.37	6.47
Maryland	2,326,483	(1)	(1)	1.38	(1)
Massachusetts	1,589,587	(1)	(1)	1.41	(1)
Michigan	4,099,657	16,358,719	3.99	1.43	5.71
Minnesota	743,722	3,840,540	5.16	1.42	7.33
New Jersey	1,418,226	(1)	(1)	1.40	(1)
New York	7,121,369	32,496,973	4.56	1.40	6.38
Ohio	11,049,203	41,772,578	3.78	1.40	5.29
Pennsylvania	21,718,501	61,616,315	2.84	1.46	4.15
Tennessee	133,966	464,086	3.46	1.42	4.91
Utah	369,145	(1)	(1)	1.69	(1)
West Virginia	2,751,565	6,578,815	2.39	1.45	3.47
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	2,726,872	12,135,087	4.45	1.34	5.96
Undistributed		29,959,160	4.57		6.54
	76,582,780	282,144,477	3.68	1.42	5.23
At merchant plants	17,460,063	76,745,913	4.40	1.39	6.12
At furnace plants	59,122,717	205,398,564	3.47	1.43	4.96
Beehive plants:					
Colorado, Utah, and Washington	110,370	398,516	3.61	1.58	5.70
Kentucky and Tennessee	10,091	18,139	1.80	1.67	3.01
Pennsylvania	3,997,312	7,911,413	1.98	1.57	3.11
Virginia	330,818	588,399	1.78	1.67	2.97
West Virginia	354,405	652,387	1.84	1.52	2.80
	4,802,996	9,568,854	1.99	1.57	3.12

[1] Included under "Undistributed."

TABLE 22.—*Average cost per net ton of coal charged into byproduct coke ovens in the United States, 1929 and 1937–40, by States*

State	1929	1937	1938	1939	1940	State	1929	1937	1938	1939	1940
Alabama	$2.49	$2.33	$2.53	$2.39	$2.41	Tennessee	$3.02	$3.42	$3.34	$3.50	$3.46
Illinois	4.29	4.62	4.59	4.55	4.57	Washington	5.26	4.87			
Indiana	4.61	4.71	4.90	4.68	4.72	West Virginia	2.41	2.54	2.46	2.33	2.39
Massachusetts	4.70	(1)	(1)	(1)	(1)						
Michigan	4.29	4.16	4.06	4.08	3.99	United States average	3.50	3.74	3.92	3.75	3.68
Minnesota	5.04	5.24	5.53	5.49	5.16						
New York	4.22	4.55	4.71	4.61	4.56	Cost of coal per ton of coke	5.04	5.27	5.61	5.36	5.23
Ohio	3.31	3.76	3.83	3.81	3.78						
Pennsylvania	2.73	2.98	3.20	2.93	2.84						

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

PREPARATION AND SOURCE OF COAL

In Colorado and Tennessee all of the coal used for coking in 1940 was washed. Most of that used in Alabama and more than a third of that used in Pennsylvania was washed prior to charging into the ovens. Other States that employed washed coal for part of their requirements were Illinois, Michigan, New Jersey, New York, Ohio, and West Virginia. This practice usually occurs where the ash or sulfur content of the available coal is high. High ash content of coal charged into coke ovens results in an even higher ash content of the coke produced. Both pneumatic cleaning and wet washing of coal are employed to prepare it for use in coke ovens, in accordance with local conditions throughout the areas concerned with the problem. Sometimes the washing is done by coal producers at the mines and sometimes by coke operators at the plants. In 1940, 19,667,262 tons (26 percent) of the coal consumed in byproduct ovens were washed; the percentage was unchanged from that in 1939. In beehive ovens 680,925 tons (14 percent) of the coal consumed (21 percent in 1939) were washed before charging.

TABLE 23.—*Washed and unwashed coal used in manufacture of byproduct and beehive coke in the United States in 1940, by States in which used, in net tons*

State	Washed	Unwashed	Total
Byproduct plants:			
Alabama	6,159,267	496,443	6,655,710
Colorado	849,977		849,977
Illinois	685,626	3,586,927	4,272,553
Indiana		8,756,244	8,756,244
Maryland		2,326,483	2,326,483
Massachusetts		1,589,587	1,589,587
Michigan	309,155	3,790,502	4,099,657
Minnesota		743,722	743,722
New Jersey	266,587	1,151,639	1,418,226
New York	785,067	6,336,302	7,121,369
Ohio	1,365,139	9,684,064	11,049,203
Pennsylvania	8,133,694	13,584,807	21,718,501
Tennessee	133,966		133,966
Utah		369,145	369,145
West Virginia	934,702	1,816,863	2,751,565
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	44,082	2,682,790	2,726,872
	19,667,262	56,915,518	76,582,780
At merchant plants	1,776,044	15,684,019	17,460,063
At furnace plants	17,891,218	41,231,499	59,122,717
Beehive plants:			
Colorado	95,735		95,735
Pennsylvania	576,372	3,420,940	3,997,312
Tennessee	8,818		8,818
Utah		14,537	14,537
Virginia		330,818	330,818
West Virginia		354,405	354,405
Kentucky and Washington		1,371	1,371
	680,925	4,122,071	4,802,996

Pennsylvania led in the production of coal used in byproduct coke plants, and West Virginia was a close second. Together these States supplied 77 percent of the coal used in byproduct ovens in 1940. Next in order of importance were Kentucky, with 11 percent; Alabama with 9 percent; and Virginia, with 2 percent. The remainder was obtained from Colorado, Georgia, Illinois, New Mexico, Ohio, Tennessee, and Utah; each supplied less than 1 million tons.

TABLE 24.—*Coal purchased for manufacture of byproduct coke in the United States in 1940, by fields of origin, in net tons*

[Based upon detailed reports from each coke plant. Difference between these totals and those shown in tables 1, 11, 20, 21, etc., is due to change in stock, loss of weight in handling, and the fact that these sometimes represent purchases during year rather than actual consumption]

State and district where coal was produced	Total purchased	States where coal was consumed—in order of importance
Alabama	6,716,803	Alabama.
Colorado:		
Canon, Crested Butte, and Walsen	126,890	Colorado.
Trinidad	719,543	Do.
Georgia	14,423	Tennessee.
Illinois: Southern	214,845	Illinois.
Kentucky, Eastern:		
Elkhorn (including Hazard)	2,067,341	Indiana, Ohio, New York, Illinois, New Jersey, Michigan, Minensota, and Wisconsin.
Harlan	4,254,922	Indiana, Illinois, Ohio, Minnesota, Michigan, New York, and Wisconsin.
Kenova-Thacker	1.709,299	Michigan, Ohio, Wisconsin, and West Virginia.
Miscellaneous	181,716	Indiana and Missouri.
New Mexico	4,413	Colorado.
Ohio	972	Ohio.
Pennsylvania:		
Central Pennsylvania:		
Medium-volatile	574,035	New York and Pennsylvania.
Low-volatile	1,738,156	Pennsylvania, New York, and Maryland.
Connellsville	17,868,048	Pennsylvania, Ohio, West Virginia, New York, Illinois, Minnesota, Indiana, and Michigan.
Freeport	1,982,018	Ohio, West Virginia, Michigan, New York, and Pennsylvania.
Pittsburgh	9,627,541	Pennsylvania, New York, Ohio, Michigan, Illinois, and Wisconsin.
Somerset	662,302	Pennsylvania and West Virginia.
Westmoreland	915,380	Pennsylvania, New York, Minnesota, Ohio, Wisconsin, and Maryland.
Miscellaneous	32,905	Pennsylvania.
Tennessee	116,138	Tennessee.
Utah	369,145	Utah.
Virginia: Southwestern [1]	671,527	Michigan, New York, New Jersey, Ohio, and Illinois.
West Virginia: [1]		
Coal and Coke	85,044	Pennsylvania.
Kanawha-Logan	8,529,353	Massachusetts, Ohio, Indiana, New Jersey, Illinois, New York, Kentucky, West Virginia, Michigan, Wisconsin, Pennsylvania, Connecticut, Rhode Island, Missouri, and Minnesota.
New River:		
High-volatile	486,874	New York, Massachusetts, and Connecticut.
Low-volatile (including Winding Gulf).	2,245,900	Massachusetts, New York, New Jersey, Michigan, Missouri, Rhode Island, Pennsylvania, Illinois, West Virginia, Connecticut, Kentucky, Maryland, Minnesota, and Ohio.
Northern	3,666,260	Maryland, Pennsylvania, Ohio, Michigan, and West Virginia.
Pocahontas (including Tug River)	11,578,864	Indiana, Ohio, Illinois, New York, Michigan, Maryland, Wisconsin, Pennsylvania, Minnesota, Kentucky, Connecticut, Alabama, Massachusetts, Tennessee, and West Virginia.
Webster-Gauley	182,586	Pennsylvania and New York.
	77,343,243	

[1] Coal from extension of the Pocahontas field in Virginia is included under Pocahontas district, West Virginia.

TABLE 25.—*Coal purchased for manufacture of byproduct coke in the United States in 1940, by States where produced and where consumed and by merchant and furnace plants, in net tons*

State where coal was consumed	Coal produced in—												
	Alabama	Colorado	Georgia	Illinois	Kentucky	New Mexico	Ohio	Pennsylvania	Tennessee	Utah	Virginia	West Virginia	Total
Alabama: Merchant plants	1,064,346											89,951	1,154,297
Furnace plants	5,652,457											16,284	5,668,741
Total Alabama	6,716,803											106,235	6,823,038
Colorado: Furnace plants		846,433				4,413							850,846
Illinois: Merchant plants				214,845	113,804			110,855			12,949	1,299,043	1,751,496
Furnace plants					1,132,301			476,740				955,560	2,564,601
Total Illinois				214,845	1,246,105			587,595			12,949	2,254,603	4,316,097
Indiana: Merchant plants												617,093	617,093
Furnace plants					3,783,497			34,606			574,300	3,714,192	8,106,595
Total Indiana					3,783,497			34,606			574,300	4,331,285	8,723,688
Maryland: Furnace plants								20,589				2,315,991	2,336,580
Massachusetts: Merchant plants												1,590,249	1,590,249
Michigan: Merchant plants					85,018			217,776			(1)	(1)	2 302,794
Furnace plants					1,327,631			317,341			207,387	899,613	2,751,972
Total Michigan					1,412,649			535,117			2 207,387	2 899,613	2 3,054,766
Minnesota: Merchant plants					43,625			75,349				199,390	318,364
Furnace plants					215,252			140,022				153,708	508,982
Total Minnesota					258,877			215,371				353,098	827,346
New Jersey: Merchant Plants					107,612						125,635	1,180,936	1,414,183
New York: Merchant plants					256,264			2,079,192			135,820	1,726,852	4,198,128
Furnace plants								2,357,640				856,371	3,214,011
Total New York					256,264			4,436,832			135,820	2,583,223	7,412,139
Ohio: Merchant plants											(1)	(1)	(1)
Furnace plants					1,067,471		972	5,978,796				3,299,608	10,346,847
Total Ohio					1,067,471		972	5,978,796			(1)	2 3,299,608	2 10,346,847

Pennsylvania: Merchant plants								111, 263				628, 325	739, 588
Furnace plants								19, 552, 869				1, 445, 020	20, 997, 889
Total Pennsylvania								19, 664, 132				2, 073, 345	21, 737, 477
Tennessee: Merchants plant			14, 423						116, 138			3, 405	133, 966
Utah: Furnace plants										369, 145			369, 145
West Virginia: Merchant plants								9, 183				862, 462	871, 645
Furnace plants					2, 056			1, 874, 082				1, 925	1, 878, 063
Total West Virginia					2, 056			1, 883, 265				864, 387	2, 749, 708
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin: Merchant plants					78, 747			44, 082				2, 646, 987	2, 769, 816
Undistributed: Merchant plants											189, 736	1, 697, 616	1, 887, 352
	6, 716, 803	846, 433	14, 423	214, 845	8, 213, 278	4, 413	972	33, 400, 385	116, 138	369, 145	1, 245, 827	26, 200, 581	77, 343, 243
At merchant plants	1, 064, 346		14, 423	214, 845	685, 070			2, 647, 700	116, 138		464, 140	12, 542, 309	17, 748, 971
At furnace plants	5, 652, 457	846, 433			7, 528, 208	4, 413	972	30, 752, 685		369, 145	781, 687	13, 658, 272	59, 594, 272

[1] Included under "Undistributed."
[2] Excludes items included under "Undistributed."

As an important adjunct of coal-preparation operations, the practice of mixing various types of coking coals before charging into the ovens is employed to a large extent in the byproduct-coke industry. This practice has several aims and takes into account factors important to the byproduct-plant operators concerned. Primarily it is designed to produce, economically, coke of satisfactory quality for the use for which it is intended. Some coals that have characteristics favorable for producing high-quality coke expand when coked; therefore their use alone would cause difficulty in discharging the coke and possibly some destructive effect on most byproduct-oven walls. However, these can be utilized by mixing them with other coking coals that neutralize this expansion upon coking, thereby eliminating this harmful effect. From an economic standpoint, mixing permits the usage of coals which have good coking properties but may have objectionable chemical analysis with reference to the limits of content of the several undesirable constituents, such as ash, sulfur, and phosphorus, and which for that reason could not be used as a 100-percent charge into the ovens to produce coke to conform with specifications upon this basis. Further, the mixing of coking coals provides a means of controlling the quality and strength of the coke and the yield of byproducts and permits flexible operation of byproduct plants with reference to the supply of coking coals.

A classification of all coal purchased for coking in byproduct ovens in 1940, as reported by the operators, indicated that 49,385,976 tons (64 percent) contained over 32 percent volatile matter; 16,395,484 tons (21 percent), 14 to 22 percent volatile matter; and 11,561,783 tons (15 percent), 23 to 31 percent volatile matter.

During 1940, 64 of the 85 byproduct plants that were active purchased coals of different volatile content. Both low-and high-volatile coals were purchased by 49 plants; low-, medium-, and high-volatile coals were purchased by 12 plants; and low- and medium-volatile coals were purchased by 3 plants. Of the 21 plants that did not purchase coals of different volatile-content classification, 15 purchased high-volatile coal and 6 medium-volatile coal. Table 26 shows the purchases, by States, of the coals used in the manufacture of byproduct coke, classified as to volatile content.

TABLE 26.—*Coal purchased for manufacture of byproduct coke in the United States in 1940, by States where consumed, and by volatile content, in net tons* [1]

State where coal was consumed	Low-volatile	Percent of total	Medium-volatile	Percent of total	High-volatile	Percent of total	Total coal consumed
Alabama: Merchant plants	89,951	7.8	1,064,346	92.2			1,154,297
Furnace plants	16,284	.3	5,652,457	99.7			5,668,741
Total Alabama	106,235	1.6	6,716,803	98.4			6,823,038
Colorado: Furnace plants			719,543	84.6	131,303	15.4	850,846
Illinois: Merchant plants	494,271	28.2	813,434	46.5	443,791	25.3	1,751,496
Furnace plants	955,560	37.3			1,609,041	62.7	2,564,601
Total Illinois	1,449,831	33.6	813,434	18.8	2,052,832	47.6	4,316,097
Indiana: Merchant plants	264,629	42.9	352,464	57.1			617,093
Furnace plants	3,792,634	46.8			4,313,961	53.2	8,106,595
Total Indiana	4,057,263	46.5	352,464	4.0	4,313,961	49.5	8,723,688
Maryland: Furnace plants	572,330	24.5	567,546	24.3	1,196,704	51.2	2,336,580
Massachusetts: Merchant plants	476,839	30.0	288,287	18.1	825,123	51.9	1,590,249
Michigan: Merchant plants	504,027	48.9	(2)		526,298	51.1	[3] 1,030,325
Furnace plants	619,758	22.5			2,132,214	77.5	2,751,972
Total Michigan	1,123,785	29.7	(2)		2,658,512	70.3	[3] 3,782,297
Minnesota: Merchant plants	69,243	21.7			249,121	78.3	318,364
Furnace plants	153,708	30.2			355,274	69.8	508,982
Total Minnesota	222,951	26.9			604,395	73.1	827,346
New Jersey: Merchant plants	314,877	22.3	34,755	2.4	1,064,551	75.3	1,414,183
New York: Merchant plants	597,791	14.2	1,020,631	24.3	2,579,706	61.5	4,198,128
Furnace plants	853,884	26.6	20,745	.6	2,339,382	72.8	3,214,011
Total New York	1,451,675	19.6	1,041,376	14.0	4,919,088	66.4	7,412,139
Ohio: Merchant plants	256,855	30.5			584,856	69.5	841,711
Furnace plants	2,764,960	26.7	109,376	1.1	7,472,511	72.2	10,346,847
Total Ohio	3,021,815	27.0	109,376	1.0	8,057,367	72.0	11,188,558

See footnotes at end of table.

TABLE 26.—*Coal purchased for manufacture of byproduct coke in the United States in 1940, by States where consumed, and by volatile content, in net tons*—Continued

State where coal was consumed	Low-volatile	Percent of total	Medium-volatile	Percent of total	High-volatile	Percent of total	Total coal consumed
Pennsylvania: Merchant plants	160, 288	21.7	227, 949	30.8	351, 351	47.5	739, 588
Furnace plants	2, 293, 844	10.9	130, 271	.6	18, 573, 774	88.5	20, 997, 889
Total Pennsylvania	2, 454, 132	11.3	358, 220	1.6	18, 925, 125	87.1	21, 737, 477
Tennessee: Merchant plants	3, 405	2.5	130, 561	97.5	-----	-----	133, 966
Utah: Furnace plants	-----	-----	-----	-----	369, 145	100.0	369, 145
West Virginia: Merchant plants	81, 799	9.4	9, 183	1.1	780, 663	89.5	871, 645
Furnace plants	143, 317	7.6	-----	-----	1, 734, 746	92.4	1, 878, 063
Total West Virginia	225, 116	8.2	9, 183	.3	2, 515, 409	91.5	2, 749, 708
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin: Merchant plants	915, 230	34.3	(2)	-----	1, 752, 461	65.7	[3] 2, 667, 691
Undistributed: Merchant plants	-----	-----	420, 235	100.0	-----	-----	420, 235
	16, 395, 484	21.2	11, 561, 783	14.9	49, 385, 976	63.9	77, 343, 243
At merchant plants	4, 229, 205	23.8	4, 361, 845	24.5	9, 157, 921	51.6	17, 748, 971
At furnace plants	12, 166, 279	20.4	7, 199, 938	12.1	40, 228, 055	67.5	59, 594, 272

[1] Low-volatile coals range from 14 to 22 percent volatile matter; medium-volatile, from 23 to 31 percent volatile matter; and high-volatile, 32 percent and over.
[2] Included under "Undistributed."
[3] Excludes items included under "Undistributed."

YIELD OF COKE PER TON OF COAL

TABLE 27.—*Yield of coke from coal in byproduct and beehive ovens in the United States, 1937–40, by States, in percent*

State	1937		1938		1939		1940	
	Byproduct	Beehive	Byproduct	Beehive	Byproduct	Beehive	Byproduct	Beehive
Alabama	72.37		70.93		71.01		71.03	
Colorado	67.36	55.71	66.79	65.01	66.03	65.41	63.95	65.20
Illinois	70.54		67.05		68.12		70.56	
Indiana	72.04		70.32		70.26		73.24	
Maryland	72.62		72.14		72.88		72.33	
Massachusetts	69.99		70.42		70.72		71.11	
Michigan	71.05		69.17		69.34		70.06	
Minnesota	70.27		70.19		69.92		70.50	
New Jersey	70.78		71.84		71.05		71.67	
New York	71.75		71.14		71.16		71.34	
Ohio	71.61		71.02		71.09		71.48	
Pennsylvania	68.83	65.50	68.46	63.00	68.71	63.42	68.43	63.80
Tennessee	69.00	53.89	68.70	55.00	73.00		70.51	59.55
Utah	56.67	54.25	58.08	48.94	58.38	60.27	59.31	50.89
Virginia		58.33		57.04		56.87		59.97
Washington	56.11							60.20
West Virginia	70.67	61.74	68.02	61.40	68.12	67.04	69.05	65.79
United States average	70.73	64.23	69.94	61.58	70.05	62.86	70.53	63.66

COKE BREEZE

TABLE 28.—*Coke breeze recovered at coke plants in the United States in 1940, by States*

State	Yield per ton of coal (percent)[1]	Produced		Used by producer: For steam raising		Used by producer: For other purposes, including water gas		Sold		Wasted (net tons)	On hand Dec. 31 (net tons)
		Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value		
Byproduct ovens:											
Alabama	4.53	301,299	$520,846	149,533	$207,850	17,127	$28,474	144,984	$306,268		49,996
Colorado	8.03	68,233	(2)	24,017	(2)			27,208	(2)	17,008	
Illinois	5.92	253,055	577,525	165,676	415,466	6,739	21,159	88,841	186,206		39,066
Indiana	4.69	410,887	853,164	259,533	566,967	120,124	222,811	20,544	43,716		27,098
Maryland	8.00	186,194	(2)	134,743	(2)	33,782	(2)				60,972
Massachusetts	7.40	117,554	(2)	92,530	(2)	5,756	(2)	32,466	(2)		5,578
Michigan	4.83	197,977	881,426	159,765	713,853	18,744	77,236	13,418	55,182		11,768
Minnesota	6.01	44,670	130,092	30,844	77,218	4,572	11,885	18,182	63,509		7,807
New Jersey	5.82	82,492	(2)	79,723	(2)			1,603	(2)		3,543
New York	4.50	320,284	897,937	180,893	499,347	70,733	210,022	68,271	188,966		60,742
Ohio	4.83	534,005	1,036,019	387,063	743,732	108,718	206,886	48,197	99,565		78,685
Pennsylvania	5.86	1,266,138	2,102,173	1,116,141	1,827,384	57,077	86,305	60,305	132,200		52,586
Tennessee	5.26	7,044	26,415					7,329	27,484		2,059
Utah	5.27	19,457	(2)	5,526	(2)	6,092	(2)	11,507	(2)		4,083
West Virginia	4.98	107,395	123,058	90,505	99,784	16,241	16,558	24,305	30,316		5,075
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	5.92	161,353	465,307	136,578	377,178	166	315	36,497	114,414		10,809
Undistributed			858,152		610,235		76,532		130,144		
Total byproduct, 1940	5.37	4,078,037	8,472,114	3,013,070	6,139,014	465,871	958,183	603,657	1,377,970	17,008	419,867
At merchant plants	5.93	994,710	2,568,537	697,253	1,788,579	44,710	123,426	308,075	799,965		142,612
At furnace plants	5.22	3,083,327	5,903,577	2,315,817	4,350,435	421,161	834,757	295,582	578,005	17,008	277,255
Total byproduct, 1939	5.52	3,354,374	7,271,050	2,455,057	5,108,827	408,577	953,608	512,375	1,264,743		335,709
Beehive ovens:											
Colorado, Utah, and Washington	4.46	4,922	4,644					4,922	4,644		71
Kentucky and Tennessee	2.28	29	55			29	55				
Pennsylvania	3.03	72,691	94,384	9,154	10,581	115	150	17,733	20,182	40,258	5,517
Virginia	.75	687	2,445			124	542	281	933	395	20
West Virginia	2.59	9,087	9,996					1,235	1,358	7,852	
Total beehive, 1940	2.79	87,416	111,524	9,154	10,581	268	747	24,171	27,117	[3] 48,505	5,608

[1] Yield computed by dividing production of breeze by the coal charged at the plants actually recovering.
[2] Included under "Undistributed."
[3] As reported: quantity produced but not used was undoubtedly greater. See Mineral Resources of the United States, 1922, part 2, pp. 726–727

CONSUMPTION OF COKE

Allowing for imports, exports, and changes in producers' stocks, the indicated consumption of coke in 1940 was 57,026,246 tons. Of this quantity, 41,839,039 tons (73 percent) were—according to figures compiled by the American Iron and Steel Institute—consumed by blast furnaces in the manufacture of pig iron and ferro-alloys. The remainder (27 percent) was used in foundries, in smelting the nonferrous metals, in the manufacture of water gas, in miscellaneous other industrial uses, and in domestic heating.

The improvement in the efficiency of fuel utilization in blast-furnace operation during recent years is shown by the fact that the quantity of coking coal required per net ton of pig iron and ferro-alloys has dropped from 3,247.5 pounds in 1913 to 2,540.9 in 1940. In terms of coke, 1,781.2 pounds were required per ton of pig iron and ferro-alloys in 1940 compared with 2,172.6 in 1913.

TABLE 29.—*Coke consumed in manufacture of pig iron and for other purposes in the United States, 1913, 1918, and 1937–40, in net tons*

Year	Total production of coke	Imports	Exports	Net changes in stocks	Indicated United States consumption [1]	Consumed by iron furnaces [2]		Remainder consumed in other ways	
						Quantity	Percent	Quantity	Percent
1913	46,299,530	101,212	987,395	(3)	45,413,347	37,192,287	81.9	8,221,060	18.1
1918	56,478,372	30,168	1,687,824	(3)	54,820,716	45,703,594	83.4	9,117,122	16.6
1937	52,375,469	286,364	526,683	+863,221	51,271,929	33,571,349	65.5	17,700,580	34.5
1938	32,495,815	135,240	486,571	+1,081,267	31,063,217	19,035,270	61.3	12,027,947	38.7
1939	44,326,641	141,911	589,925	−1,074,455	44,953,082	31,422,272	69.9	13,530,810	30.1
1940	57,072,134	112,550	804,095	−645,657	57,026,246	41,839,039	73.4	15,187,207	26.6

[1] Production plus imports minus exports, plus or minus the decrease or increase, respectively, of the net changes in stocks.
[2] From Report of American Iron and Steel Institute. Figures include coke consumed in the manufacture of ferro-alloys.
[3] Data not available.

TABLE 30.—*Coke and coking coal consumed per net ton of pig iron made in the United States, 1913, 1918, and 1937–40*

Year	Coke per net ton of pig iron and ferro-alloys [1] (pounds)	Yield of coke from coal (percent)	Coking coal per net ton of pig iron and ferro-alloys calculated (pounds)	Year	Coke per net ton of pig iron and ferro-alloys [1] (pounds)	Yield of coke from coal (percent)	Coking coal per net ton of pig iron and ferro alloys calculated (pounds)
1913	2,172.6	66.9	3,247.5	1938	1,801.0	69.7	2,583.9
1918	2,120.7	66.4	3,193.8	1939	1,778.0	69.8	2,547.3
1937	1,830.6	70.3	2,604.0	1940	1,781.2	70.1	2,540.9

[1] From report of American Iron and Steel Institute; the consumption per ton of pig iron only, excluding the furnaces making ferro-alloys, was 2,172.6 in 1913, 2,120.7 in 1918, 1,806.7 in 1937, 1,774.6 in 1938, 1,760.0 in 1939, and 1,756.9 in 1940.

FURNACE, FOUNDRY, DOMESTIC, AND OTHER COKE

The terms "furnace coke" and "foundry coke," as used in the trade, refer to the size and grade of the coke, as well as to the use for which it may be intended. Byproduct furnace coke is usually run-of-oven coke from which the breeze and all small coke have been removed. Byproduct foundry coke is usually a blocky coke larger than furnace coke, from which all sizes under 2½ to 3 inches are screened out. Coke smaller than furnace and foundry (excluding breeze) is often called domestic coke. It may result from the screening of furnace or foundry coke or, where the demand for domestic coke is greater, may be obtained by crushing the larger product. Other sizes and grades may be prepared for special purposes. Thus, not all furnace coke finds its way to blast furnaces or all foundry coke to foundries proper, for either grade may be purchased by other classes of consumers.

Coke is burned as a domestic fuel chiefly under two regional conditions—in areas where there is a surplus production of metallurgical coke, or when the manufacture and distribution of large quantities of city gas as a primary objective result in the yield of correspondingly large quantities of coke that also must find a market. The consumption of coke for domestic heating tends to be localized in regions near centers of production. A majority of the coking plants are equipped to screen and size coke for domestic use.

In 1940, byproduct coke sold for furnace use, including all coke sold to financially affiliated corporations, totaled 5,134,395 tons—26 percent more than 1939. The sales for other uses and their increase over 1939 are as follows: Foundry use, 1,858,664 tons (25 percent); domestic use, 8,131,947 tons (8 percent); and other industrial, including that used in the manufacture of water gas, 1,754,917 tons (16 percent).

Beehive coke sold for furnace use in 1940 totaled 1,799,292 tons—an increase of 175 percent over 1939. The percentages of increase for other uses are as follows: Foundry use, 16 percent; domestic use, 12 percent; and other industrial use, 7 percent.

TABLE 31.—*Byproduct coke produced and sold or used by producer in the United States in 1940, by States*

[Exclusive of screenings or breeze]

State	Produced		Used by producer in blast furnaces [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	4, 727, 378	$13, 748, 837	3, 767, 651	$9, 384, 128	(4)	(4)	(4)	(4)	138, 263	$526, 028	135, 215	$648, 615	911, 910	$4, 278, 444
Colorado	543, 548	(4)	515, 329	(4)	----------	----------	7, 375	(4)	427	(4)	20, 102	(4)	27, 904	(4)
Illinois	3, 014, 840	18, 217, 939	2, 001, 868	11, 528, 557	(4)	(4)	(4)	(4)	799, 143	4, 555, 131	87, 932	481, 122	1, 113, 497	7, 316, 667
Indiana	6, 412, 716	37, 308, 469	5, 725, 874	33, 103, 046	(4)	(4)	(4)	(4)	390, 134	1, 798, 599	101, 029	430, 456	749, 867	4, 645, 498
Maryland	1, 682, 701	(4)	1, 599, 462	(4)	----------	----------	----------	----------	24, 898	(4)	49, 441	(4)	74, 339	(4)
Massachusetts	1, 130, 311	(4)	176, 147	(4)	4, 738	(4)	52, 896	(4)	928, 596	(4)	42, 961	(4)	1, 029, 191	(4)
Michigan	2, 872, 026	15, 445, 452	1, 236, 258	5, 948, 942	131, 656	$686, 123	(4)	(4)	1, 202, 890	6, 234, 113	(4)	(4)	1, 689, 300	9, 834, 587
Minnesota	524, 360	3, 662, 908	243, 694	1, 442, 668	(4)	(4)	(4)	(4)	319, 892	2, 586, 758	41, 605	269, 284	381, 708	2, 961, 693
New Jersey	1, 016, 481	(4)	224, 955	(4)	25, 514	(4)	36, 792	(4)	493, 165	(4)	266, 488	(4)	821, 959	(4)
New York	5, 080, 403	29, 519, 871	1, 687, 817	9, 659, 447	1, 702, 303	8, 782, 408	(4)	(4)	1, 562, 396	10, 253, 097	(4)	(4)	3, 466, 236	20, 303, 866
Ohio	7, 897, 929	38, 568, 313	6, 437, 319	30, 958, 561	619, 976	3, 248, 516	294, 565	$1, 890, 849	446, 049	2, 083, 583	111, 589	600, 051	1, 472, 179	7, 822, 999
Pennsylvania	14, 861, 657	58, 619, 692	12, 190, 468	45, 231, 582	1, 734, 784	7, 181, 124	203, 501	1, 924, 640	636, 141	3, 54 , 049	233, 093	1, 379, 336	2, 807, 519	14, 029, 149
Tennessee	94, 454	588, 448	44, 481	222, 405	----------	----------	32, 227	249, 759	19, 102	109, 837	28, 937	195, 325	80, 266	554, 921
Utah	218, 949	(4)	163, 878	(4)	123	(4)	----------	----------	2, 113	(4)	50, 209	(4)	52, 445	(4)
West Virginia	1, 899, 849	5, 135, 184	1, 705, 118	4, 111, 375	(4)	(4)	(4)	(4)	54, 592	239, 243	(4)	(4)	207, 293	1, 064, 524
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	2, 036, 707	13, 197, 673	144, 921	960, 532	415, 938	1, 880, 355	197, 128	1, 973, 720	1, 114, 146	7, 454, 990	267, 098	1, 630, 660	1, 994, 310	12, 939, 725
Undistributed	----------	26, 343, 780	----------	13, 579, 212	499, 363	1, 941, 933	1, 034, 180	10, 077, 080	----------	9, 628, 848	319, 218	4, 646, 649	----------	13, 380, 208
Grand total, 1940	54, 014, 309	260, 356, 566	37, 865, 240	166, 130, 455	5, 134, 395	23, 720, 459	1, 858, 664	16, 116, 048	8, 131, 947	49, 014, 276	1, 754, 917	10,281,498	16, 879, 923	99, 132, 281
At merchant plants	12, 549, 132	78, 554, 814	1, 938, 075	10, 331, 167	2, 037, 899	10, 389, 111	1, 439, 213	13, 132, 280	6, 454, 983	41, 096, 335	1, 256, 517	7, 602, 537	11, 188, 612	72, 220, 263
At furnace plants	41, 465, 177	181, 801, 752	35, 927, 165	155, 799, 288	3, 096, 496	13, 331, 348	419, 451	2, 983, 768	1, 676, 964	7, 917, 941	498, 400	2, 678, 961	5, 691, 311	26, 912, 018
Grand total, 1939	42, 882, 313	206, 457, 873	29, 264, 241	127, 515, 006	4, 079, 235	18, 893, 662	1, 482, 846	12, 087, 253	7, 549, 937	44, 511, 672	1, 506, 683	8, 495, 722	14, 618, 701	83, 988, 309

[1] Includes 1,529,239 net tons valued at $7,953,324 used to make producer or water gas and 440,067 tons, $2,290,494 used for other purposes than in blast furnaces.
[2] Includes 2,686,737 net tons valued at $11,407,387 sold to financially affiliated corporations for blast furnace use; 973,004 tons, $5,606,034 sold for other purposes; and 1,474,654 tons, $6,707,038 reported as merchant sales.
[3] Includes 569,150 net tons valued at $3,673,636 sold for manufacture of water gas.
[4] Included under "Undistributed."

TABLE 32.—*Beehive coke produced and sold or used by producer in the United States in 1940, by States*

State	Produced		Used by producer in blast furnace [1]		Sold			
					Furnace [2]		Foundry	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Colorado, Utah, and Washington	69,874	$483,552	(4)	(4)			(4)	(4)
Kentucky and Tennessee	6,051	33,490			(4)	(4)	(4)	(4)
Pennsylvania	2,550,367	10,979,384	609,556	$2,767,433	1,540,216	$6,596,568	158,172	$782,492
Virginia	198,379	943,753			64,350	306,953	43,775	222,176
West Virginia	233,154	1,035,665	(4)	(4)	(4)	(4)	26,654	161,896
Undistributed			62,815	439,337	194,726	832,959	2,697	16,244
Total: 1940	3,057,825	13,475,844	672,371	3,206,770	1,799,292	7,736,480	231,298	1,182,808
1939	1,444,328	6,426,177	220,820	1,141,729	654,901	2,845,064	199,354	949,269

State	Sold—Continued					
	Domestic use		Industrial and other use (including water gas) [3]		Total	
	Net tons	Value	Net tons	Value	Net tons	Value
Colorado, Utah, and Washington	(4)	(4)	7,794	$48,329	7,867	$48,885
Kentucky and Tennessee	(4)	(4)	334	1,809	4,888	27,431
Pennsylvania	95,903	$373,307	185,612	713,132	1,979,903	8,465,499
Virginia	1,483	5,754	91,899	423,119	201,507	958,002
West Virginia	(4)	(4)	11,881	44,565	233,011	1,035,790
Undistributed	1,680	6,304				
Total: 1940	99,066	385,365	297,520	1,230,954	2,427,176	10,535,607
1939	88,204	311,135	277,304	1,151,986	1,219,763	5,257,454

[1] Includes 4,940 net tons valued at $22,153 used for other purposes than in blast furnaces.
[2] Includes 207,282 net tons valued at $931,555 sold to financially affiliated corporations for blast-furnace use; 40,424 tons, $197,265 sold for other purposes; and 1,551,586 tons, $6,607,660 reported as merchant sales.
[3] Includes 108,935 net tons valued at $385,354, sold for manufacture of water gas.
[4] Included under "Undistributed."

TABLE 33.—*Total supply of coke in the United States, classified as furnace, foundry, other industrial, and domestic, 1915–16, 1918–21, 1923, 1925, 1927, 1929, and 1931–40 in net tons*

[Exclusive of screenings or breeze]

Year	Furnace (including all coke used by producer)[1]	Foundry	Other industrial and domestic			Total sold and used by producer[3]
			Other industrial (not including coke used by producer)[2]	Domestic	Total	
By product:						
1915	(4)	(4)	(4)	(4)	(4)	(4)
1916	(4)	(4)	(4)	(4)	(4)	(4)
1918	21,901,043	1,631,052	(5)	(5)	2,537,059	26,069,154
1919	22,444,563	1,480,516	(5)	(5)	2,885,270	26,810,349
1920	26,903,425	1,715,982	(5)	(5)	2,361,737	30,981,144
1921	16,063,714	736,391	(5)	(5)	1,679,911	18,480,016
1923	30,829,347	1,897,955	1,638,226	2,637,518	4,275,744	37,003,046
1925	32,601,679	1,833,372	2,072,635	4,085,068	6,157,703	40,592,754
1927	34,613,722	1,938,653	2,022,838	4,702,529	6,725,367	43,277,742
1929	41,862,839	2,114,690	1,693,223	7,376,320	9,069,543	53,047,072
1931	20,140,393	1,106,518	1,551,613	8,376,652	9,928,265	31,175,176
1932	10,422,925	908,518	1,095,624	9,422,343	10,517,967	21,849,410
1933	14,670,392	833,633	1,550,268	10,215,360	11,765,628	27,269,653
1934	17,333,587	1,077,216	1,573,483	10,174,114	11,747,597	30,158,400
1935	22,467,069	1,299,836	1,913,607	9,161,980	11,075,587	34,842,492
1936	32,699,393	1,672,538	1,512,688	9,643,507	11,156,195	45,528,126
1937	37,275,525	1,700,405	1,596,290	7,807,792	9,404,082	48,380,012
1938	21,244,761	1,051,143	1,188,262	7,129,384	8,317,646	30,613,550
1939	33,343,476	1,482,846	1,506,683	7,549,937	9,056,620	43,882,942
1940	42,999,635	1,858,664	1,754,917	8,131,947	9,886,864	54,745,163
Beehive:						
1915	(4)	(4)	(4)	(4)	(4)	(4)
1916	(4)	(4)	(4)	(4)	(4)	(4)
1918	28,101,945	2,230,156	(5)	(5)	210,511	30,542,612
1919	17,598,092	1,349,483	(5)	(5)	143,930	19,091,505
1920	18,393,698	1,807,256	(5)	(5)	192,142	20,393,096
1921	4,453,190	1,011,343	(5)	(5)	56,874	5,521,407
1923	16,945,061	1,702,764	645,662	95,896	741,558	19,389,383
1925	9,408,655	1,153,665	572,949	392,698	965,647	11,527,967
1927	5,703,408	809,590	569,749	111,103	680,852	7,193,850
1929	4,922,883	773,818	641,776	134,703	776,479	6,473,180
1931	467,782	250,758	286,953	118,665	405,618	1,124,158
1932	101,571	146,253	199,666	207,857	407,523	655,347
1933	152,176	171,252	286,719	275,677	562,396	885,824
1934	171,158	184,923	319,112	346,181	665,293	1,021,374
1935	119,544	184,617	322,505	264,406	586,911	891,072
1936	556,187	249,279	520,086	377,836	897,922	1,703,388
1937	2,027,198	338,417	450,850	299,726	750,576	3,116,191
1938	315,141	164,637	284,078	93,306	377,384	857,162
1939	875,721	199,354	277,304	88,204	365,508	1,440,583
1940	2,471,663	231,298	297,520	99,066	396,586	3,099,547
Total:						
1915 [6]	36,702,573	1,664,548	(5)	(5)	1,974,102	40,341,223
1916 [6]	47,875,153	2,680,104	(5)	(5)	2,616,320	53,171,577
1918	50,002,988	3,861,208	(5)	(5)	2,747,570	56,611,766
1919	40,042,655	2,829,999	(5)	(5)	3,029,200	45,901,854
1920	45,297,123	3,523,238	(5)	(5)	2,553,879	51,374,240
1921	20,516,904	1,747,734	(5)	(5)	1,736,785	24,001,423
1923	47,774,408	3,600,719	2,283,888	2,733,414	5,017,302	56,392,429
1925	42,010,334	2,987,037	2,645,584	4,477,766	7,123,350	52,120,721
1927	40,317,130	2,748,243	2,592,587	4,813,632	7,406,219	50,471,592
1929	46,785,722	2,888,508	2,334,999	7,511,023	9,846,022	59,520,252
1931	20,608,175	1,357,276	1,838,566	8,495,317	10,333,883	32,299,334
1932	10,524,496	1,054,771	1,295,290	9,630,200	10,925,490	22,504,757
1933	14,822,568	1,004,885	1,836,987	10,491,037	12,328,024	28,155,477
1934	17,504,745	1,262,139	1,892,595	10,520,295	12,412,890	31,179,774
1935	22,586,613	1,484,453	2,236,112	9,426,386	11,662,498	35,733,564
1936	33,255,580	1,921,817	2,032,774	10,021,343	12,054,117	47,231,514
1937	39,302,723	2,038,822	2,047,140	8,107,518	10,154,658	51,496,203
1938	21,559,902	1,215,780	1,472,340	7,222,690	8,695,030	31,470,712
1939	34,219,197	1,682,200	1,783,987	7,638,141	9,422,128	45,323,525
1940	45,471,298	2,089,962	2,052,437	8,231,013	10,283,450	57,844,710

[1] Sales of furnace coke plus total quantity reported "used by producer." Includes coke consumed for other than blast-furnace use.
[2] Includes coke sold for manufacture of water gas.
[3] These figures represent quantity distributed in year without taking into account changes in producers' stocks and therefore differ slightly from published totals of production. In 1915 and 1916, moreover, they do not include quantity exported.
[4] Separate figures for by-product and beehive not available.
[5] "Other industrial" and "domestic" were not reported separately before 1923.
[6] Figures do not include exports and hence are not strictly comparable with other years.

STOCKS OF COKE AND COKING COAL

As a general rule, stocks of coke held by producers decline when pig-iron and coke production increases. At the end of 1940, 1,913,134 tons of byproduct coke were on hand, 26 percent below the stocks at the beginning of the year. During the same period, stocks of furnace coke declined 12 percent; of foundry coke, 72 percent; and of domestic and other coke, 29 percent. Beehive plants carry small stocks of coke; at the end of 1940, only 43,308 tons were in reserve.

TABLE 34.—*Stocks of furnace, foundry, and domestic coke and of breeze in the United States on January 1, 1941, by States, in net tons*

State	Coke				Breeze
	Furnace	Foundry	Domestic and other	Total	
Byproduct plants:					
Alabama	98,442	4,756	28,287	131,485	49,996
Colorado	1,349	330		1,679	
Illinois	18,640	878	222,958	242,476	39,066
Indiana	49,873	563	18,744	69,180	27,098
Maryland	45,414			45,414	60,972
Massachusetts	106	495	185,685	186,286	5,578
Michigan	2,244	(1)	24,335	(2) 26,579	(1)
Minesota	7,504	492	149,253	157,249	7,807
New Jersey			58,882	58,882	3,543
New York	(1)		254,350	(2) 254,350	60,742
Ohio	126,720	368	72,146	199,234	78,685
Pennsylvania	140,435	(1)	142,086	(2) 282,521	52,586
Tennessee	12,566	76	2,000	14,642	2,059
Utah	1,622		9,487	11,109	4,083
West Virginia	10,216	89	9,851	20,156	5,075
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	(1)	4,031	195,149	(2) 199,180	(1)
Undistributed	10,667	2,045		12,712	22,577
	525,798	14,123	1,373,213	1,913,134	419,867
At merchant plants	16,332	12,287	1,142,209	1,170,828	142,612
At furnace plants	509,466	1,836	231,004	742,306	277,255
Beehive plants:					
Colorado, Utah, and Washington	23	77	12	112	71
Kentucky and Tennessee	302	505	350	1,157	
Pennsylvania	11,984	1,762	21,515	35,261	5,517
Virginia	1,972	1,052		3,024	20
West Virginia	1,741	577	1,436	3,754	
	16,022	3,973	23,313	43,308	5,608

[1] Included under "Undistributed."
[2] Excludes items included under "Undistributed."

TABLE 35.—*Summary of total stocks of coke on hand at all byproduct and beehive plants in the United States on January 1, 1929, and 1937–41, in net tons*

[Exclusive of screenings or breeze]

	1929	1937	1938	1939	1940	1941
Byproduct plants:						
Furnace	750,318	282,144	610,840	931,644	597,550	525,798
Foundry	24,426	8,981	29,828	88,334	49,771	14,123
Domestic and other	1,018,205	1,408,350	1,878,652	2,611,645	1,922,369	1,373,213
	1,792,949	1,699,475	2,519,320	3,631,623	2,569,690	1,913,134
Beehive plants:						
Furnace	38,446	5,622	13,542	7,228	16,402	16,022
Foundry	8,020	8,508	13,264	8,336	8,312	3,973
Domestic and other	8,511	18,461	49,161	29,367	7,695	23,313
	54,977	32,591	75,967	44,931	32,409	43,308
Total:						
Furnace	788,764	287,766	624,382	938,872	613,952	541,820
Foundry	32,446	17,489	43,092	96,670	58,083	18,096
Domestic and other	1,026,716	1,426,811	1,927,813	2,641,012	1,930,064	1,396,526
	1,847,926	1,732,066	2,595,287	3,676,554	2,602,099	1,956,442

TABLE 36.—*Total stocks of coke at all furnace and nonfurnace byproduct plants in the United States on first of each month, 1939–40, in net tons*

[Includes funrace, foundry, and domestic, but not breeze]

Month	Furnace plants		Other plants		Total	
	1939	1940	1939	1940	1939	1940
January	1,310,577	905,073	2,321,046	1,664,617	3,631,623	2,569,690
February	1,306,506	842,123	2,088,995	1,163,723	3,395,501	2,005,846
March	1,241,895	783,795	1,874,450	914,190	3,116,345	1,697,985
April	1,198,286	800,388	1,839,050	837,927	3,037,336	1,638,315
May	1,090,811	930,677	1,876,078	1,083,632	2,966,889	2,014,309
June	950,989	954,997	1,799,755	1,105,553	2,750,744	2,060,550
July	930,706	877,078	1,726,356	935,429	2,657,062	1,812,507
August	945,242	846,352	1,826,656	1,068,714	2,771,898	1,915,066
September	916,256	807,393	2,004,807	1,219,423	2,921,063	2,026,816
October	867,744	776,446	1,944,687	1,281,090	2,812,431	2,057,536
November	806,097	739,770	1,793,611	1,289,625	2,599,708	2,029,395
December	835,525	713,004	1,770,993	1,283,970	2,606,518	1,996,974

TABLE 37.—*Stocks of bituminous coal at byproduct-coke plants in the United States at end of each month, 1937–40, in net tons*

Month	1937	1938	1939	1940
January	8,030,871	6,469,457	7,373,871	6,613,253
February	8,687,389	5,822,943	7,372,654	5,978,167
March	9,638,317	5,231,300	7,221,632	5,373,567
April	8,543,774	4,934,840	4,434,124	5,217,870
May	8,187,883	4,867,332	2,598,470	5,995,170
June	7,770,256	4,999,856	3,548,326	6,506,396
July	7,432,741	5,364,442	4,534,922	7,448,266
August	7,455,932	5,539,623	5,631,984	7,831,640
September	7,760,533	5,951,617	6,220,015	8,860,832
October	8,066,938	6,459,096	7,250,436	9,711,983
November	8,114,094	7,172,900	8,114,807	10,091,259
December	7,273,403	7,462,163	7,992,848	10,184,443

Stocks of bituminous coal used by the byproduct ovens closely follow the trend of monthly coke production. In 1940 the highest reserves were on hand at the end of December, when 10,184,443 tons were reported. The lowest supply of coal was at the end of April, when 5,217,870 tons were in reserve. The largest quantity of byproduct coke was produced in December and the lowest in April.

VALUE AND PRICE

In previous years, reference has been made in the Coke chapters to the various accounting methods used by coke operators affiliated with iron and steel plants, by which the coke sometimes is charged to the furnace department at cost and sometimes includes a percentage of profit at the current market price. On the open market, however, price cutting, long-term contracts, and other factors materially affect the prices at which coke-plant operators actually dispose of coke. According to sales data furnished by the operators, average receipts for byproduct coke sold rose as follows: Furnace coke, 35 cents; foundry, 52 cents; domestic, 13 cents; and other industrial, 22 cents. Receipts for beehive coke in 1940 differed from those in 1939 as follows: Furnace coke, 3 cents less; foundry coke, 35 cents more; domestic coke, 36 cents more; and other industrial coke, only 1 cent less.

TABLE 38.—*Average receipts per net ton for coke sold in the United States in 1940 by States*

State	Byproduct				Beehive			
	Furnace [1]	Foundry	Domestic	Other industrial, including water gas	Furnace [1]	Foundry	Domestic	Other industrial, including water gas
Alabama	(2)	$7.28	$3.80	$4.80	-------	-------	-------	-------
Colorado, Utah, Washington, and Wisconsin	$7.00	(2)	6.86	7.05	-------	(2)	(2)	$6.20
Connecticut, Massachusetts, and Rhode Island	(2)	8.10	6.94	7.39	-------	-------	-------	-------
Illinois	3.85	(2)	5.70	5.47	-------	-------	-------	-------
Indiana	(2)	(2)	4.61	4.26	-------	-------	-------	-------
Kentucky, Michigan, and Missouri	(2)	(2)	5.12	(2)	-------	-------	(2)	(2)
Maryland and New Jersey	(2)	(2)	6.90	6.18	-------	-------	-------	-------
Minnesota	(2)	(2)	8.09	6.47	-------	-------	-------	-------
New York	5.16	(2)	6.56	6.05	-------	-------	-------	-------
Ohio	5.24	6.42	4.67	5.38	-------	-------	-------	-------
Pennsylvania	4.14	9.46	5.57	5.92	$4.28	$4.95	$3.89	3.84
Tennessee	-------	7.75	5.75	6.75	(2)	(2)	-------	(2)
Virginia	-------	-------	-------	-------	4.77	5.08	3.88	4.60
West Virginia	(2))	(2)	4.38	(2)	(2)	6.07	(2)	3.75
Undistributed	4.06	9.68	-------	5.44	4.28	6.02	3.75	5.42
United States average	4.62	8.67	6.03	5.86	4.30	5.11	3.89	4.14
At merchant plants	5.10	9.13	6.37	6.05	-------	-------	-------	-------
At furnace plants	4.31	7.11	4.72	5.38	-------	-------	-------	-------

[1] Includes coke sold to affiliated corporations for all other purposes and merchant sales.
[2] Included under "Undistributed."

According to trade-journal quotations published during 1940, the cost of byproduct foundry coke increased in all of the markets listed except New England, which showed no change. The increases ranged from an addition of 38 cents at Birmingham to 75 cents at Cleveland and Indianapolis. Connellsville prices for beehive coke, which were usually the basis for the entire industry, rose 33 cents for both furnace and foundry coke.

TABLE 39.—*Average monthly prices per net ton at ovens of spot or prompt Connellsville furnace and foundry coke, 1929 and 1937–40* [1]

Month	Furnace coke					Foundry coke				
	1929	1937	1938	1939	1940	1929	1937	1938	1939	1940
January	$2.75	$4.00	$4.00	$3.75	$4.20	$3.75	$4.50	$5.00	$4.75	$5.50
February	2.90	4.06	4.00	3.75	4.00	3.75	4.50	5.00	4.75	5.31
March	2.98	4.25	4.00	3.75	4.00	3.75	4.50	5.00	4.75	5.25
April	2.78	4.51	4.00	3.75	4.00	3.75	5.00	5.00	4.75	5.25
May	2.75	4.60	4.00	3.75	4.00	3.75	5.25	5.00	4.75	5.25
June	2.75	4.58	3.85	3.75	4.00	3.75	5.25	4.85	4.75	5.25
July	2.75	4.35	3.75	3.75	4.20	3.75	5.00	4.75	4.75	5.25
August	2.73	4.35	3.75	3.75	4.63	3.75	5.00	4.75	4.75	5.25
September	2.65	4.27	3.75	4.25	4.75	3.75	5.00	4.75	5.12	5.25
October	2.65	4.25	3.75	4.90	4.75	3.75	5.00	4.75	5.65	5.25
November	2.65	4.25	3.75	5.00	5.10	3.75	5.00	4.75	5.75	5.63
December	2.64	4.00	3.75	5.00	5.38	3.75	5.00	4.75	5.75	5.75
Average	2.75	4.29	3.86	4.09	4.42	3.75	4.92	4.86	5.02	5.35

[1] Iron Age.

TABLE 40.—*Average monthly prices per net ton of byproduct foundry coke, in 11 markets in the United States, 1936–40, as quoted by Steel*

	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
Birmingham, Ala. (at ovens):													
1936	$6.50	$6.50	$6.50	$6.50	$6.50	$6.50	$6.50	$6.50	$6.50	$6.50	$6.50	$6.50	$6.50
1937	6.50	6.50	6.50	6.95	7.25	7.25	7.25	7.25	7.30	7.50	7.50	7.50	7.10
1938	7.50	7.50	7.50	7.50	7.50	7.50	7.00	7.00	7.00	7.00	7.00	7.00	7.25
1939	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	8.05	7.50	7.12
1940	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
Buffalo, N. Y. (delivered at consumers' works): [1]													
1936	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	9.15	10.50	10.50	8.14
1937	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50
1938	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50
1939	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	11.25	11.25	10.62
1940	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.75	11.75	11.33
Chicago, Ill. (at ovens):													
1936	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
1937	9.50	9.50	9.50	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.06
1938	10.25	10.25	10.25	10.25	10.25	10.25	10.10	9.75	9.75	9.75	9.75	9.75	10.03
1939	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.95	10.50	10.50	9.89
1940	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	11.00	11.00	11.00	10.62
Cincinnati, Ohio (delivered at consumers' works):													
1936	9.50	9.50	9.50	9.50	9.50	9.50	9.50	9.50	9.50	9.50	9.50	9.50	9.50
1937	9.70	9.75	9.75	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.31
1938	10.50	10.50	10.50	10.50	10.50	10.50	9.90	9.75	9.75	9.75	9.75	9.75	10.14
1939	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	10.50	10.50	9.88
1940	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	11.00	11.00	11.00	10.62
Cleveland, Ohio (delivered at consumers' works):													
1936	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.90	10.30	10.30	9.85
1937	10.30	10.30	10.30	10.80	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.05	10.81
1938	11.05	11.05	11.05	11.05	11.05	11.05	10.75	10.30	10.30	10.30	10.30	10.30	10.71
1939	10.30	10.30	10.30	10.30	10.30	10.30	10.30	10.30	10.30	10.30	11.05	11.05	10.42
1940	11.05	11.05	11.05	11.05	11.05	11.05	11.05	11.05	11.05	11.55	11.55	11.55	11.17
Detroit, Mich. (delivered at consumers' works): [1]													
1936	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.64	10.70	10.70	9.34
1937	10.50	10.70	10.70	10.89	11.10	11.10	11.10	11.10	11.10	11.10	11.10	11.10	10.97
1938	11.10	11.10	11.10	11.10	11.10	11.10	10.90	10.25	10.25	10.25	10.25	10.25	10.73
1939	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.25	11.00	11.00	10.38
1940	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.50	11.50	11.08

[1] Up to Oct. 26, 1936, quotations are "at ovens."

TABLE 40.—*Average monthly prices per net ton of byproduct foundry coke, in 11 markets in the United States, 1936–40, as quoted by Steel*—Continued

	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
Indianapolis, Ind. (delivered at consumers' works):													
1936	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40
1937	9.60	9.65	9.65	10.33	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.27
1938	10.50	10.50	10.50	10.50	10.50	10.50	10.00	10.00	10.00	10.00	10.00	10.00	10.25
1939	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.75	10.75	10.12
1940	10.75	10.75	10.75	10.75	10.75	10.75	10.75	10.75	10.75	11.25	11.25	11.25	10.87
Newark, N. J. (delivered at consumers' works):													
1936	9.60	9.70	9.70	9.70	9.70	9.70	9.70	9.70	9.70	10.20	10.20	10.20	9.82
1937	10.17	10.17	10.17	10.85	10.85	10.85	10.85	10.85	10.85	10.85	10.85	10.88	10.68
1938	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88
1939	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	11.25	11.38	11.38	10.99
1940	11.38	11.38	11.38	11.38	11.38	11.38	11.38	11.38	11.38	11.38	11.87	11.85	11.46
New England (delivered at consumers' works):													
1936	11.50	11.50	11.50	11.50	11.50	11.50	11.50	11.50	11.50	11.70	12.00	12.00	11.60
1937	12.00	12.00	12.00	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.38
1938	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50
1939	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50
1940	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50
Philadelphia, Pa. (delivered at consumers' works):													
1936	9.38	9.38	9.38	9.38	9.38	9.38	9.38	9.38	9.38	9.88	9.88	9.88	9.50
1937	9.85	9.85	9.85	10.40	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.40
1938	10.62	10.63	10.63	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.64
1939	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.65	11.02	11.15	11.15	10.76
1940	11.15	11.15	11.15	11.15	11.15	11.15	11.15	11.15	11.15	11.15	11.63	11.63	11.23
St. Louis, Mo. (delivered at consumers' works):													
1936	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
1937	10.10	10.50	10.50	10.80	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	10.83
1938	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
1939	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.75	11.75	11.12
1940	11.75	11.75	11.75	11.75	11.75	11.75	11.75	11.75	11.75	11.75	11.75	11.75	11.75

SHIPMENTS BY RAIL AND WATER

TABLE 41.—*Beehive coke loaded for shipment on originating railroads and waterways in the United States in 1940, by routes, as reported by coke producers*

Route	State	Net tons: By States	Net tons: Total	Percent of total
Railroads:				
Baltimore & Ohio	Pennsylvania	512,634	540,876	18.3
	West Virginia	28,242		
Chesapeake & Ohio	West Virginia	28,622	28,622	1.0
Denver & Rio Grande Western	Colorado	66,745	75,181	2.5
	Utah	8,436		
Interstate	Virginia	176,109	176,109	6.0
Ligonier Valley	Pennsylvania	42,000	42,000	1.4
Nashville, Chattanooga & St. Louis	Tennessee	4,431	4,431	.2
Monongahela	Pennsylvania	786,227	786,227	26.6
New York Central	West Virginia	177,697	177,697	6.0
Norfolk and Western	Virginia	24,640	24,640	.8
Pennsylvania	Pennsylvania	1,024,008	1,024,008	34.7
Pittsburgh & Lake Erie	do	68,080	68,080	2.3
Total railroad shipments		2,947,871	2,947,871	99.8
Waterway: Ohio River	Pennsylvania	4,290	4,290	.2
Grand total		2,952,161	2,952,161	100.0

DISTRIBUTION OF BYPRODUCT AND BEEHIVE COKE IN 1940

Consumption of coke in the United States during 1940 increased 23 percent over 1936—the year covered by the latest previous distribution survey made by the Bureau of Mines. Pennsylvania, the leading coke-producing State, likewise led in tonnage consumed, with 27 percent of the total United States consumption. Ohio, New York, and Indiana were next in the order named, using, respectively, 17, 10, and 9 percent of the total; Alabama and Illinois followed, each using 8 percent.

Increased activity in the steel industry raised the tonnage of coke consumed by that industry to a point approaching record proportions at the end of 1940. In 1936, 46,668,547 tons of coke were used for all purposes, while in 1940, 57,170,633 tons were consumed. Of these totals, 31,062,616 and 42,401,997 tons supplied furnace demands in 1936 and 1940, respectively, the difference amounting virtually to the increase in total consumption during the period. Use of domestic coke decreased 1,674,058 tons compared with 1936, while coke going into the manufacture of water gas increased 685,065 tons.

Furnace coke was consumed in 23 States during 1940. However, 82 percent of the total tonnage was used by 5 States—Pennsylvania, Ohio, Indiana, Alabama, and Illinois. Coke for foundry use was shipped into all States but 2 during 1940. Coke was used for manufacturing producer gas in 12 States and for producing water gas in 31. Other industrial needs indicated widespread usage generally throughout the country; only 4 States received no shipments of coke under this classification. Domestic coke was consumed in all but 5 States during 1940. New York, Michigan, and Massachusetts were the principal consumers, and together accounted for 44 percent of the total used for this purpose.

Pennsylvania and Ohio used more than 80 percent of their production in blast furnaces. Indiana used 65 percent and Illinois 60 percent of their respective outputs for that purpose. Maryland used all of its production within the State and supplemented this by shipments from nearby States. Alabama shipped coke to 30 other States and West Virginia to 24 other States and the District of Columbia.

Table 42.—*Summary of byproduct and beehive coke and breeze consumed in each State in 1940, in net tons*

[Based upon reports from all United States producers showing destination of coke used by producer or sold in 1940. Does not include imported coke, which totaled 112,550 net tons in 1940]

Consuming State	Coke							Coke breeze
	Furnace use	Foundry use	Making producer gas	Making water gas	Other industrial use	Domestic use	Total	
Alabama	4,099,434	123,394			42,982	99,102	4,364,912	239,550
Arizona		4,053			(1)	(1)	4,348	(1)
Arkansas		1,444		(1)		(1)	2,049	4,226
California	(1)	36,426			18,972	(1)	67,680	(1)
Colorado	521,698	11,604		(1)	12,235	(1)	545,894	28,316
Connecticut		34,847	(1)	(1)	14,196	203,534	366,521	(1)
Delaware	(1)	2,758			1,198	(1)	7,046	(1)
District of Columbia		395		(1)	(1)	2,430	67,330	
Florida		1,017		(1)	(1)	4,961	36,268	(1)
Georgia		13,765		(1)	(1)	15,478	40,200	
Idaho		(1)			(1)		3,900	(1)
Illinois	3,332,028	172,455	(1)	(1)	109,302	683,630	4,362,136	282,839
Indiana	4,305,518	106,063		35,868	101,719	380,826	4,929,994	386,722
Iowa		33,721		8,193	22,993	10,915	75,822	(1)
Kansas		7,510			(1)	(1)	10,347	(1)
Kentucky	(1)	20,341		(1)	3,371	41,993	296,564	40,004
Louisiana		2,883			21,656	7,374	31,913	
Maine		(1)		(1)		49,473	54,610	
Maryland	1,849,917	23,891	(1)	(1)	7,958	28,050	1,959,295	(1)
Massachusetts	88,830	48,872	76,674	74,804	11,120	933,356	1,233,656	130,883
Michigan	1,076,370	333,791	40,509	3,413	209,566	1,135,694	2,799,343	200,793
Minnesota	225,569	15,684	7,637		34,366	331,682	614,938	53,598
Mississippi		(1)				(1)	2,206	
Missouri	(1)	34,426		(1)	43,029	269,036	367,231	4,101
Montana	(1)	2,060			(1)		24,793	9,845
Nebraska	(1)	2,320		(1)	3,320	819	23,316	(1)
Nevada		(1)			(1)		(1)	
New Hampshire		(1)		(1)		55,709	58,768	
New Jersey	(1)	86,161	(1)	227,744	110,804	488,890	1,008,575	89,501
New Mexico		(1)			(1)		1,237	(1)
New York	2,615,108	141,372	315,225	705,426	363,286	1,563,584	5,704,001	280,379
North Carolina		13,410		(1)	(1)	4,169	23,932	
North Dakota				(1)	(1)	(1)	(1)	
Ohio	8,619,762	304,373	(1)	(1)	171,777	460,339	9,576,950	533,490
Oklahoma		2,205			(1)	(1)	2,396	(1)
Oregon		(1)			(1)		4,609	
Pennsylvania	14,319,836	219,232	51,244	91,882	170,305	537,204	15,389,703	1,239,470
Rhode Island		10,199	(1)	(1)	(1)	154,770	189,393	(1)
South Carolina		3,613		(1)	(1)	3,160	9,509	
South Dakota		(1)			(1)	1,767	2,449	
Tennessee	54,312	59,724		(1)	42,797	(1)	177,149	60,116
Texas	(1)	15,991		(1)	14,511	(1)	47,625	15,970
Utah	(1)	10,337			55,234	(1)	231,474	23,213
Vermont		5,433		(1)	(1)	32,587	41,311	
Virginia	52,715	31,258		303,483	71,358	8,957	467,771	945
Washington		3,089			(1)	(1)	4,719	
West Virginia	787,694	12,657		(1)	58,803	(1)	1,279,433	133,532
Wisconsin		99,327	64,511	43,760	12,654	432,778	653,030	55,679
Wyoming					(1)	(1)	2,472	
Undistributed	453,206	9,337	255,324	665,972	31,709	32,041	1,815	256,521
Total, United States	42,401,997	2,061,438	811,124	2,160,545	1,761,221	7,974,308	57,170,633	4,069,693
Exports	81,627	98,337		714	189,603	303,796	674,077	46,498
Grand total: 1940	42,483,624	2,159,775	811,124	2,161,259	1,950,824	8,278,104	57,844,710	4,116,191
1936	31,094,267	2,025,007	831,653	1,477,988	1,739,948	10,062,651	47,231,514	3,695,092

[1] Included under "Undistributed."

Figures showing the distribution, by States of destination, of coke shipped by producers in 1940 are shown in the following tables. Additional data and discussion relating to the geographic distribution of coke in 1940, by principal uses, will be published in Distribution of Byproduct and Beehive Coke in 1940, which may be obtained on request from the Coal Economics Division, Bureau of Mines.

TABLE 43.—*Distribution of coke shipped or used by producer in 1940*

PRODUCED IN ALABAMA

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
Alabama	4,099,434	122,377	35,914	98,812	4,356,537	236,525
Arizona, Colorado, New Mexico, and Utah	----------	2,575	379	----------	2,954	----------
Arkansas, Oklahoma, and Texas	----------	16,223	13,746	263	30,232	14,224
California, Oregon, and Washington	----------	9,987	(1)	(1)	20,277	----------
Florida, Georgia, and Mississippi	----------	13,149	40,035	18,518	71,702	(1)
Idaho, Montana, and Wyoming	----------	(1)	(1)	----------	647	----------
Illinois, Indiana, Iowa, Michigan, and Missouri	----------	40,612	3,726	22,338	66,676	(1)
Kansas and Nebraska	----------	1,074	(1)	(1)	1,772	----------
Kentucky, Ohio, and Virginia	----------	24,450	3,075	1,381	28,906	----------
Louisiana	----------	2,595	21,656	7,374	31,625	----------
North Carolina	----------	1,851	5,066	3,811	10,728	----------
South Carolina	----------	(1)	(1)	3,160	7,567	----------
Tennessee	----------	(1)	(1)	3,491	37,925	(1)
Exported	----------	(1)	(1)	----------	12,013	----------
Undistributed	----------	31,022	29,967	1,500	----------	60,895
	4,099,434	265,915	153,564	160,648	4,679,561	311,644

PRODUCED IN COLORADO, UTAH, AND WASHINGTON

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
Arizona, New Mexico, Oregon, and Wyoming	----------	1,393	2,647	157	4,197	54
California	(1)	(1)	4,133	(1)	15,715	(1)
Colorado	521,698	(1)	11,495	(1)	541,424	28,316
Idaho	----------	(1)	(1)	----------	3,867	(1)
Iowa, Kansas, Oklahoma, and South Dakota	----------	1,200	2,024	69	3,293	11,606
Montana	(1)	----------	(1)	----------	20,466	9,845
Nebraska	(1)	(1)	(1)	----------	2,011	(1)
Nevada	----------	(1)	(1)	----------	(1)	----------
Texas	(1)	(1)	510	----------	17,129	5,684
Utah	(1)	(1)	55,234	(1)	221,182	23,213
Washington	----------	286	(1)	(1)	508	----------
Exported	----------	----------	(1)	----------	(1)	----------
Undistributed	210,949	9,151	6,569	2,359	82	554
	732,647	12,030	82,612	2,585	829,874	79,272

PRODUCED IN CONNECTICUT, MASSACHUSETTS, AND RHODE ISLAND

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
Connecticut	----------	27,882	120,982	203,449	352,313	(1)
Maine, New Hampshire, and Rhode Island	----------	(1)	(1)	249,885	290,958	(1)
Massachusetts	88,830	46,842	151,659	908,413	1,195,744	(1)
New York and Pennsylvania	----------	(1)	----------	(1)	(1)	----------
Vermont	----------	5,433	(1)	(1)	9,783	----------
Exported	----------	(1)	----------	----------	(1)	----------
Undistributed	----------	27,389	27,500	21,604	31,070	191,221
	88,830	107,546	300,141	1,383,351	1,879,868	191,221

PRODUCED IN ILLINOIS

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
Arizona, Colorado, and Utah	----------	7,828	----------	----------	7,828	----------
Arkansas, Oklahoma, and Texas	----------	(1)	----------	----------	(1)	(1)
California, Oregon, and Washington	----------	2,510	----------	----------	2,510	----------
Illinois	1,875,204	91,891	119,803	602,237	2,689,135	250,980
Indiana	72,347	(1)	(1)	13,357	114,838	8,772
Iowa	----------	(1)	(1)	3,570	24,390	(1)
Kansas, Nebraska, and South Dakota	----------	2,504	1,620	----------	4,124	----------
Michigan, New York, and Ohio	----------	45,120	(1)	(1)	52,278	(1)
Minnesota	----------	(1)	2,583	(1)	9,309	----------
Missouri	----------	(1)	----------	(1)	128,579	(1)
Wisconsin	----------	17,352	13,280	48,755	79,387	61
Exported	----------	(1)	----------	----------	(1)	----------
Undistributed	----------	58,245	5,935	131,224	2,987	1,443
	1,947,551	225,450	143,221	799,143	3,115,365	261,256

See footnotes at end of table.

TABLE 43.—*Distribution of coke shipped or used by producer in 1940*—Continued

PRODUCED IN INDIANA

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
California, Montana, Oregon, and Washington		16,511	1,383		17,894	
Colorado, New Mexico, and Texas		1,130			1,130	
Illinois	1,449,391	52,714	33,763	32,557	1,568,425	22,251
Indiana	4,231,010	54,811	87,789	323,593	4,697,203	377,950
Iowa, Kentucky, Missouri, and Oklahoma		12,906	5,219	3,446	21,571	
Kansas, Nebraska, and South Dakota		875	130	140	1,145	
Michigan	60	61,963	16,254	16,825	95,102	
Minnesota, Ohio, and Wisconsin		36,194	995	13,573	50,762	
Exported		855	21,654		22,509	
	5,680,461	237,959	167,187	390,134	6,475,741	400,201

PRODUCED IN KENTUCKY, MISSOURI, TENNESSEE, AND VIRGINIA

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
Alabama		(1)	4,541	(1)	5,821	(1)
Arkansas		375			375	
California		2,228			2,228	
Colorado, New Mexico, and Oklahoma		607	53		660	
District of Columbia, Maryland, New York, and Pennsylvania	(1)	2,032	4,478	(1)	8,471	
Florida and West Virginia		3,867	(1)	(1)	19,097	(1)
Georgia		2,423	(1)	(1)	6,188	
Illinois	7,433	6,182	18,337	2,367	34,319	(1)
Indiana	(1)	5,399	(1)	(1)	33,411	
Iowa, Michigan, Minnesota, and Wisconsin		2,171	15,075	35,477	52,723	
Kansas		(1)	(1)		2,325	
Kentucky	221,698	12,415	12,177	21,386	267,676	(1)
Louisiana		(1)			(1)	
Missouri	(1)	11,148	(1)	(1)	215,763	(1)
Nebraska, Oregon, South Dakota, and Washington		1,187	(1)	(1)	1,474	
North Carolina		10,861	1,287	358	12,506	
Ohio		(1)	(1)	(1)	130,222	(1)
South Carolina		(1)	(1)		(1)	
Tennessee	54,312	32,017	37,728	15,142	139,199	(1)
Texas		(1)	(1)		2,273	
Utah		2,865			2,865	
Virginia	(1)	(1)	184,835	(1)	258,408	(1)
Exported	(1)	(1)	17,369	(1)	21,336	
Undistributed	74,521	35,253	93,462	266,165	1,891	64,917
	357,964	131,030	389,342	340,895	1,219,231	64,917

PRODUCED IN MARYLAND

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
Maryland	1,598,781	424	49,698	24,898	1,673,801	168,525

PRODUCED IN MICHIGAN, MINNESOTA, AND WISCONSIN

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
Arizona, Colorado, New Mexico, and Utah		(1)	(1)		3,458	
California		9,211	5,513		14,724	
Illinois		(1)	(1)	16,180	31,350	(1)
Indiana, Kentucky, New Jersey, New York, and Rhode Island	(1)	34,367	20,476	(1)	61,716	(1)
Iowa		5,064	1,341	2,522	8,927	
Kansas		850			850	
Michigan	1,076,310	128,965	225,614	1,006,459	2,437,348	185,608
Minnesota	225,569	6,268	39,042	331,054	601,933	53,598
Missouri		8,314			8,314	
Montana		(1)	(1)		1,937	
Nebraska, North Dakota, and Oklahoma		1,497	17,039	1,724	20,260	
Ohio	(1)	(1)	(1)	(1)	75,759	(1)
Oregon, Texas, and Wyoming		(1)	(1)		2,979	
Pennsylvania	(1)	(1)	(1)		10,547	(1)
South Dakota			398	1,577	1,975	
Washington		(1)	(1)		361	
Wisconsin		62,247	106,999	369,182	538,428	55,618
Exported	(1)	49,238	(1)	144,966	306,706	5,468
Undistributed	96,574	85,772	43,375	3,865		851
	1,398,453	391,793	459,797	1,877,529	4,127,572	301,143

TABLE 43.—*Distribution of coke shipped or used by producer in 1940*—Continued

PRODUCED IN NEW JERSEY

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
New Jersey		30,476	380,023	442,261	852,760	80,723
New York		6,015	136,934	50,904	193,853	603
Pennsylvania		301			301	
		36,792	516,957	493,165	1,046,914	81,326

PRODUCED IN NEW YORK

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
Illinois, Michigan, and Wisconsin				21,627	21,627	
Maryland, New Jersey, and Pennsylvania	(1)	(1)	20,891	(1)	45,241	(1)
Massachusetts, New Hampshire, Rhode Island, and Vermont		(1)	(1)	47,800	61,673	
New York	(1)	(1)	(1)	1,348,585	4,835,440	279,194
Exported		(1)	50,670	(1)	190,072	(1)
Undistributed	2,376,309	11,569	1,123,578	153,024		40,703
	2,376,309	11,569	1,195,139	1,571,036	5,154,053	319,897

PRODUCED IN OHIO

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
Alabama, Kentucky, Virginia, and West Virginia	(1)	(1)	161,966	22,559	250,830	(1)
Illinois, Iowa, and Missouri			12,382	575	12,957	
Indiana		(1)	4,058	(1)	40,920	
Michigan		(1)	(1)	45,084	133,437	(1)
New York	(1)	(1)	(1)	9,936	64,339	
Ohio	6,659,317	164,214	151,298	330,477	7,305,306	520,918
Pennsylvania	75,351	(1)		(1)	78,910	
Exported		11,165	(1)	(1)	22,799	
Undistributed	94,831	120,885	7,182	38,218		23,060
	6,829,499	296,264	336,886	446,849	7,909,498	543,978

PRODUCED IN PENNSYLVANIA

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
Connecticut		6,965	7,158	85	14,208	(1)
Delaware	(1)	2,758	1,018	(1)	6,866	(1)
District of Columbia		(1)	(1)	(1)	60,474	
Illinois		(1)	(1)	(1)	801	
Indiana		(1)	(1)	2,949	10,874	
Kentucky, Tennessee, and Virginia		1,535	5,129	994	7,658	(1)
Maine				774	774	
Maryland	217,458	21,720	3,442	1,698	244,318	(1)
Massachusetts		(1)	(1)	5,488	7,447	(1)
Michigan		1,085	1,555	15,793	18,433	
Missouri and Nebraska		(1)		(1)	318	(1)
New Hampshire and Rhode Island		(1)	(1)	1,848	2,436	
New Jersey	(1)	55,647	(1)	25,151	111,751	(1)
New York	215,534	63,461	132,368	118,387	529,750	(1)
Ohio	1,237,288	18,390	17,579	25,299	1,298,556	5,704
Pennsylvania	14,159,706	163,701	302,388	517,854	15,143,649	1,234,340
Vermont				3,777	3,777	
West Virginia	15,687	(1)	12,328	(1)	36,433	
Exported	2,047	24,373	54,711	7,792	88,923	(1)
Undistributed	1,415	9,672	99,284	4,155		20,481
	15,849,135	369,307	636,960	732,044	17,587,446	1,260,525

PRODUCED IN WEST VIRGINIA

Destination	For blast-furnace use	For foundry use	For other industrial use	For domestic use	Total coke	Coke breeze
Alabama, South Carolina, and Kentucky.		2,085			2,085	
California, Montana, Oregon, and Utah		1,088			1,088	
Delaware, Maryland, and New Jersey	23,584		6,138	9,454	39,176	
District of Columbia		(1)	(1)	1,803	2,258	
Illinois, Missouri, and Wisconsin		1,748			1,748	
Indiana	(1)	(1)			2,561	
Massachusetts, New Hampshire, Rhode Island, and Vermont		(1)		(1)	4,538	
Michigan		(1)	(1)	1,178	5,378	(1)
New York			(1)	(1)	14,764	
North Carolina		698			698	
Ohio	(1)	2,691	(1)	4,636	723,214	6,668
Pennsylvania	(1)	(1)	11,029	18,489	151,827	(1)
Virginia	(1)	(1)	41,728	(1)	48,789	(1)
West Virginia	706,989	1,455	429,194	3,021	1,140,659	120,349
Exported		7,003			7,003	
Undistributed	793,987	56,928	3,614	17,246		5,269
	1,524,560	73,696	491,703	55,827	2,145,786	132,286

Included under "Undistributed."

EXPORTS AND IMPORTS [2]

Exports of coke from the United States in 1940 totaled 804,095 net tons valued at $5,024,992—an increase of 214,170 tons (36 percent) over 1939. Canada, the principal country to which coke was exported, received 722,740 tons (90 percent of all exports), the bulk going via Buffalo and Michigan. Other than Canada, the export market for American coke is relatively small, although Mexico and Cuba each purchased nearly 20,000 tons, and 10,291 tons of coke were shipped to Sweden in 1940—large increases over their respective tonnages in 1939.

TABLE 44.—*Coke exported from the United States, 1938–40, by customs districts*

Customs district	1938		1939		1940	
	Net tons	Value	Net tons	Value	Net tons	Value
Buffalo	222,484	$1,431,715	224,900	$1,358,559	304,390	$1,676,244
Chicago	22,813	100,381			11,128	41,752
Dakota	7,254	57,958	7,031	51,749	5,864	47,007
Duluth-Superior	3,214	27,745	3,171	25,639	11,427	71,225
Florida	4	53	409	4,041	5,851	53,166
Galveston	2,199	10,995				
Laredo	353	4,219	539	4,227	18,696	153,449
Maryland	1,993	13,025	1,379	16,972	9,006	76,866
Michigan	169,293	975,592	247,192	1,333,605	371,125	2,220,943
Mobile	7,127	109,810	8,202	135,756	9,825	186,565
New Orleans	2,461	21,244	8,989	103,103	8,112	78,341
New York	12,517	89,905	27,685	337,031	11,868	132,735
Ohio	20,974	110,857	11,050	61,053	17,982	116,369
Philadelphia	11,255	51,770	40,369	331,175	9,220	80,448
St. Lawrence	1,440	16,590	1,049	11,774	488	4,279
San Diego	252	4,176	172	2,816	443	7,121
San Francisco	40	839	1,324	30,940	15	134
Virginia	567	5,266	5,617	64,856	7,411	68,376
Other districts	331	2,965	847	4,939	1,244	9,972
	486,571	3,035,105	589,925	3,878,235	804,095	5,024,992

[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.

Coke imports form a very small part of the requirements of the country and under normal conditions are important in certain regions only. In 1940, 112,550 tons were received in the United States, supplied entirely by Canada and the United Kingdom.

TABLE 45.—*Coke exported from the United States, 1938–40, by countries*

Country	1938		1939		1940	
	Net tons	Value	Net tons	Value	Net tons	Value
North America:						
Canada	461,310	$2,760,529	495,389	$2,848,584	722,740	$4,182,630
Mexico	790	10,287	875	8,761	19,922	165,196
Panama	100	1,162	100	2,329	158	3,370
West Indies:						
Cuba	2,168	17,299	5,929	49,503	19,787	168,234
Trinidad and Tobago	213	2,223	6,523	67,642		
Other North America	353	4,729	535	7,291	453	5,944
South America:						
Argentina	2	42	6	107	1,557	13,575
Bolivia	445	6,638	133	1,177	264	4,542
Brazil	281	2,393	8,000	101,158	5,512	51,660
Chile	1,750	9,679	2,181	18,878	1,493	17,409
Peru			879	10,359	1,425	11,046
Other South America	212	3,237	541	8,930	632	12,210
Europe:						
Denmark			3,345	35,087		
France	6,013	53,108	45,901	413,578		
Germany	1,417	10,628				
Italy	2,760	40,861	1,176	19,550		
Norway	2,198	10,995	4,480	31,000	2,567	28,087
Sweden			1	10	10,291	77,458
Switzerland	5,880	90,703	3,229	57,660	3,591	31,259
United Kingdom	679	10,592	844	15,742	2,120	37,267
Other Europe					28	503
Asia:						
China			16	163	563	6,060
Japan			7,923	136,791	8,019	172,860
Philippine Islands			1,861	42,984	2,811	32,653
Other Asia			57	936	123	2,242
Africa			1	15	39	787
	486,571	3,035,105	589,925	3,878,235	804,095	5,024,992

TABLE 46.—*Coke imported for consumption in the United States, 1938–40, by customs districts*

Customs district	1938		1939		1940	
	Net tons	Value	Net tons	Value	Net tons	Value
Buffalo	24,527	$496,159	55,425	$956,814	47,377	$949,150
Hawaii	726	6,436				
Los Angeles	23,752	130,187	11,392	64,458	3,035	13,548
Maine and New Hampshire	252	1,866	350	2,590	292	2,145
Maryland					3,390	27,241
Massachusetts	19,852	76,212	10,976	43,871	14,091	74,196
Michigan			11	65	10	74
Montana and Idaho	28,902	162,154	26,688	148,183	26,885	141,598
New York	6,983	32,683	19,211	69,445	10,782	54,888
Oregon	2,259	14,085	1,156	6,418		
Rhode Island	1,120	6,005				
St. Lawrence	61	446	76	486	65	446
San Francisco	19,983	125,245	9,849	53,879	3,611	20,619
Vermont	260	1,910	278	1,775	291	2,247
Washington	6,563	40,758	6,499	39,188	2,721	18,988
	135,240	1,094,146	141,911	1,387,172	112,550	1,305,140

TABLE 47.—*Coke imported for consumption in the United States, 1938–40, by countries*

Country	1938 Net tons	1938 Value	1939 Net tons	1939 Value	1940 Net tons	1940 Value
Belgium	35,772	$165,724	37,080	$152,606	----	----
Canada	58,065	691,611	85,818	1,129,337	77,642	$1,114,683
Germany	21,907	108,327	4,321	26,126	----	----
Netherlands	----	----	10	80	----	----
United Kingdom	19,496	128,484	14,682	79,023	34,908	190,457
	135,240	1,094,146	141,911	1,387,172	112,550	1,305,140

WORLD PRODUCTION

The continuation through 1940 of the European War, which involved more than half of the countries listed in the following world table, was chiefly responsible for the dearth of data on 1940 production. Coke production in Canada established a new record during 1940, which exceeded by 345,534 metric tons the previous peak production, attained in 1929. Decreases are noted in the output of coke by Indochina and in the coke exports of China. Production of coke in the Straits Settlements, which in the previous years covered by the table showed little change, indicated a sharper increase during 1940, exceeding each of the 1937, 1938, 1939 figures by more than 1,300 metric tons.

TABLE 48.—*Coke produced in principal countries of the world, 1929 and 1937–40, in metric tons* [1] [2]

[Compiled by L. P. Lounsbery]

Country [2]	1929	1937	1938	1939	1940
Australia:					
New South Wales	471,813	955,030	1,153,670	(3)	(3)
Queensland	4,144	30,949	31,481	31,057	(3)
Belgium	6,192,960	6,083,910	4,894,980	5,176,650	(3)
Bulgaria	----	4,550	3,923	4,758	(3)
Canada	1,986,532	1,984,581	1,808,588	1,830,425	2,332,066
China (exports)	13,467	9,062	11,630	22,562	18,456
Czechoslovakia	3,170,629	3,279,864	[4] 2,367,000	(3)	(3)
France	9,080,127	7,900,000	7,785,000	(3)	(3)
Germany	39,421,033	40,920,357	43,511,082	(3)	(3)
Saar	2,423,000				
Great Britain [5]	13,637,421	15,171,482	13,031,396	(3)	(3)
Hungary	2,092	35,092	53,092	(3)	(3)
India, British [6]	843,504	1,900,413	1,738,178	1,947,455	(3)
Indochina	637	128	3,503	4,022	2,608
Italy	791,607	1,693,024	1,739,417	(3)	(3)
Mexico	493,777	(3)	(3)	(3)	(3)
Netherlands	2,402,566	3,364,885	3,158,065	(3)	(3)
New Caledonia	----	----	43,317	(3)	80,000
Peru	35,899	3,607	----	(3)	(3)
Poland	1,858,052	2,125,519	2,523,290	(3)	(3)
Rhodesia, Southern	100,001	56,029	47,986	32,785	(3)
Rumania	----	78,010	86,030	(3)	(3)
Spain	768,040	(3)	(3)	(3)	(3)
Straits Settlements	15,667	10,134	10,400	10,490	11,835
Sweden	103,778	121,630	112,107	115,150	(3)
Turkey	----	74,792	84,930	63,472	(3)
Union of South Africa	99,297	109,133	163,315	184,522	(3)
U. S. S. R.	4,700,000	20,000,000	20,700,000	16,670,000	(3)
United States	54,325,427	47,513,978	29,479,553	40,212,242	51,774,699
	142,941,000	[7] 153,000,000	[7] 135,000,000	(3)	(3)

[1] Gas-house coke is not included.
[2] In addition to countries listed above, coke is produced in Chosen and Japan, but data of production are not available.
[3] Data not available.
[4] Excluding Sudetenland since October.
[5] In Great Britain the production of gas-house coke (including breeze), not included above, is especially important and was as follows: 1937, 13,151,057 tons; 1938, 13,049,139 tons.
[6] Figures for 1929 represent "hard" and "soft" coke made at collieries only (73,616 tons of "hard" coke and 769,888 tons of "soft" coke). Data for other years shown represent total "hard" coke manufactured. In addition, the following quantities of "soft" coke were made at collieries: 1937, 850,581 tons; 1938, 921,479 tons; 1939, data not available.
[7] Exclusive of Mexico and Spain.

COKE-OVEN BYPRODUCTS

The recovery of the valuable byproducts formed during the coking process represents, to coke-plant operators, a source of additional revenue and a means of reducing to a minimum the cost of conversion of coal to coke. To the national economy, it represents an important asset in the recovered products, essential to the public welfare, that would be lost with use of the earlier methods and equipment designed for the recovery of coke only. For example, the value at the plant of the byproducts recovered in 1940, which would have been wasted if the coke had been made in beehive ovens, is estimated at more than $200,000,000. Of these byproducts recovered, gas, tar, and light oils had a calorific value equivalent to 19,036,000 net tons of coal. Modern byproduct coke ovens therefore are a definite contribution to progress in the conservation of our mineral resources. Conditions of demand for all the byproducts of the coking process, however, are not always favorable, and the quantity produced is also affected by the demand for coke. The total number of byproducts, identified as chemical compounds, that might be obtained by distilling coal in byproduct ovens has never been actually determined. A conservative estimate of the number of definite compounds present in tar alone is 200, but only a few have been separated in the pure state. The statistics in the following tables are confined to the major products of byproduct coke ovens, which fall into five general groups. They are (1) gas, the most valuable byproduct, followed by (2) light oil and its derivatives, (3) ammonia, (4) tar, and (5) miscellaneous products.

Although the quantity of coke produced by byproduct ovens in 1940 established a new record, the output of the major byproducts (with the exception of light oil) fell slightly short of the previous record attained in 1929.

The total sales value of all byproducts sold in 1940 (excluding the value of tar used by the producers and the value of coke breeze produced) was $145,081,877—56 percent of the value of the byproduct coke produced. It is noteworthy that, of this sales value, $4,257,088 is represented by tar derivatives reported from 11 byproduct plants. There is some indication of a trend toward more extensive incorporation into byproduct recovery plants of tar-distillation units to produce the several derivatives in the pure or crude state.

In addition to providing the fuel requirements of the byproduct ovens from which it is evolved, coke-oven gas supplies various other fuel needs. During 1940, 523,640,555 M cubic feet (63 percent of the 833,761,720 M cubic feet of gas produced) were used or sold for industrial purposes and for distribution through city gas mains. Its average sales value as reported by operators was $0.155 per M cubic feet—a decrease of $0.011 per M cubic feet under the 1939 figure of $0.166. In this connection it is noted that, of the volume of surplus gas placed on the market by the increased production of byproduct coke, 12,555,062 M cubic feet were wasted compared with 8,567,855 M cubic feet in 1939.

National defense requirements place important emphasis on the byproducts of the coking process, particularly on toluol (a derivative of light oil) and on ammonia. Toluol is a principal ingredient of trinitrotoluene (one of the more important explosives), and ammonia is an important raw material for producing nitric acid and also is used in the manufacture of explosives. The production of 26,406,407 gallons of byproduct toluol in 1940 was the highest on record, exceeding that for 1939 by approximately 7 million gallons, while the output of ammonia (NH_3 equivalent of all forms) totaled 416,054,299 pounds. In the absence of heavy demand by the industries manufacturing explosives, the major portion of byproduct toluol production must seek other outlets on the market, chiefly as a motor-fuel ingredient or as a commercial solvent. In this event, it is seldom of nitration quality, and its value is diminished considerably. In 1939, the average value of toluol was $0.194 a gallon; in 1940 this had advanced to $0.242 a gallon. As usual, the bulk of the ammonia recovered in 1940 went into the production of ammonium sulfate. The demand of the fertilizer industry is chiefly responsible for the conversion of the ammonia to the sulfate. The average value of sulfate production in 1940 was $0.012 a pound—an increase of $0.001 of $0.011 a pound over the 1939 figure.

TABLE 49.—*Byproducts obtained from coke-oven operations in the United States, 1940* [1]

[Exclusive of screenings or breeze]

Product	Production	Sales		
		Quantity	Value	
			Total	Average
Tar ... gallons	673,286.517	350,691,110	$16,051,496	$0.046
Ammonia:				
Sulfate ... pounds	1,436.462,003	1,453,008,364	17,876,168	.012
Ammonia liquor (NH_3 content) ... do	56,938,798	56,249,546	1,798,109	.032
			19,674,277	
Sulfate equivalent of all forms ... do	1,664,217,195	1,678,006,548		
NH_3 equivalent of all forms ... do	416,054,299	419,501,637		
Gas:				
Used under boilers, etc ... M cubic feet	[2] 833,761,720	36,498,403	2,648,328	.073
Used in steel or affiliated plants ... do		305,890,735	31,171,675	.102
Distributed through city mains ... do		151,688,271	43,931,892	.290
Sold for industrial use ... do		29,563,146	3,650,152	.123
	[2] 833,761,720	523,640,555	81.402,047	.155
Light oil and derivatives:				
Crude light oil ... gallons	[3] 215,213,667	10,324,670	829,031	.080
Benzol, crude and refined ... do	31,880.556	31,121,220	3,941,364	.127
Motor benzol ... do	101,140,079	95.329,911	8,037,526	.084
Toluol, crude and refined ... do	26,406,407	25.918,829	6,282,946	.242
Solvent naphtha ... do	5,220.979	4.742,859	754,578	.159
Xylol ... do	5,645,993	5,335,574	1,239.603	.232
Other light-oil products ... do	7,500,617	5,110,041	419,081	.082
	[4] 177,794,631	177,883.104	21,504,129	.121
Naphthalene, crude and refined ... pounds	72,426,443	72,522,476	1,248,051	.017
Tar derivatives:				
Creosote oil, distillate as such ... gallons	27,150,656	16,798,632	1.832 348	.109
Creosote oil in coal-tar solution ... do	2,449,812	923,766	114,771	.124
Pitch of tar ... net tons	307,040	1,743	11,641	6.679
Other tar derivatives			2,298,328	
Light carbolic oil ... gallons	2,431,293	2,399,778	215,865	.090
Phenol ... do	82,045	71,340	29,130	.408
Pyridine, crude and refined ... do	241,075	218 165	296,441	1.359
Sodium phenolate ... do	168,285	168,287	13,528	.080
Other products [5]			389,825	
Value of all byproducts sold			[6] 145.081,877	

[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 ovens.
[3] Refined on premises to make the derived products shown: 207,272,848 gallons.
[4] Total gallons of derived products.
[5] Ammonia thiocyanate, asphalt paint, cyanogen, sodium carbolate, sodium prussiate, spent soda solution, sulfur, vented vapors, and a small amount of miscellaneous products.
[6] Exclusive of value of breeze production, which was $8,472,114 in 1940.

Due to the increasing importance of tar acids, used largely for making plastics, some byproduct coke plants which do not have facilities for the complete processing of crude tar have installed equipment for "topping" the tar to recover these acids. "Topping" is designed primarily to strip from the tar its constituents comprising the light oil and tar acid oil fractions, and in some cases, even higher fractions. The process represents a means of conserving these materials where full refining equipment is not available at the byproduct plant, or

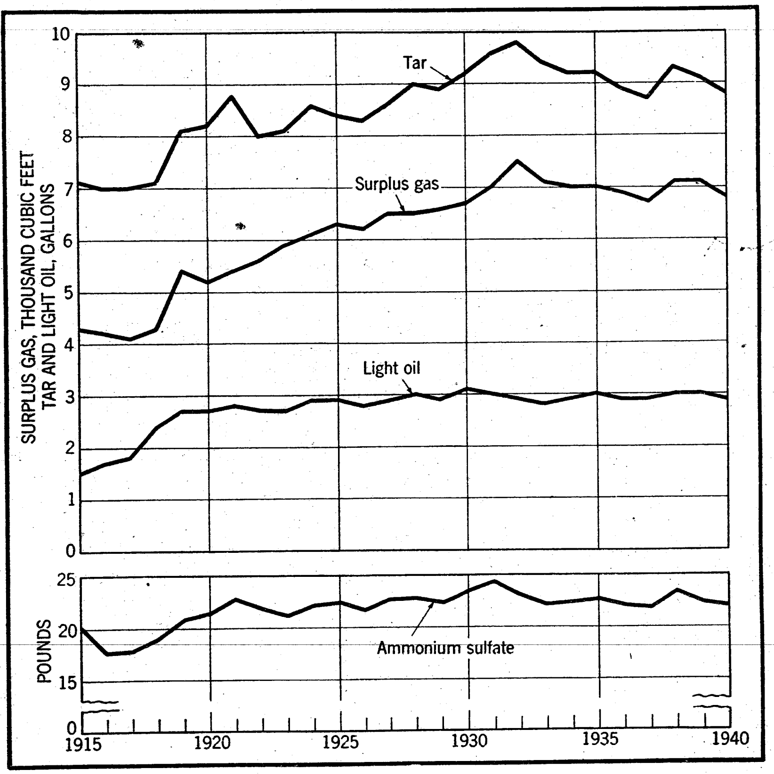

FIGURE 2.—Average yield of principal byproducts per net ton of coal carbonized in byproduct coke ovens, 1915–40. Figures for light oil represent average at plants recovering light oil.

when the crude tar cannot be sold to tar refineries. The "topped" tar is available for further refining or for use as fuel. Information regarding the quantity of tar "topped" at byproduct coke plants was collected by the Bureau of Mines for the first time in 1940. Returns from producers indicate that 94,890,278 gallons of tar were "topped" during 1940.

Statistics covering the production and sales of coke-oven byproducts during 1940 are shown in tables 49 through 56. Figure 2 supplies information on yield per ton of coal carbonized.

TABLE 50.—*Coal equivalent of byproducts of byproduct coking in the United States, 1913, 1914, 1918, and 1939–40*

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
1939	3,354	434	554,406	170,963	67,080	238,700	83,161	22,225	411,166	15,693,000	24.7
1940	4,078	524	673,287	215,214	81,560	288,200	100,993	27,978	498,731	19,036,000	23.4

COKE-OVEN GAS

TABLE 51.—*Coke-oven gas produced and sold in the United States, in 1940, by States*

State	Active plants	Produced (M cubic feet)	Used in heating ovens (M cubic feet)	Surplus sold or used			Wasted (M cubic feet)
				M cubic feet	Value		
					Total	Average	
Alabama	7	72,870,639	32,047,398	39,027,507	$2,877,615	$0.074	1,795,734
Colorado	1	10,145,552	4,903,692	5,165,888	(1)	(1)	75,972
Illinois	9	43,271,626	12,772,551	28,612,945	5,393,474	.188	1,886,130
Indiana	5	93,510,094	37,928,284	54,363,788	9,680,968	.178	1,218,022
Maryland	1	22,410,968	9,631,912	12,477,958	(1)	(1)	301,098
Massachusetts	2	18,242,714	4,405,220	13,789,923	(1)	(1)	47,571
Michigan	8	45,110,180	5,451,959	39,541,493	4,562,031	.115	116,728
Minnesota	3	8,719,103	3,182,208	5,523,606	1,523,655	.276	13,289
New Jersey	2	16,552,785	3,423,169	13,129,616	(1)	(1)	----------
New York	8	76,133,327	19,170,953	55,798,593	16,217,110	.291	1,163,781
Ohio	15	115,790,271	49,086,766	63,192,770	6,993,160	.111	3,510,735
Pennsylvania	12	242,692,013	97,839,787	143,367,654	16,214,547	.113	1,484,572
Tennessee	1	1,217,915	530,294	687,621	161,683	.235	----------
Utah	1	5,009,612	2,129,084	2,565,044	(1)	(1)	315,484
West Virginia	4	30,700,772	8,662,729	21,887,996	1,948,440	.089	150,047
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	6	31,384,149	6,400,097	24,508,153	6,880,123	.281	475,899
Undistributed	----------	----------	----------	----------	8,949,241	.190	----------
Grand total, 1940	85	833,761,720	297,566,103	523,640,555	81,402,047	.155	12,555,062
At merchant plants	40	190,057,839	42,772,100	144,418,639	39,052,602	.270	2,867,100
At furnace plants	45	643,703,881	254,794,003	379,221,916	42,349,445	.112	9,687,962
Grand total, 1939	84	675,143,201	232,864,056	433,711,290	71,876,455	.166	8,567,855

[1] Included under "Undistributed."

TABLE 52.—*Disposal of surplus coke-oven gas in the United States, in 1940, by States*

State	Used by producer						Sold					
	Under boilers			In steel or other affiliated plants			Distributed through city mains			Sold for industrial purposes		
	M cubic feet	Value		M cubic feet	Value		M cubic feet	Value		M cubic feet	Value	
		Total	Average		Total	Average		Total	Average		Total	Average
Alabama	7,528,720	$268,029	$0.036	24,381,520	$1,855,368	$0.076	5,071,193	$562,169	$0.111	2,046,074	$192,049	$0.094
Colorado				5,165,888	(1)	(1)						
Illinois	2,388,517	197,526	.083	4,210,996	528,450	.125	20,189,646	4,499,480	.223	1,823,786	168,018	.092
Indiana	3,539,667	214,881	.061	42,681,717	5,615,106	.132	6,096,545	3,263,030	.535	2,045,859	587,951	.287
Maryland				7,388,931	(1)	(1)	5,089,027	(1)	(1)			
Massachusetts	11,907	(1)	(1)	1,064	(1)	(1)	13,674,230	(1)	(1)	102,722	(1)	(1)
Michigan	4,765,187	506,376	.106	27,802,133	3,046,698	.110	3,144,979	621,838	.198	3,829,194	387,119	.101
Minnesota	101,417	5,102	.050	1,359,250	197,080	.145	4,062,939	1,321,473	.325			
New Jersey							13,129,616	(1)	(1)			
New York	3,151,775	261,850	.083	13,338,475	1,552,455	.116	37,165,386	14,102,520	.379	2,142,957	300,285	.140
Ohio	4,727,454	449,852	.095	48,473,753	4,730,896	.098	6,903,878	1,480,571	.214	3,087,685	331,841	.107
Pennsylvania	7,277,862	518,393	.071	111,261,688	10,522,784	.095	16,558,125	4,378,745	.264	8,269,979	794,625	.096
Tennessee	63,320	2,162	.034							624,301	159,521	.256
Utah	1,740,743	(1)	(1)	74,223	(1)	(1)	560,369	(1)	(1)	189,709	(1)	(1)
West Virginia	156,997	10,086	.064	19,751,097	1,618,287	.082				1,979,902	320,067	.162
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	1,044,837	100,741	.096				20,042,338	6,410,935	.320	3,420,978	368,447	.108
Undistributed		113,330	.065		1,504,551	.119		7,291,131	.225		40,229	.138
Grand total, 1940	36,498,403	2,648,328	.073	305,890,735	31,171,675	.102	151,688,271	43,931,892	.290	29,563,146	3,650,152	.123
At merchant plants	8,222,236	647,596	.079	7,934,172	712,337	.090	110,869,308	35,306,372	.318	17,392,923	2,386,297	.137
At furnace plants	28,276,167	2,000,732	.071	297,956,563	30,459,338	.102	40,818,963	8,625,520	.211	12,170,223	1,263,855	.104
Grand total, 1939	28,714,866	1,967,142	.069	237,890,694	24,301,060	.102	144,876,573	42,891,370	.296	22,229,157	2,716,883	.122

[1] Included under "Undistributed."

TAR

TABLE 53.—*Coke-oven tar produced and sold in the United States, in 1940, by States*

State	Produced [1] (gallons)		Sold					Used by producer [2] (gallons)			On hand, Dec. 31 (gallons)
	Total	Per ton of coal coked	For use as fuel [3] (gallons)	For refining into tar products (gallons)	Total sold (gallons)	Value: Total	Value: Average	As fuel under boilers	In open-hearth or affiliated plants	Otherwise	
Alabama	57,101,546	8.58	6,658,552	24,737,309	31,395,861	$1,517,554	$0.048	42,516	27,856,894	153,011	2,424,084
Colorado	9,089,216	10.69		91,584	91,584	(4)	(4)		3,816,020	5,363	511,065
Illinois	33,740,741	7.90	6,270,897	27,013,711	33,284,608	1,477,899	.044		738,181	38,357	3,898,995
Indiana	54,503,446	6.22	9,602,010	8,546,452	18,148,462	796,337	.044		25,594,905	71,551	3,130,052
Maryland	17,885,279	7.69		18,230,901	18,230,901	(4)	(4)		46,807		1,315,255
Massachusetts	12,995,019	8.18	593,410	12,447,238	13,040,648	(4)	(4)				258,565
Michigan	34,605,702	8.44	22,460	27,365,351	27,387,811	1,143,197	.042		7,299,258	650	3,036,962
Minnesota	6,462,198	8.69		6,958,148	6,958,148	351,869	.051				392,788
New Jersey	11,614,730	8.19		11,774,411	11,774,411	(4)	(4)				714,786
New York	65,113,250	9.14	8,235,464	43,878,114	52,113,578	2,477,083	.048		10,234,010	21,605	5,343,691
Ohio	90,135,541	8.16	4,548,208	43,683,613	48,231,821	2,227,210	.046	2,331,667	38,493,609	352,569	4,546,936
Pennsylvania	221,897,903	10.22	3,711,489	28,549,326	32,260,815	1,483,871	.046	841,180	58,015,976	761,707	15,985,639
Tennessee	987,642	7.37		985,812	985,812	47,294	.048				30,452
Utah	4,303,394	11.66	109	4,329,262	4,329,371	(4)	(4)		900		159,930
West Virginia	30,574,870	11.11		30,274,579	30,274,579	1,293,260	.043		641,843		683,124
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	22,276,040	8.17		22,182,700	22,182,700	1,070,815	.048			4,177	884,923
Undistributed						2,165,107	.046				
Grand total, 1940	673,286,517	8.79	39,642,599	311,048,511	350,691,110	16,051,496	.046	3,215,363	172,738,403	1,408,990	43,317,247
At merchant plants	152,249,433	8.72	8,384,833	142,516,926	150,901,759	6,860,200	.045	83,745		139,481	9,355,203
At furnace plants	521,037,084	8.81	31,257,766	168,531,585	199,789,351	9,191,296	.046	3,131,618	172,738,403	1,269,509	33,962,044
Grand total, 1939	554,406,216	9.06	66,142,880	278,391,502	344,534,382	16,585,734	.048	4,656,863	85,363,841	877,249	44,936,639

[1] Includes 151,545,371 gallons of tar "refined at plant."
[2] Excludes 151,545,371 gallons of tar "refined at plant" that the Bureau of Mines is not at liberty to publish by States.
[3] Comprises 1,081,657 gallons of tar sold to affiliated corporations and 38,560,942 gallons sold to other purchasers.
[4] Included under "Undistributed."

AMMONIA

TABLE 54.—*Ammonia produced at coke-oven plants in the United States and sold in 1940, by States*

State	Active plants	Sulfate equivalent of all forms (pounds)		Produced as—		Sold as—			
						Sulfate		Liquor (NH_3 content)	
		Total	Per ton of coal coked	Sulfate (pounds)	Liquor (NH_3 content) (pounds)	Pounds	Value	Pounds	Value
Alabama	7	159,802,374	24.01	142,256,518	4,386,464	148,289,395	$1,941,917	4,387,056	$155,533
Colorado	1	19,939,880	23.46	19,939,880	----------	20,370,029	(1)	----------	----------
Illinois	7	84,075,316	20.72	66,480,316	4,398,750	69,203,053	785,069	4,149,330	(1)
Indiana	5	157,451,451	17.98	138,689,043	4,690,602	133,243,663	1,536,112	4,604,319	152,343
Maryland	1	46,494,302	19.98	46,494,302	----------	47,286,890	(1)	----------	----------
Massachusetts	2	36,623,536	23.04	32,483,840	1,034,924	30,987,020	(1)	1,038,413	(1)
Michigan	8	85,657,312	20.89	36,426,968	12,307,586	34,471,200	383,089	12,014,431	266,321
Minnesota	3	16,780,031	22.56	16,780,031	----------	14,995,080	171,910	----------	----------
New Jersey	2	28,628,394	20.19	28,628,394	----------	26,772,200	(1)	----------	----------
New York	8	155,194,040	21.79	125,269,704	7,481,084	125,649,152	1,689,833	7,413,309	267,756
Ohio	15	241,790,928	21.88	202,348,924	9,860,501	207,179,069	2,506,057	9,949,722	353,676
Pennsylvania	11	507,601,971	23.48	494,610,483	3,247,872	506,191,490	6,063,539	3,375,494	(1)
Tennessee	1	3,266,803	24.39	3,266,803	----------	3,358,800	46,454	----------	----------
Utah	1	10,213,300	27.67	10,213,300	----------	10,153,325	(1)	----------	----------
West Virginia	3	52,623,746	24.38	52,623,746	----------	54,857,650	764,395	----------	----------
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	5	58,073,811	21.54	19,949,751	9,531,015	20,000,348	262,430	9,317,472	296,152
Undistributed	----------	----------	----------	----------	----------	----------	1,725,363	----------	306,328
Grand total, 1940	80	1,664,217,195	22.00	1,436,462,003	56,938,798	1,453,008,364	17,876,168	56,249,546	1,798,109
At merchant plants	35	367,086,706	22.22	216,764,022	37,580,671	217,111,133	2,795,125	36,590,687	1,222,845
At furnace plants	45	1,297,130,489	21.94	1,219,697,981	19,358,127	1,235,897,231	15,081,043	19,658,859	575,264
Grand total, 1939	80	1,353,604,372	22.33	1,160,548,288	48,264,021	1,153,901,833	13,153,642	48,034,809	1,480,879

1 Included under "Undistributed."

LIGHT OIL AND ITS DERIVATIVES

TABLE 55.—*Crude light oil produced at coke-oven plants in the United States and derived products obtained and sold in 1940, by States*

State	Active plants	Produced (gallons)		Refined on premises (gallons)	Derived products obtained and sold		
		Total	Per ton of coal coked		Produced (gallons)	Sold [1] (gallons)	Value [1]
Alabama	7	19,188,504	2.88	18,286,845	16,289,727	15,798,009	$1,828,550
Colorado	1	2,797,638	3.29	2,792,736	2,174,373	1,893,917	(2)
Illinois	5	9,229,191	2.43	5,179,801	4,347,082	4,121,179	499,799
Indiana	4	21,770,524	2.63	22,767,872	19,795,334	19,025,465	2,329,776
Maryland	1	7,974,637	3.43	7,959,850	6,870,295	6,526,874	(2)
Michigan	4	10,772,272	2.83	9,130,523	8,222,375	3,938,120	556,202
New York	7	16,996,855	2.69	23,624,814	19,853,527	19,497,611	2,743,833
Ohio	15	33,339,187	3.02	30,174,674	25,190,258	24,622,722	2,976,642
Pennsylvania	11	67,896,978	3.14	66,959,218	57,327,094	54,779,099	6,514,902
Tennessee	1	322,741	2.41	320,632	251,774	215,546	24,236
Utah	1	1,535,729	4.16	1,520,490	1,129,344	1,089,817	(2)
West Virginia	4	9,575,726	3.48	9,972,405	8,458,841	8,139,331	1,215,237
Connecticut, Kentucky, Massachusetts, Minnesota, Missouri, New Jersey, Rhode Island, and Wisconsin	8	13,813,685	2.52	8,582,988	7,884,607	7,910,744	987,913
Undistributed							998,008
Grand total, 1940	69	215,213,667	2.93	207,272,848	177,794,631	167,558,434	20,675,098
At merchant plants	25	35,258,257	2.43	29,402,749	25,694,274	24,898,245	3,329,460
At furnace plants	44	179,955,410	3.05	177,870,099	152,100,357	142,660,189	17,345,638
Grand total, 1939	65	170,963,199	2.99	163,947,167	139,805,191	133,435,416	16,306,449

[1] Excludes 10,324,670 gallons valued at $829,031 of crude oil sold as such.
[2] Included under "Undistributed."

NAPHTHALENE

TABLE 56.—*Crude and refined naphthalene sold by byproduct-coke operators in the United States, 1936–40*

Year	Pounds	Value		Receipts per ton of coke (cents)
		Total	Average receipts per pound (cents)	
1936	34,946,890	$570,295	1.6	1.3
1937	60,315,581	1,182,992	2.0	2.4
1938	25,456,400	437,654	1.7	1.4
1939	46,551,432	727,947	1.6	1.7
1940	72,522,476	1,248,051	1.7	2.3

BYPRODUCT COKE OVENS OWNED BY CITY-GAS COMPANIES (PUBLIC UTILITY PLANTS)

Adaptation of byproduct coke ovens to the needs of city-gas manufacture has led a number of gas companies to install batteries of byproduct ovens to supplement or even replace their coal or water-gas plants. Although more emphasis is placed upon the production of gas of proper analysis than upon the grade of coke obtained, from the point of view of supply and demand for coke and byproducts these installations belong to the byproduct-coke industry and are therefore included in the statistics furnished by the Bureau of Mines.

During 1940, 16 byproduct plants owned by city-gas companies were active and contributed 3,356,403 tons of coke (6 percent of the total production of the byproduct industry)—an increase of 197,274 tons over 1939, when 17 plants were active.

The following table presents salient statistics for 1939 and 1940 of the city-gas byproduct-coke plants in relation to the industry as a whole.

TABLE 57.—*Production of coke, breeze, gas, and byproducts in the United States at byproduct-coke plants owned by city-gas companies (public utilities) and at all other byproduct-coke plants, 1939–40*

Product	1939			1940		
	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	67	17	84	69	16	85
Coke:						
Production...net tons	39, 723, 184	3, 159, 129	42, 882, 313	50, 657, 906	3, 356, 403	54, 014, 309
Value	$186, 275, 463	$20, 182, 410	$206, 457, 873	$238, 125, 557	$22, 231, 009	$260, 356, 566
Average	$4. 69	$6. 39	$4. 81	$4. 70	$6. 62	$4. 82
Screenings or breeze:						
Production...net tons	3, 098, 018	256, 356	3, 354, 374	3, 814, 091	263, 946	4, 078, 037
Sales...do	470, 586	41, 789	512, 375	565, 942	37, 715	603, 657
Value	$1, 159, 829	$104, 914	$1, 264, 743	$1, 285, 916	$92, 054	$1, 377, 970
Average	$2. 46	$2. 51	$2. 47	$2. 27	$2. 44	$2. 28
Coal charged into ovens:						
Quantity...net tons	56, 697, 045	4, 518, 854	61, 215, 899	71, 803, 507	4, 779, 273	76, 582, 780
Coke:						
Used by producer:						
Quantity...net tons	28, 527, 680	736, 561	29, 264, 241	37, 102, 304	762, 936	37, 865, 240
Value	$122, 872, 502	$4, 642, 504	$127, 515, 006	$161, 344, 141	$4, 786, 314	$166, 130, 455
Sales:						
Quantity...net tons	12, 107, 076	2, 511, 625	14, 618, 701	14, 102, 810	2, 777, 113	16, 879, 923
Value	$67, 877, 767	$16, 110, 542	$83, 988, 309	$80, 485, 357	$18, 646, 924	$99, 132, 281
Byproducts:						
Gas:						
Production M cubic feet	622, 399, 116	52, 744, 085	675, 143, 201	778, 583, 598	55, 178, 122	833, 761, 720
Sales of surplus:						
Used under boilers:						
Quantity M cubic feet	28, 696, 140	18, 726	28, 714, 866	36, 457, 763	40, 640	36, 498, 403
Value	$1, 963, 902	$3, 240	$1, 967, 142	$2, 641, 776	$6, 552	$2, 648, 328
Used in steel or affiliated plants:						
Quantity M cubic feet	237, 875, 390	15, 304	237, 890, 694	305, 874, 831	15, 904	305, 890, 735
Value	$24, 296, 469	$4, 591	$24, 301, 060	$31, 166, 904	$4, 771	$31, 171, 675
Distributed through city mains:						
Quantity M cubic feet	98, 015, 739	46, 860, 834	144, 876, 573	103, 034, 048	48, 654, 223	151, 688, 271
Value	$24, 024, 630	$18, 866, 740	$42, 891, 370	$25, 180, 149	$18, 751, 743	$43, 931, 892
Sold for industrial use:						
Quantity M cubic feet	20, 327, 643	1, 901, 514	22, 229, 157	27, 341, 091	2, 222, 055	29, 563, 146
Value	$2, 107, 883	$609, 000	$2, 716, 883	$2, 982, 098	$668, 054	$3, 650, 152
Tar:						
Production...gallons	509, 885, 368	44, 520, 848	554, 406, 216	627, 585, 932	45, 700, 585	673, 286, 517
Sales:						
Quantity...do	300, 488, 889	44, 045, 493	344, 534, 382	304, 117, 805	46, 573, 305	350, 691, 110
Value	$14, 545, 104	$2, 040, 630	$16, 585, 734	$13, 880, 054	$2, 171, 442	$16, 051, 496
Average	$0. 048	$0. 046	$0. 048	$0. 046	$0. 047	$0. 046
Ammonia:						
Production (NH_3 equivalent of all forms) pounds	314, 838, 954	23, 562, 139	338, 401, 093	391, 415, 668	24, 638, 631	416, 054, 299
Liquor (NH_3 content):						
Production...pounds	45, 094, 454	3, 169, 567	48, 264, 021	53, 322, 055	3, 616, 743	56, 938, 798
Sales...do	44, 915, 616	3, 119, 193	48, 034, 809	52, 659, 414	3, 590, 132	56, 249, 546
Value	$1, 431, 624	$49, 255	$1, 480, 879	$1, 732, 850	$65, 259	$1, 798, 109

See footnote at end of table.

TABLE 57.—*Production of coke, breeze, gas, and byproducts in the United States at byproduct coke plants owned by city-gas companies (public utilities) and at all other byproduct-coke plants, 1939–40*—Continued

Product	1939			1940		
	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
Byproducts—Continued.						
Ammonia—Continued.						
Sulfate:						
Production..pounds..	1,078,978,000	81,570,288	1,160,548,288	1,352,374,453	84,087,550	1,436,462,003
Sales..........do....	1,075,488,293	78,413,540	1,153,901,833	1,368,332,551	84,675,813	1,453,008,364
Value...............	$12,269,765	$883,877	$13,153,642	$16,794,508	$1,081,660	$17,876,168
Crude light oil:						
Production....gallons..	167,279,063	3,684,136	170,963,199	211,282,923	3,930,744	215,213,667
Sales.............do....	6,525,552	2,858,355	9,383,907	7,353,610	2,971,060	10,324,670
Value...............	$510,753	$217,012	$727,765	$597,497	$231,534	$829,031
Light-oil derivatives:						
Production....gallons..	139,218,163	587,028	139,805,191	177,134,556	660,075	177,794,631
Sales.............do....	132,831,952	603,464	133,435,416	166,955,002	603,432	167,558,434
Value...............	$16,217,241	$89,208	$16,306,449	$20,586,693	$88,405	$20,675,098
Naphthalene, crude and refined:						
Production....pounds..	47,763,810	696,361	48,460,171	71,914,774	511,669	72,426,443
Sales.............do....	45,850,071	701,361	46,551,432	71,994,045	528,431	72,522,476
Value...............	$720,216	$7,731	$727,947	$1,240,402	$7,649	$1,248,051
All other products, value.	$3,848,597	$106,966	$3,955,563	$5,120,569	$81,308	$5,201,877

[1] Includes all byproduct ovens built by city-gas companies, some of which are operated in conjunction with coal, oil, and water-gas plants. Does not include independent byproduct plants, which may sell gas to public utility companies for distribution.

FUEL BRIQUETS AND PACKAGED FUEL[1]

By G. S. Goodman

SUMMARY OUTLINE

Fuel briquets produced in the United States in 1940 amounted to 1,050,870 net tons—an increase of 17.8 percent over 1939; production of packaged fuel (treated separately in this report) amounted to 284,513 tons—an increase of 32.0 percent over 1939. The combined output totaled 1,335,383 tons, valued at $8,830,874.

Records on the production of fuel briquets have been collected since 1907; that in 1940 was the third highest in the history of briquetting and was exceeded only in 1929 and 1936. Data on packaged fuel, obtained by the Bureau of Mines since 1935 (graphically illustrated for the first time in these reviews in fig. 2), show that a new high record was made in 1940, as the output rose to more than 11 times that in 1935.

The widespread trend toward the packaging of merchandise has also invaded the bulk-briquet market to some extent, according to returns received in response to a special item on the Bureau of Mines questionnaire for 1940. The advantages of cleanliness and of buying packaged fuels in less than ton lots appeal to small householders; however, the packaging of bulk briquets is a merchandising feature only—the briquets are not fired in the package—whereas in packaged fuel the entire package usually is placed in the stove or furnace. Eleven fuel-briquet operators reported that about 47,000 tons were boxed or bagged at the plant, including 45,000 tons distributed by the operators in paper bags containing 25 to 50 pounds each and in burlap bags of 100 pounds each; the remainder—2,000 tons—was packaged in cartons holding 40 pounds. Several operators reported that retailers are doing some packaging.

Technologic developments.—Production has increased materially and research continued, although industrial conditions have not especially

[1] Directories of fuel-briquetting and packaged-fuel plants operating in 1940 and names of manufacturers of equipment will be furnished on request by the Coal Economics Division, Bureau of Mines, Washington, D. C.
Data on employment and the principal expenses in the manufacture of fuel briquets may be obtained from the Bureau of the Census, which collects and publishes such data in alternate years.
Briquets made from charcoal, wood wastes, and fruit pits are not included in the Bureau of Mines review.

favored the construction of new plants. The 1940 review of the industry revealed five plants under construction in 1940—two in Illinois using Illinois coals, one in North Dakota using carbonized lignite, one in Michigan using bituminous coal, and one in Rhode Island using Pennsylvania anthracite; it is understood that several of these have begun to operate commercially.

Commercial briquetting of Texas lignite (without charring) was reported in 1940; however, the tonnage involved is small. No information is available regarding the details of the process. The plentiful supplies of natural gas and oil in this area are likely to present difficulties in developing a market for briquets.

Research in briquetting Illinois coals is nearing the demonstration stage at the Illinois Geological Survey.

Under appropriation from the 1939 General Assembly of Illinois a commercial-scale briquetting press designed by Dr. R. J. Piersol [2] and built by the J. P. Devine Manufacturing Co., Inc., of Mt. Vernon, Ill., is now installed in the recently completed Applied Research Laboratory of the Illinois Geological Survey at Urbana, Ill. This press system weighs about 34 tons, costs less than $50,000, and at 60 r. p. m. has a capacity of 500 tons per 24-hour day. Demonstrations on the briquetting of various Illinois coals will be made during 1941.

Dr. Piersol discovered recently as a result of laboratory investigations that coals in central and northern Illinois may be briquetted by his process without preheating or predrying; such briquets have about four times the crushing strength of those made with binder. He also found that deduster dust and sludges from many Illinois coals contain a concentration of fusain high enough to produce smokeless briquets by his process commercially without partial devolatilization.

The use of briquets in orchard heating and the economic phases of such frost protection are discussed in considerable detail by Floyd D. Young [3] in a recent report.

Smoke tests [4] of packaged fuel made from high-volatile bituminous screenings from various sources indicated considerable reduction in smoke. However, it is reported that the increased price of high-volatile screenings has retarded the development of this type of packaged fuel.

FUEL BRIQUETS

The salient statistics of the fuel-briquetting industry from 1936 to 1940 are summarized in the following table. Similar data for earlier years are to be found in annual issues of Mineral Resources (part II), which include chapters on briquetting, beginning with 1907, and Minerals Yearbook.

Production.—The output of fuel briquets in 1940 totaled 1,050,870 net tons valued at $6,438,952 (see fig. 1) and represents an increase of 17.8 percent in tonnage and 11 percent in value over 1939.

Briquets were produced in 17 States, and 13 of these showed increases over 1939. The bulk of the output continues to be concentrated in Wisconsin; but the Eastern States made the greatest gain, and West Virginia almost doubled its 1939 production. Wis-

[2] Piersol, R. J., Briquetting Illinois Coals Without a Binder by Compression and by Impact: Illinois State Geol. Survey Rept. of Investigations 31, 1933, 70 pp.; Briquetting Illinois Coals Without a Binder by Impact: Illinois State Geol. Survey Rept. of Investigations 37, 1935, 75 pp.; Smokeless Briquets; Impacted Without Binder from Partially Volatilized Illinois Coals: Illinois State Geol. Survey Rept. of Investigations 41, 1936, 30 pp.; The Smoke Index: Coal Heat, vol. 39, No. 2, 1941, pp. 59–60.

[3] Young, Floyd D., Frost and the Prevention of Frost Damage: U. S. Dept. of Agriculture Farmers' Bull. 1588, rev. December 1940, pp. 21 and following.

[4] Mitten, Ray F., Reducing Smoke by Means of Packaged Fuel: Coal Heat, vol. 37, No. 4, April 1940, p. 34; Reduce Smoke with Packaged Fuel: Coal Heat, vol. 37, No. 5, May 1940, p. 41.

Salient statistics of the fuel-briquetting industry in the United States, 1936–40

[Data regarding packaged fuel are given separately at end of this chapter]

Year	Production: Eastern States (thousands of net tons)	Production: Central States (thousands of net tons)	Production: Pacific Coast States (thousands of net tons)	Production: Total (thousands of net tons)	Imports (thousands of net tons)	Exports[1] (thousands of net tons)	Consumption[2] (thousands of net tons)	Value of production (thousands of dollars)	Plants in operation	Average output per plant (thousands of net tons)	Average value per net ton, f. o. b. plant: Eastern States	Average value per net ton, f. o. b. plant: Central States	Average value per net ton, f. o. b. plant: Pacific Coast States
1936	351	702	72	1,125	20	(1)	[1]1,145	7,043	32	35	$4.19	$6.95	$9.64
1937	271	636	89	996	7	25	978	6,394	31	32	4.19	7.01	8.94
1938	251	546	74	871	14	17	868	5,702	35	25	4.34	7.18	9.38
1939	243	574	75	892	1	13	880	5,802	31	29	4.23	7.15	8.96
1940	331	652	68	1,051	------	23	1,028	6,439	32	33	3.95	6.95	8.84

[1] Exports not reported separately by Bureau of Foreign and Domestic Commerce before 1937.
[2] Production plus imports minus exports.

consin and Pennsylvania also reported considerable gains. Other States producing over 20,000 tons, in relative order of importance, were Oregon, Missouri, North Dakota, Minnesota, and Washington.

The sharp increase in 1940 probably is due to the heavier demand occasioned by the unusually severe winter in the North Central States in 1940.

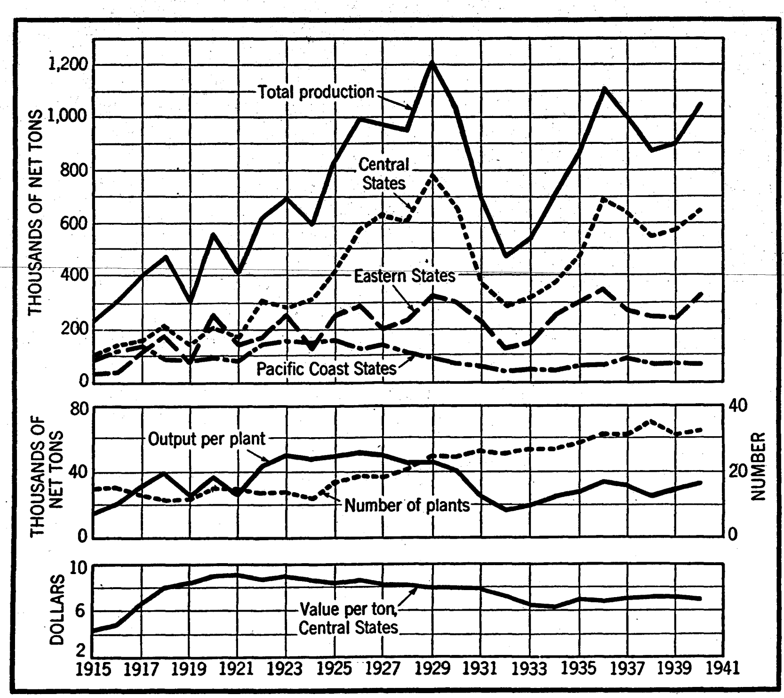

FIGURE 1.—Production of fuel briquets, number of plants in operation, and average value per ton, f. o. b. plant (Central States), 1915–40.

Production of fuel briquets in the United States, 1939–40

	1939			1940				
							Percentage of change in—	
	Plants	Net tons	Value	Plants	Net tons	Value	Tonnage	Value
Eastern States	4	243,429	$1,028,852	4	330,985	$1,308,789	+36.0	+27.2
Central States	21	574,108	4,103,496	23	651,880	4,529,114	+13.5	+10.4
Pacific Coast States	6	74,676	669,318	5	68,005	601,049	−8.9	−10.2
	[1] 31	892,213	5,801,666	[1] 32	1,050,870	6,438,952	+17.8	+11.0

[1] 1939: 10 plants in Wisconsin; 3 in Washington; 2 each in California, Minnesota, Nebraska, and West Virginia; and 1 each in Arkansas, Illinois, Massachusetts, Michigan, Missouri, North Dakota, Ohio, Oregon, Pennsylvania, and Wyoming. 1940: 11 plants in Wisconsin; 2 each in California, Minnesota, Nebraska, Washington, and West Virginia; and 1 each in Arkansas, Illinois, Massachusetts, Michigan, Missouri, North Dakota, Ohio, Oregon, Pennsylvania, Texas, and Wyoming.

Wisconsin, with 11 companies operating in 1940, is the only State for which figures on production and value can be published separately without revealing the operations of individual companies.

Production of fuel briquets in Wisconsin, 1935–40

Year	Plants	Net tons	Value	Year	Plants	Net tons	Value
1935	6	410,715	$2,986,847	1938	10	422,281	$3,085,873
1936	9	588,163	4,178,981	1939	10	430,554	3,158,859
1937	10	507,462	3,639,183	1940	11	487,574	3,440,676

Monthly production of fuel briquets in the United States, 1938–40, in net tons

Month	1938	1939	1940	Month	1938	1939	1940
January	141,397	113,698	157,091	August	51,098	57,267	58,706
February	79,414	99,195	76,550	September	78,128	78,012	84,466
March	36,556	58,840	68,981	October	87,446	113,315	92,295
April	28,806	34,001	43,936	November	99,651	89,465	128,301
May	49,599	51,384	66,449	December	120,351	83,579	140,133
June	61,531	71,273	57,814				
July	37,283	42,184	76,148		871,260	892,213	1,050,870

January and December were the months in 1940 when production was highest. The peak output in January reflects the fuel demand caused by the unusually severe weather in that month in the North Central States, where departures from normal reached a low of −15.2°. According to the Weather Bureau,[5] this was the coldest January of record in large areas.

Eighteen plants operated every month in the year—7 between 8 and 11 months and 7 between 4 and 6 months.

Value.—The sales realizations on briquets in the scattered producing centers in a given year vary considerably. An average value per ton for the entire industry therefore has doubtful significance because of the different conditions under which briquets are manufactured in various parts of the country. The most important factors that influence the value per ton realized at any plant probably are the cost of raw materials and the price of competing fuels; hence, the general trend of fuel-briquet prices [6] from year to year is indicated best in this review by the average values in the Eastern, Central, and Pacific Coast States, shown in the foregoing table of salient statistics.

[5] Reed, W. W., The Weather of 1940 in the United States: U. S. Dept. of Agriculture Monthly Weather Rev., vol. 68, No. 2, February 1941, p. 49.

[6] Retail fuel-briquet prices for certain cities are issued by the Retail Price Division, Bureau of Labor Statistics, Department of Labor, Washington, D. C., in its monthly releases, Retail Fuel Prices by Cities.

These figures are not the prices paid by the consumers. Some plants are distant from the markets they serve, and transportation charges and the margin of the wholesaler or retailer, sometimes both, must be added to the value at the plant.

The total value of fuel briquets manufactured in 1940 was $6,438,952 f. o. b. plant—an increase of $637,286 or 11 percent compared with 1939.

In the eastern part of the country the average value of $3.95 a ton is relatively low because virtually the entire output comes from plants in the low-volatile bituminous fields of West Virginia and in the anthracite region of Pennsylvania, where the freight charges are not so important an item in the cost of raw fuel. In the Central States most of the raw fuel (bituminous low-volatile and Pennsylvania anthracite) comes from the Lake docks, and the average value of $6.95 a ton discloses the extent to which freight charges affect value. In the Pacific Coast States, where carbon residue from the manufacture of oil gas forms the greater part of the raw fuel used, the average value dropped from $8.96 in 1939 to $8.84 in 1940.

Number of plants.—Thirty-two plants reported commercial production in 1940; all but one of these (that in Texas, which reported for the first time) were also active in 1939. One plant at the Lake docks changed hands in 1940. Ten plants were idle in 1940; all of these were also idle in 1939, and three of them (in Rhode Island, Pennsylvania, and North Dakota) went out of business in 1940. Five plants under construction in 1940 expect to begin operations in 1941 (two in Illinois, one in Michigan, one in North Dakota, and one in Rhode Island).

Size of plants.—The following table classifies the plants operating in 1939–40 according to actual production as well as actual capacity; however, a better indication of the size of the plants is gained from their capacity, even though the latter is affected by seasonal variations in output.

The total annual capacity of the 32 plants active in 1940, as reported by the operators, is 3,082,400 net tons—almost three times the 1940 production of 1,050,870 tons. It is interesting to note that although the figure for 1940 represented a 17.8 percent advance over 1939, these plants drew on only one-third of their potential annual capacity.

The average output of the individual plants increased 14 percent—from 29,000 tons in 1939 to 33,000 in 1940. Eighteen plants operating every month in 1940 produced 954,571 tons—91 percent of the total.

Classification of briquetting plants in the United States, 1939–40, by size of output and annual capacity

Output (net tons)	Plants		Annual capacity (net tons)	Plants	
	1939	1940		1939	1940
Less than 2,000	6	5	Less than 5,000	2	2
2,000 and less than 5,000	2	5	5,000 and less than 10,000	3	2
5,000 and less than 10,000	6	3	10,000 and less than 25,000	6	7
10,000 and less than 25,000	8	8	25,000 and less than 100,000	13	13
25,000 and less than 100,000	6	6	100,000 and less than 200,000	2	4
100,000 and over	3	5	200,000 and less than 400,000	3	2
			400,000 and over	2	2
	31	32		31	32

Raw fuels.—The briquetting process is now applied to a wide variety of raw fuels ranging from Texas lignite (without charring) and North Dakota lignite (after carbonization at low temperature) to Pennsylvania anthracite and includes petroleum coke and the residual carbons from oil-gas manufacture and natural-gas pyrolysis. The number of plants, by type of fuel used, is shown below.

Classification of fuel-briquetting plants in the United States in 1940, by kinds of raw fuel used

Kind of raw fuel used:	*Plants*
Anthracite and semianthracite fines exclusively	5
Mixture of Pennsylvania anthracite and bituminous	6
Bituminous:	
Low-volatile	13
High-volatile	1
Lignite	1
Semicoke (lignite char)	1
Residual carbon from pyrolysis of natural gas	1
Residual carbon from manufacture of oil gas	2
Petroleum coke	5
	[1] 35

[1] 4 plants made two kinds of briquets, hence the sum of these items exceeds the total number of plants.

The use of bituminous coals in the manufacture of briquets, now representing virtually two-thirds of the raw fuels used, continues to increase each year, while the use of Pennsylvania anthracite has decreased since 1934 from about one-third to less than one-fourth of the total raw fuels used. As shown in the following table, however, the greatly increased production of briquets in 1940 over 1939 represents increases in the tonnage of both bituminous and anthracite raw fuels used.

Operations of one of the country's largest briquetting companies, using bituminous coal at its plant at the mine and also at its second plant at the Lake docks, are described pictorially in the modern manner in The Coal Dealer.[7] The successful briquetting of North Dakota lignite is discussed in considerable detail by R. Dawson Hall [8] in Coal Age and by W. B. Pratt [9] in the Mining Congress Journal.

Raw fuels used in making fuel briquets in the United States, 1939–40

	Net tons		Percent of total	
	1939	1940	1939	1940
Anthracite and semianthracite culm and fine sizes	196,758	222,618	23.5	22.2
Bituminous and subbituminous slack [1]	503,431	636,312	60.2	63.4
Residual carbons from oil-gas manufacture and natural-gas pyrolysis; petroleum coke; and semicoke (lignite char)	136,213	144,167	16.3	14.4
	836,402	1,003,097	100.0	100.0

[1] Includes small tonnage of Texas lignite used without charring.

[7] Coal Dealer, Berwind in the Dock Trade since 1907: Vol. 37, No. 1, 1940, pp. 26–27. The Story of Glen Rogers Briquets—as Portrayed by the Camera Lens: Vol. 37, No. 2, 1940, pp. 60–61.

[8] Hall, R. Dawson, North Dakota Plant Carbonizes Lignite at Mine Mouth and Briquets Resultant Char for Shipment: Coal Age, vol. 45, No. 8, 1940, pp. 47–48.

[9] Pratt, W. B., Lignite Progresses—Future Promising: Min. Cong. Jour., vol. 26, No. 9, 1940, pp. 30–32.

Eight operators reported washing their raw fuel (totaling 230,937 tons) before its manufacture into briquets.

Two kinds of briquets were made by a large Wisconsin operator—one a mixture of Pennsylvania anthracite and low-volatile bituminous coal and the other low-volatile bituminous exclusively. Two kinds (petroleum coke and semianthracite) were also reported by two Nebraska operators; and an operator in Missouri made two kinds from the hard coals of Arkansas.

The success of a briquetting plant depends largely on its location with relation to the source of the raw-fuel supply and to the consuming market for the finished product, freight rates, cost of raw fuel, and prices of competing fuels to the consumer. In 1940, as indicated in the following table, plants at the mines, particularly those in West Virginia and Pennsylvania, reported the largest increase in production over 1939.

Production of fuel briquets in 1939–40, with reference to sources of raw fuels used

Location of plant	Net tons		Change in 1940
	1939	1940	Percent
At or near Lake Superior or Lake Michigan coal docks	443,215	511,336	+15.4
At coal mines	323,141	414,490	+28.3
At or near petroleum refineries and oil- and natural-gas plants	113,413	111,667	−1.5
At other locations [1]	12,444	13,377	+7.5
	892,213	1,050,870	+17.8

[1] Fall River, Mass., and Omaha, Nebr.

Binders and recarbonization.—Asphaltic pitch continues to be the preferred binder in the briquetting of coal and petroleum coke. Two plants briquetting the carbon residue from the manufacture of oil gas and one plant using low-volatile bituminous coal employed no binder. The percentage of binder by weight ranged from slightly less than 5 to more than 9 percent; the majority of plants used 5 to 7 percent.

No recarbonization of the briquets after leaving the presses, to drive off smoke caused by the binder, was reported by any operator in 1940.

Classification of briquetting plants in the United States in 1940, by type and percentage of binder used

Type of binder	Plants	Ratio of binder to raw fuel (by weight)	Plants
Asphaltic pitch	24	Less than 5 percent	2
Mixed pitches	3	5 and less than 7 percent	16
Asphalt and starch	1	7 and less than 9 percent	8
Starch	1	9 percent and over	3
No binder	[1] 3	No binder	[1] 3
	32		32

[1] 2 plants use residual carbon from manufacture of oil gas, and 1 uses bituminous coal as raw fuel.

Weight and shape.—Pillow-shaped briquets predominate in the United States. Of the total production in 1940, 26 of the 32 active plants produced 766,347 tons (73 percent) of pillow-shaped briquets; 3 plants 267,348 tons (25 percent) of cylindrical type; and 3 plants 17,175 tons (less than 2 percent) of cube-shaped briquets.

According to reports received, only one plant made briquets in more than one shape in 1940—an operator in Wisconsin who produced a square pillow type of Pennsylvania anthracite and bituminous low-volatile and a modified pillow type of bituminous low-volatile exclusively.

In 1940 all but 1.7 percent of the total briquets made weighed less than 5 ounces each.

Two plants made two sizes—one in Nebraska a 20-ounce petroleum coke cube and a 24-ounce semianthracite cube; the other in Wisconsin (the plant referred to above) a Pennsylvania anthracite and bituminous low-volatile pillow briquet (2 by 2 by 1¼ inches) and a bituminous low-volatile modified-pillow briquet (2 by 1½ by 1¼ inches).

Prevailing weight of briquets produced in the United States in 1940

Weight (ounces)	Plants	Production		Weight (ounces)	Plants	Production	
		Net tons	Percent of total			Net tons	Percent of total
Less than 2	4	58,984	5.6	6 and under 10			
2 and under 3	15	598,482	57.0	10 and under 16			
3 and under 4	5	308,224	29.3	16 and under 25	3	17,175	1.6
4 and under 5 5 and under 6	4 1	68,005	6.5		32	1,050,870	100.0

Distribution.—The distribution of briquets as indicated by reports from the manufacturers is penetrating new markets and increased 17 percent over 1939. In 1940 briquets were shipped into 41 States, the District of Columbia, and Alaska and exported [10] to Canada, Sweden, Bolivia, Brazil, and other countries.

Shipments into Wisconsin (and within the State) again led in 1940, with Minnesota, Michigan, North Dakota, and South Dakota following in order of importance. Notable increases over 1939 occurred in Indiana, Michigan, Minnesota, Missouri, and Ohio.

It is not possible to show the shipments from each producing State because in many States there are only one or two producers and the results of individual companies would be revealed. For a graphic presentation of the centers of production with corresponding States of destination, see Minerals Yearbook 1937 (p. 965, fig. 65).

Information on tonnages shipped by rail and truck was requested for the first time on the 1938 questionnaire and published in Minerals Yearbook 1939 (p. 918). Similar data for 1939 and 1940, shown below, indicate slight increases in tonnages moving by truck in the Central States. Generally speaking, rail movement represents shipments to destination at considerable distances, and truck shipments represent local and nearby consumption.

Virtually all tonnages move by rail from the Eastern States, three-fourths by rail from the Central States, and about one-third from the Pacific Coast States.

[10] See table of exports for quantities exported by countries.

Shipments of fuel briquets of domestic manufacture by States of destination, 1939–40, in net tons

State	1939	1940	State	1939	1940
Alaska	70	94	New Hampshire	1,794	2,412
Arkansas	147	150	New Jersey	992	1,176
California	12,829	9,798	New York	22,807	26,091
Connecticut	1,467	1,059	North Carolina	9,373	12,770
Delaware	249	250	North Dakota	60,475	66,114
District of Columbia	651	423	Ohio	27,791	49,722
Florida	368	671	Oklahoma	135	24
Georgia	123	159	Oregon	32,606	29,378
Idaho	----------	33	Pennsylvania	10,706	10,272
Illinois	28,139	31,895	Rhode Island	4,305	3,793
Indiana	14,175	25,946	South Carolina	1,827	3,820
Iowa	22,580	25,509	South Dakota	56,961	60,723
Kansas	4,888	5,145	Tennessee	----------	35
Kentucky	3,416	5,635	Texas	155	590
Louisiana	----------	77	Vermont	290	190
Maine	3,810	6,113	Virginia	13,965	17,638
Maryland	2,442	2,073	Washington	25,048	20,359
Massachusetts	34,615	38,324	West Virginia	192	488
Michigan	54,051	77,513	Wisconsin	198,084	230,840
Minnesota	189,421	217,068	Wyoming	1,455	1,646
Missouri	9,341	16,738			
Montana	34	50		876,253	1,028,175
Nebraska	24,476	25,371			

Shipments of fuel briquets by rail and truck, 1939–40, in net tons

Produced in—	1939			1940		
	Rail	Truck [1]	Total	Rail	Truck [1]	Total
Eastern States	239,408	3,554	242,962	325,175	4,855	330,030
Central States	431,333	145,061	576,394	489,793	167,255	657,048
Pacific Coast States	22,537	48,630	71,167	18,087	40,679	58,766
Total United States	693,278	197,245	890,523	833,055	212,789	1,045,844

[1] Includes local deliveries.

Imports and exports.[11]—Before 1922 the quantity of fuel briquets imported into the United States was negligible. The anthracite shortages of 1922–23 and 1925–26, however, created a demand for the European product (mostly from Germany, Belgium, and France, mainly for consumption in the anthracite-consuming States), which in 1926 reached a record of 123,593 net tons.

Imports continued at a comparatively high level in the following years; in 1932 they amounted to 80,288 tons but thereafter dropped markedly and since the beginning of the war in September 1939 have ceased. The last shipment (1,344 net tons), from Belgium to Massachusetts, arrived in February 1939.

Records of imports of briquets since 1919, the first year of record, are included in the Mineral Resources and Minerals Yearbooks.[12]

Exports of briquets were reported separately for the first time by the Bureau of Foreign and Domestic Commerce in 1937, when they totaled 25,350 tons. In 1939 the exports dropped to 12,576 tons but in 1940 rose to 23,285 tons.

Nearly all exports usually are destined for Canada, but in 1940, 3,118 tons were shipped to Sweden. The only other shipments to

[11] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.
[12] 1919–29, Mineral Resources, 1929, pt. II, p. 32; 1930–35, Minerals Yearbook 1936, p. 657.

Europe on record were in 1937, when 69 tons were shipped to the United Kingdom, and in 1939, when 1 ton was shipped to Turkey. Exports to Bolivia and Brazil were recorded for the first time in 1940.

Briquets (coal and coke) and other composition coals for fuels imported for consumption in the United States, 1936–40

Year	Net tons	Value	Year	Net tons	Value
1936	20,350	$80,210	1939	1,344	$5,752
1937	6,674	28,549	1940	------	------
1938	13,814	67,366			

Briquets (coal and coke) exported from the United States, 1939–40, by countries and customs districts

Country	1939 Net tons	1939 Value	1940 Net tons	1940 Value
Bermuda	1	$13	------	------
Bolivia	------	------	1,595	$10,870
Brazil	------	------	1,126	9,300
Canada	12,375	94,852	17,285	116,701
Chile	28	574	------	------
Cuba	------	------	96	830
Curaçao (N. W. I.)	34	438	------	------
Dominican Republic	------	------	7	67
Mexico	24	338	2	25
Peru	112	1,485	------	------
Philippine Islands	------	------	4	70
Trinidad and Tobago	------	------	52	348
Sweden	------	------	3,118	23,408
Turkey	1	12	------	------
Venezuela	1	13	------	------
	12,576	97,725	23,285	161,619

Customs district	1939 Net tons	1939 Value	1940 Net tons	1940 Value
Arizona	22	$313	------	------
Buffalo	8,600	65,158	9,149	$64,659
Dakota	36	640	------	------
Duluth and Superior	222	1,632	125	909
Maryland	------	------	1,062	7,233
Michigan	589	3,752	1,733	11,590
New Orleans	------	------	96	830
New York	177	2,535	4,784	36,412
Ohio	------	------	2,510	9,546
St. Lawrence	2,770	22,204	3,474	27,321
San Diego	2	25	2	25
San Francisco	------	------	4	70
Virginia	------	------	52	348
Washington	158	1,466	294	2,676
	12,576	97,725	23,285	161,619

World production.—Official data on the production of fuel briquets in other countries in 1939 and 1940 have been meager, owing to the war. Such revisions as are possible will be made in forthcoming issues of this series.

World figures for 1938, though still incomplete, indicate a peak output of about 65 million metric tons, including about 51 million produced by Germany, about 7.5 million by France, 1.7 million by Belgium, 1.3 million by the Netherlands, and about 1 million by the United States.

The United States proportion of the world production of fuel briquets rose from less than 0.50 percent in 1913 to nearly 1.5 percent in 1938.

World production of fuel briquets, 1936–40, by countries, in metric tons [1]

[Compiled by L. P. Lounsbery]

Country [1]	1936	1937	1938	1939	1940
Algeria	60,885	68,682	(2)	(2)	(2)
Australia: Victoria [3]	363,340	396,760	420,704	421,254	(2)
Belgium	1,559,890	1,849,280	1,712,280	[4] 1,525,790	(2)
Bulgaria	41,802	47,106	85,770	88,496	(2)
Czechoslovakia:					
Coal	414,896	459,680	(2)	(2)	(2)
Lignite	189,304	264,482	(2)	(2)	(2)
Eire (Irish Free State)	2,745	10,725	20,501	(2)	(2)
France	8,518,480	8,321,000	7,475,000	(2)	(2)
Germany:					
Coal	6,044,310	6,785,537	6,897,245	(2)	(2)
Lignite	36,074,489	41,951,141	44,007,268	(2)	(2)
Hungary	317,916	373,519	441,081	(2)	(2)
Indochina	104,644	132,225	131,558	185,400	114,000
Italy	46,533	58,860	51,047	(2)	(2)
Netherlands:					
Coal	1,119,585	1,277,305	1,262,716	1,268,926	(2)
Lignite	31,190	49,539	60,543	68,607	(2)
Netherlands Indies	56,347	55,349	82,123	85,079	(2)
New Zealand	21,445	31,582	29,947	29,889	(2)
Poland	167,416	209,347	222,531	(2)	(2)
Portugal	[5] 850	7,772	19,865	(2)	(2)
Rumania	220,461	262,330	232,662	(2)	(2)
Tunisia	79,138	82,805	86,478	(2)	(2)
Turkey	(2)	14,761	37,285	14,792	(2)
United Kingdom	725,234	826,600	507,415	(2)	(2)
United States [6]	1,080,814	1,035,970	936,402	1,004,902	1,211,433
Yugoslavia	13,350	61,323	100,945	132,466	(2)
Total [7]	57,255,064	64,633,680	64,821,366	4,825,601	(2)

[1] In addition to the countries listed, briquets are produced in Canada, New Caledonia, and Spain; data on output are not available.
[2] Data not available.
[3] Data for year ended Mar. 31 of year stated.
[4] Incomplete figures.
[5] From domestic coal only.
[6] Includes packaged fuel as follows: 1936, 60,261 tons; 1937, 132,482 tons; 1938, 146,012 tons; 1939, 195,504 tons; 1940, 258,105 tons.
[7] Totals incomplete, representing sum of figures given in table only.

PACKAGED FUEL [13]

Packaged fuel differs from fuel briquets in that the former is a more or less friable product wrapped to withstand weathering and breakage in shipment. Packaged fuel, designed primarily for local or nearby consumption, consists of 3- to 4-inch cubes (usually six to a package, weighing about 10 pounds), wrapped tightly in heavy paper and sealed with gummed tape. It is made from various types of high-quality coal or coke screenings, usually mixed with a neutral binder.

The manufacture and merchandising methods employed by a number of the larger successful operators are discussed in the trade journals.[14]

The National Association of Packaged Fuel Manufacturers, which met several times during 1940, has divided the field into 10 districts, with a view toward closer contacts and increased service for its membership.[15]

[13] Directories of operations and manufacturers of equipment may be obtained free from the Coal Economics Division, Bureau of Mines, Washington, D. C.

[14] Black Diamond, Starting in the Packaged-fuel Business: Vol. 104, No. 12, June 15, 1940, pp. 70, 86. A Mammoth Package Fuel Plant: Vol. 102, No. 7, April 8, 1939, p. 23. Cliffs Opens New Coal Block Plant: Vol. 104, No. 3, February 10, 1940, pp. 14–15.
Coal Dealer, Packaged Fuel Meeting with Heavy Demand: Vol. 37, No. 7. November 1940, p. 58.
Retail Coalman, New Coal Block Plant: Vol. 76, No. 1, January 1940, pp. 14–15.

[15] Black Diamond, Packaged-fuel Manufacturers Meet in Annual Convention: Vol. 104, No. 12, June 15, 1940, p. 69.
Coal Dealer, May 1940, vol. 37, No. 1, p. 37.
National Association of Packaged Fuel Manufacturers, Sales-merchandising Bulletin: Vol. 2, No. 7, December 24, 1940, p. 2.

The industry continues to grow and reached a new high output of 284,513 net tons produced in 1940 valued at the plant at $2,391,922. Although comparatively few operators have achieved conspicuous success,[16] a large number of retailers, as evidenced by the results of inquiry since 1935, have found it a profitable side line if not their principal business activity.

The manufacture of packaged fuel, which began with the idea of utilizing the degradation resulting from handling the coarser sizes at retail yards, has grown so rapidly that shipped-in slack from the mines and Lake docks now represents 80 percent of the raw fuel used.

Of the total production in 1940, 246,006 tons were reported by 72 operators as machine-wrapped and 36,501 tons by 34 operators as hand-wrapped; 2,006 tons were sold unwrapped.

Two kinds of packaged fuel were made by six operators; four made bituminous low-volatile and petroleum-coke cubes, one bituminous high-volatile and petroleum coke, and one Arkansas semianthracite and petroleum-coke cubes.

Packaged-fuel sales in 1940 amounted to 281,905 tons, of which all but 6,900 tons were sold for local or nearby consumption; seven operators reported 4,529 tons were shipped by rail. The balance of the tonnage was either called for or delivered by truck.

Processes.—No new processes or types of machinery were reported in 1940. The Eberling process,[17] introduced about 6 years ago (for briquetting slack or screenings with a starch binder and wrapping the cubes by machine or hand) was used by 86 manufacturers in 1940. This type of briquet is adapted primarily for local consumption. The processes used by the other plants are described briefly in the following paragraphs.

The Johnson Coal Cubing Co.[18] of Detroit, Mich., the largest operator since 1932, has used a process and equipment of its own design to produce cubes bearing the trade-mark "Koal Pak," eight to a package, wrapped in heavy paper; in 1939 it began to make pillow-shaped fuel briquets in bulk, known as "Black Knight Fire Quets."

In the Glenn Smith process,[19] used in the manufacture of both bulk briquets and packaged fuel, the heated mixture of raw fuel and liquid binder is molded under very high pressure. The resulting cubes are cooled on a conveyor that feeds them to the wrapping machine, which automatically wraps and labels the packages. Packaged-fuel manufacturers using this process in 1940 sold a small part of their product unwrapped.

The Leemon process,[20] introduced commercially in 1939, was used by 14 plants in 1940. Equipped with a mixture of slack and volatile binder, the machine produces 3- to 4-inch cubes, which are wrapped 6 to a package, averaging 190 to 200 packages to the net ton.

The salient statistics of the packaged-fuel industry from 1935 to 1940 are summarized in the following table; 1935 is the first year for which these data were collected by the Bureau of Mines.

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[16] Black Diamond, The Place of Packaged Fuel and Coal Blocks in the Retail Solid Fuel Industry: Vol. 105, No. 6, September 21, 1940, pp. 20, 38.
[17] Eberling, C. M., Packaged Fuel by the Eberling Process: 1938 catalog, 6002 Ellen Ave., Cleveland, Ohio.
[18] Black Diamond, vol. 102, No. 7, April 8, 1939, p. 23.
[19] Black Diamond, vol. 100, No. 6, March 12, 1938, p. 60.
[20] Black Diamond, vol. 102, No. 12, June 17, 1939, p. 15.

Salient statistics of the packaged-fuel industry in the United States, 1935–40

[Data regarding fuel briquets are given separately in beginning of this chapter]

Year	Production (thousands of net tons)			Value of production (thousands of dollars)	Plants in operation	Average output per plant (thousands of net tons)	Average value per net ton, f. o. b. plant	
	Eastern and Pacific Coast States	Central States	Total				Eastern and Pacific Coast States	Central States
1935	(1)	25	25	(2)	25	1	(2)	(2)
1936	6	60	66	505	48	1	$8.84	$7.49
1937	10	136	146	1,287	64	2	9.62	8.76
1938	9	152	161	1,405	76	2	9.92	8.66
1939	9	207	216	1,867	103	2	9.69	8.62
1940	8	277	285	2,392	106	3	10.12	8.36

[1] Less than 1.000 net tons; no packaged-fuel plants in Pacific Coast States in 1935.
[2] Data not available.

Production and value.—The 106 active plants, all but 7 of which are in the Central States, produced 284,513 net tons valued at $2,391,922 in 1940 (see fig. 2). The production indicated a 32-percent increase

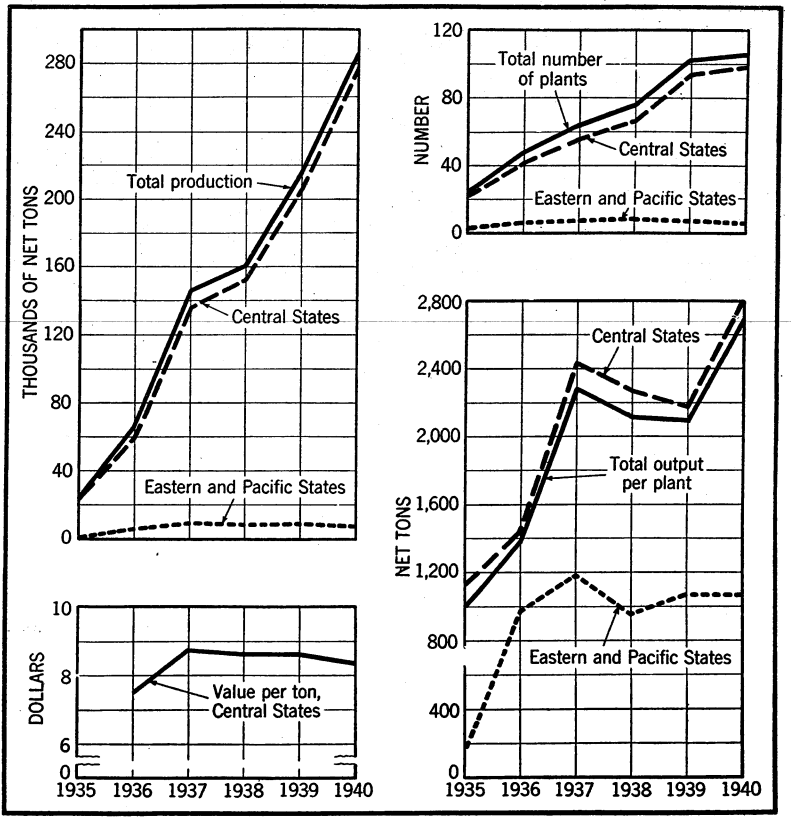

FIGURE 2.—Production of packaged fuel, number of plants in operation, output per plant, and average value per ton, f. o. b. plant (Central States), 1935–40.

over 1939 and the value a 28-percent increase. All States showed a considerable advance in tonnage except four, and the drop in production in these was but slight. However, only three more plants were active at the close of 1940 than at the same time in 1939. The States leading in production were, in order, Michigan, Ohio, Wisconsin, Minnesota, and Indiana.

Average values per ton were $10.15 in Minnesota; $9.58 in Illinois; $9.23 in Virginia; $8.67 in Wisconsin; $8.29 in Ohio; $7.93 in Michigan; $7.81 in Indiana; and $7.14 in Missouri.

Returns indicate that there were seven cities (in Indiana, Michigan, Minnesota, Missouri, and Ohio) where 3 to 12 plants operated in 1940 and that in this group there were idle plants in two cities only. Some plants were idle in 1940 because purchase of packaged fuel for resale was more profitable than operating. All cities showed large increases in production except one, where there was a small decrease. A lower average value per ton f. o. b. plant in 1940 as compared with 1939 was general in these cities, based upon total receipts of all operators in each locality.

Competing fuels and burning equipment, particularly the small oil space heaters which are gaining ground rapidly in some Michigan markets, are said to be particularly hard on the smaller retailers.[21]

Production of packaged fuel in the United States, 1939–40, by States

[Plants and production in this table not included in preceding fuel-briquet tables]

State	1939			1940		
	Plants	Net tons	Value	Plants	Net tons	Value
Central States:						
Idaho	1	(1)	(1)	1	(1)	(1)
Illinois	5	3,998	$40,487	6	3,813	$36,531
Indiana	5	12,234	99,909	7	15,774	123,255
Iowa	2	(1)	(1)	2	(1)	(1)
Michigan	41	86,903	716,851	36	112,244	889,720
Minnesota	8	22,763	250,397	7	28,931	293,623
Missouri	1	(1)	(1)	3	9,150	65,353
Nebraska	1	(1)	(1)	1	(1)	(1)
Ohio	19	45,646	369,692	23	61,941	513,499
Wisconsin	12	28,637	241,946	13	37,968	329,101
Undistributed [2]		6,732	64,201		7,173	64,748
Total Central States	95	206,913	1,783,483	99	276,994	2,315,830
Eastern and Pacific Coast States	[3] 8	8,594	83,268	[4] 7	7,519	76,092
Total United States	103	215,507	1,866,751	106	284,513	2,391,922

[1] Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.
[2] Includes States entered as "(1)" above.
[3] Maine 2, Pennsylvania 1, Virginia 4, and Washington 1.
[4] Maine 2, Pennsylvania 1, Virginia 3, and Washington 1.

Before 1939 December and July were the high and low months of production; in 1939, however, peak production was attained in March and in 1940 in November.

The peak season of production is generally from October through April—7 months—but in 1940 the season for the Central States as a whole (which began in September 1939) lasted well into May and opened up again in September 1940, a month earlier than usual.

In addition to extremely cold weather in January 1940 in the North Central States, negative departures from normal extended through May in this area.[22]

[21] Black Diamond, In the Realm of the Retail Merchant: Vol. 106, No. 3, February 8, 1941, pp. 16, 46.
[22] Reed, W. W., The Weather of 1940 in the United States: U. S. Department of Agriculture Monthly Weather Rev., vol. 68, No. 2, February 1941, p. 49.

In making comparisons between spring and fall production in 1940 it should be borne in mind that six new plants began operations in the fall.

Monthly production of packaged fuel in the United States in 1939–40, in net tons

Month	1939	1940	Month	1939	1940
January	27,722	36,160	August	4,605	7,350
February	28,047	29,460	September	14,743	21,680
March	28,532	34,035	October	26,280	29,564
April	25,621	31,518	November	25,524	36,181
May	5,417	17,429	December	26,981	35,656
June	1,180	2,811			
July	855	2,669		215,507	284,513

Number of plants.—As shown in the following table, the marked rise in number of plants before 1940 is somewhat offset by the increasing number of plants that were idle and went out of business in the last 3 years.

There were only 3 more plants active in 1940 than in 1939, but 15 of the total began operations in 1940. Five that operated part of the year went out of business; of the 15 that were idle, 9 also went out of business.

Activity in number of packaged-fuel plants, 1935–40

Year	Active	New	Idle	Out of business	Year	Active	New	Idle	Out of business
1935	25	(1)	5		1938	76	16	8	1
1936	48	23	5	2	1939	103	29	11	9
1937	64	17	6	3	1940	106	[2] 16	[3] 15	[4] 14

[1] Data not available.
[2] 6 in Ohio, 3 in Missouri, 2 each in Indiana and Michigan, and 1 each in Illinois, Minnesota, and Wisconsin.
[3] 6 in Ohio, 4 in Michigan, 2 in Virginia, and 1 each in Minnesota, Missouri, and Oregon.
[4] 4 each in Michigan and Ohio, 2 each in Minnesota and Virginia, and 1 each in Indiana and Oregon.

Size of plants.—The average production per plant rose from 2,100 tons in 1939 to 2,700 in 1940. The majority of the plants (82 out of a total of 106) produced less than 3,000 tons each in 1940—about the same proportion as in 1939; but the number of plants that produced over 10,000 tons increased from 2 in 1939 to 5 in 1940. The Johnson Coal Cubing Co. of Detroit, Mich., continues to be the largest operator in the industry.

Reports submitted on individual capacity indicate that the 106 active plants were equipped to produce about 777,000 tons (nearly three times the 1940 actual production) if operated at full capacity throughout the year.

Classification of packaged-fuel plants in the United States, 1939–40, by size of output and annual capacity

Output (net tons)	Plants		Annual capacity (net tons)	Plants	
	1939	1940		1939	1940
Less than 500	28	[1] 23	Less than 5,000	58	62
500 and less than 1,000	18	19	5,000 and less than 10,000	31	25
1,000 and less than 3,000	39	40	10,000 and less than 15,000	5	6
3,000 and less than 5,000	10	10	15,000 and less than 25,000	5	7
5,000 and less than 10,000	6	9	25,000 and less than 40,000	3	5
10,000 and less than 25,000	1	4	40,000 and less than 60,000		
25,000 and over	1	1	60,000 and over	1	1
	103	106		103	106

[1] 4 of these are new plants, which began operations in the fall of 1940.

Raw fuels.—The tonnage of raw fuels used in the manufacture of packaged fuel in 1940 totaled 281,334 net tons. Low-volatile bituminous slack continued to be the principal raw fuel, representing 87.4 percent of the total, with petroleum coke, bituminous high-volatile, and Arkansas semianthracite following in the order named. Petroleum coke increased from 5.0 percent of the total raw fuels used in 1939 to 10.9 percent in 1940; this type of packaged fuel was made in Minnesota, Missouri, Iowa, Nebraska, and Washington. The reported raw-fuel tonnages used in 1940 were as follows: Bituminous low-volatile, 245,881 tons by 91 operators; petroleum coke, 30,555 tons by 15 operators; and bituminous high-volatile and Arkansas semianthracite, 4,898 tons by 6 operators. Several used mixtures of these various fuels.

Of the total raw fuels used about 224,000 tons (80 percent) were shipped in by the operators from the mines and Lake docks; and the remainder (about 57,000 tons—or 20 percent) represents the total yard screenings used. Of the 106 operations in 1940, 47 operators used shipped-in slack exclusively; 22 packaged only their yard screenings; and 37 used both.

Raw fuels used in making packaged fuel in the United States, 1939–40

	Net tons		Percentage of total	
	1939	1940	1939	1940
Bituminous high-volatile and semianthracite	[1] 7,322	4,898	3.5	1.7
Bituminous low-volatile	194,023	245,881	91.5	87.4
Petroleum coke	10,696	30,555	5.0	10.9
	212,041	281,334	100.0	100.0

[1] Includes small tonnage of Pennsylvania anthracite.

Binders.—Cornstarches, averaging about 15 pounds per ton of packaged fuel produced, are the principal binders. Ninety-six operators used starch binders exclusively; 4, cement; 3, asphalt; 1, starch and asphalt; 1, starch and cement; and 1, a byproduct of sulfite pulp manufacture. The last type of binder, reported in 1940 for the first time, is described by the distributor as a neutralized and dehydrated product derived from the manufacture of sulfite pulp.

One operator, who makes both petroleum-coke and bituminous low-volatile cubes, reported using no binder in manufacturing his bituminous cubes.

PEAT

By Joseph A. Corgan

SUMMARY OUTLINE

The production of peat in 1940 totaled 70,097 short tons valued at $516,865, an increase of 26 percent in quantity and 43 percent in value over 1939. Peat output in the United States reached its peak in 1918, when 107,261 short tons were produced by 25 plants operating in 13 States. In that year the demand for processed peat exceeded the supply, and some producers could not serve even their regular customers because of inadequate facilities. Moreover, owing to war conditions, no peat was imported. Since 1918 annual production has been irregular in volume, ranging between a high of 73,204 tons in 1920 and a low of 30,406 tons in 1921.

Imports of peat moss fell from 78,611 short tons valued at $1,204,883 in 1939 to 21,689 tons valued at $454,632 in 1940, owing again to war conditions. No exports were reported in either year. Thus, on account of the drastic curtailment of peat moss imports the total quantity available for domestic consumption in 1940 (production plus imports) was only 91,786 tons—a substantial decrease from the 134,094 tons available in 1939. The loss of foreign supplies of peat moss has doubtless inconvenienced former users of that product materially; on the other hand, it presents an opportunity for United States producers of moss peat to capture a share of this market.

A directory listing the names and addresses of operators who reported production in 1940 to the Bureau of Mines has been prepared and will be sent upon request to those who may be interested.

Reserves.—The peat reserves in the United States are extensive, and about half of the 48 States contain some peat resources. The total, calculated as air-dried peat, has been estimated at 13,827,000,000 short tons.[1]

PRODUCTION

The Federal Government made no canvass of the peat industry from 1927 to 1933, inclusive, and no data for these years are available. Taking this into consideration, the production of 70,097 short tons in 1940 was the largest output since 1925, when 72,436 tons were produced.

[1] Soper, E. K., and Osbon, C. C., The Occurrence and Uses of Peat in the United States: Geol. Survey Bull. 728, 1922, p. 92.

As the following table indicates, the 1940 output was well ahead of the 1939 production. Upon a percentage basis 1940 showed an increase of 26 percent in quantity and 43 percent in value over 1939. The average value a ton in 1940 was $7.37, compared with $6.53 and $6.23 in 1939 and 1938, respectively. The trend of peat production and value is presented graphically in figure 1.

Peat produced in the United States, 1935–40

Year	Short tons	Value	Year	Short tons	Value
1935	37,060	$199,377	1938	45,933	$286,127
1936	46,126	266,883	1939	55,483	362,066
1937	51,223	305,156	1940	70,097	516,865

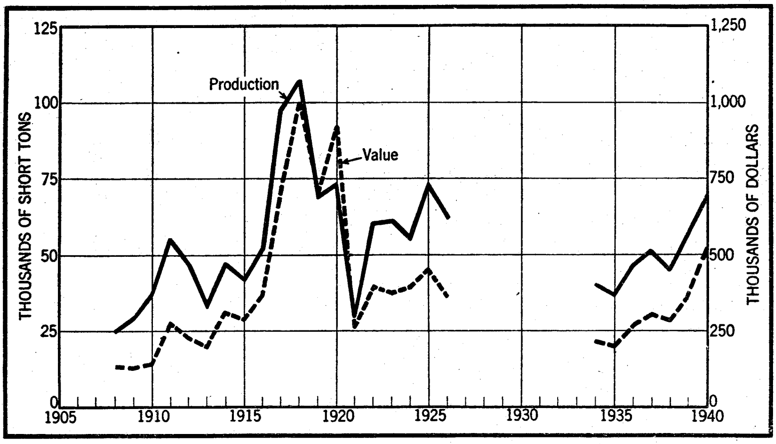

FIGURE 1.—Quantity and value of peat production, 1908–40. No data are available for 1927–33.

In 1940, 50 producers reported their output to the Bureau of Mines, a gain of 11 over 1939, and a large increase over 1918, when 25 plants operating in 13 States reported a total output of 107,261 short tons. Thus, it would seem that, should there be an increased demand for peat from domestic sources such as was experienced in 1918 the peat industry today, being more widespread and comprising more producing plants, would be better equipped to take care of it.

The same 15 States reported output in 1940 as in 1939, but their rank in terms of tons produced differed. In 1940 the producing States, in order of output, were: New York, New Jersey, Pennsylvania, Maine, Michigan, California, Connecticut, Florida, Ohio, Iowa, Minnesota, Colorado, Massachusetts, Washington, and New Hampshire.

Peat humus represented 45 percent of the total production, reed or sedge peat 36 percent, and moss peat and other 19 percent. Peat humus was produced in 10 States, reed or sedge in 8 States, and moss peat in 6 States.

The production of shredded peat was reported by 31 plants, while 17 reported raw peat and 10 cultivated peat.

USES

Of the total sales of peat in the United States during 1940, 93 percent was employed for soil improvement. Two percent of the sales were used in mixed fertilizers. Other uses, including litter for barns and poultry yards, took 5 percent. Peat is also utilized for other purposes, such as packing material for eggs, shrubs, fruits, vegetables, and fragile articles. As has been the case in recent years, no sales of peat for fuel were reported, although in 1918, in the war period, 20,567 tons were used for that purpose. In some European countries peat is utilized extensively for fuel and power purposes; but, except for regional emergencies, it has not been burned as fuel on a commercial scale in this country because of our vast resources of higher-grade fuels.

United States Government specifications.—There is a great difference in the kinds of peat, both in character and value, for specific uses. In purchasing its peat requirements the Federal Government has certain specifications that must be met. These may be obtained from the Procurement Division, United States Treasury Department, Washington, D. C.

IMPORTS [2]

The sharp decrease in peat-moss imports into the United States for 1940 is due chiefly to the war in Europe and the British blockade of Germany. In 1940 imports totaled 21,689 short tons valued at $454,632—a large decrease from 1939 when 78,611 tons valued at $1,204,883 were imported.

Germany has been for many years the principal source of peat moss imported by the United States. In 1939 imports from Germany were 28,127 short tons valued at $389,597; in 1940 the tonnage had fallen to 41 tons valued at $340. The Netherlands and Sweden together exported 35,181 tons of peat moss to the United States in 1939, but in 1940 the imports from these two countries totaled only 5,815 tons, a decrease of 83 percent. Canada and the United Kingdom supplied 15,298 tons or 71 percent of the total peat-moss imports in 1940. It will be noted that these two countries were the only ones from which imports were received during the last 6 months of 1940 and that several European countries that have supplied peat moss to the United States in recent years did not ship any here during 1940.

Peat moss imported for consumption in the United States, 1935–40

Year	Short tons	Value	Year	Short tons	Value
1935	54,547	$677,513	1938	69,509	$1,092,942
1936	75,066	955,807	1939	78,611	1,204,883
1937	86,871	1,219,127	1940	21,689	454,632

Peat moss was imported into continental United States through 22 customs districts. In 1939 the imports were received through 27 districts. In 1940 the New York district received 20 percent of the total imports and the Washington district 40 percent of the total.

The average value of the imported product a ton varies considerably with the country of origin. In 1940 the average value of the total imports was $20.96 a short ton—a large increase over 1939 and 1938, when the averages were $15.33 and $15.72, respectively. The increase in 1940 is due principally to the high valuation of the Canadian product. Of the total quantity imported, Canada shipped 61 percent to this country at an average value of $23.28 a 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.

Peat moss imported for consumption in the United States, 1939–40, by countries

Country	1939		1940 [1]	
	Short tons	Value	Short tons	Value
Canada	6,922	$147,342	13,122	$305,544
Denmark	2,396	44,971	389	8,556
Estonia	1,424	28,566		
Finland	153	2,949		
Germany [2]	28,127	389,597	41	340
Latvia	1,701	33,820	146	2,889
Mexico	15	564		
Netherlands	17,824	185,828	3,136	44,394
Newfoundland and Labrador	1	27		
Norway	625	16,262		
Poland and Danzig [2]	764	11,436		
Sweden	17,357	323,158	2,679	64,749
U. S. S. R.[2]	517	9,593		
United Kingdom	785	10,770	2,176	28,160
	78,611	1,204,883	21,689	454,632

[1] Effective June 16, 1940, peat moss was broken down into two grades—poultry and stable and fertilizer; these have been combined in the above table. Since the change in classification was made imports have been received only from Canada and the United Kingdom, as follows: Canada, poultry and stable, 1,825 short tons, $46,857; fertilizer, 7,003 tons, $153,661; United Kingdom, 120 tons, $2,241 and 1,269 tons, $17,161, respectively.

[2] For statistical purposes trade with Danzig and that part of Poland occupied by Germany has been included with Germany, and trade with that part of Poland occupied by U. S. S. R. has been included with U. S. S. R. after November 16, 1939.

WORLD PRODUCTION

Unsettled conditions in Europe have made it difficult to obtain complete statistics on peat from the affected countries. The latest data are given in the following table.

World production of peat, 1937–40, by countries [1]

[Compiled by L. P. Lounsbery]

Country [1]		1937	1938	1939	1940
Canada (fuel)	metric tons	434	454	404	(2)
Eire [3]	do	3,646,603	(2)	(2)	(2)
Estonia	do	169,779	185,600	(2)	(2)
Finland	bales	294,913	(2)	(2)	(2)
Do	cubic meters	7,653	(2)	(2)	(2)
Do	metric tons	21,560	(2)	(2)	(2)
Italy	do	3,385	(2)	(2)	(2)
Latvia:					
Litter	cubic meters	97,718	90,369	80,000	(2)
Waste	do	22,484	14,901	20,000	(2)
Insulation	do	2,455	2,440	3,000	(2)
Lithuania	metric tons	142,000	180,000	230,000	(2)
Netherlands	do	(2)	800,000	822,400	(2)
Sweden:					
Fuel	do	34,277	25,711	22,953	(2)
Litter, baled	do	115,034	99,998	(2)	(2)
Litter and "mull," unbaled	cubic meters	38,511	36,578	(2)	(2)
"Mull" baled	metric tons	32,767	31,959	(2)	(2)
Switzerland	do	8,000	10,000	15,000	(2)
U. S. S. R.	do	23,822,000	26,460,700	(2)	(2)
United States	do	46,468	41,669	50,333	63,591

[1] In addition to the countries listed Argentina, Austria, France, Germany, Hungary, Norway, and Poland produce peat, but data of production are not available.

[2] Data not available.

[3] About 60 percent of the farmsteads in the country depend entirely on peat fuel, the annual consumption of which is estimated at 6 to 8 million tons. About 50,000 tons of peat-moss litter and peat mull are manufactured annually in Eire, and some 10,000 tons of air-dried turf are used annually for power purposes. (The Mineral Position of the British Empire, London, 1937, p. 30.)

CRUDE PETROLEUM AND PETROLEUM PRODUCTS[1]

By A. G. White, G. R. Hopkins, H. A. Breakey, and A. T. Coumbe

SUMMARY OUTLINE

The European war caused major changes in the World markets for petroleum and its products during 1940. In the first half of the year consumption was drastically curtailed in European countries, even where imports were still possible; in the latter half of the year, closing of the French and Mediterranean markets and the British blockade cut off the flow of oil to virtually all the principal markets of the continent. The effects of the international situation on the oil industry of the United States were to reduce exports by 58 million barrels—from 189 million in 1939 to 131 million in 1940—and to increase imports by 24 million barrels—from 59 million in 1939 to 83 million in 1940. Thus net exports (exports minus imports) were reduced from 130 million barrels in 1939 to only 48 million in 1940. The continuance of these trends, as indicated by available current data, may well result in an approximate balance between exports and imports in 1941.

The estimated world production of crude petroleum in 1940 was 2,149 million barrels—a gain of 70 million or 3.4 percent. United States production rose from 61 percent of the world total in 1939 to 63 percent in 1940—a gain of 87 million barrels; production in the rest of the world declined 16 million barrels. Russia showed no substantial change, while output in Venezuela decreased 21 million barrels, in Iraq 5 million, and in Rumania 3 million. Colombian production gained 4 million. Increased exports of crude and refined oils to the United States from Caribbean countries partly offset the loss of their continental European markets and helped to maintain their crude output at a higher level than might have been expected.

[1] Data for 1940 are preliminary; detailed statistics with final revisions will be released later

In the United States the new production of all oils increased by 91 million barrels, rising from 1,319 million in 1939 to 1,410 million in 1940. This output, however, exceeded demand, as indicated by an increase of 39 million barrels in the stocks of all oils compared to a decrease of 41 million in the stocks of all oils in 1939.

Domestic demand for all oils increased 92 million barrels—from 1,231 million in 1939 to 1,323 million in 1940. The domestic demand for motor fuel in 1940 was 6 percent greater than in 1939. The increase for residual fuel oil was 5 percent, for distillate fuel oil 19 percent, and for kerosene 14 percent. The large relative increase in the demand for heating oils was due to abnormally cold weather in the first quarter of the year. The effect of the defense program in increasing industrial activity and employment began to be felt in the last quarter of 1940.

At the beginning of 1940 stocks of gasoline were abnormally high as a result of increased output in expectation of a war export demand that did not materialize, whereas stocks of distillate and residual fuel oil were relatively low. During the first quarter of the year refinery runs were forced to high levels to meet an unexpected demand for fuel oils owing to unusually cold weather. The domestic demand for distillate fuel oil increased 26 percent over the same period of the previous year, almost half of the increase probably being abnormal. In spite of low gasoline yields, high fuel-oil yields, and large fuel-oil imports, there was a further excess build-up of gasoline stocks. This situation was accompanied by overproduction of crude, as indicated by an increase of 13 million barrels in crude stocks of domestic origin. During the quarter stocks of all oils increased by 19 million barrels.

Throughout the second quarter of 1940 refinery operations were maintained at a relatively high rate in an effort to build up fuel-oil stocks. Stocks of motor fuel remained abnormally high and exerted a depressing effect on refinery prices of gasoline. A further addition of 10 million barrels was made to stocks of domestic crude as well as an increase of 10 million in stocks of refined oils.

In the third quarter of 1940 an excellent balance was maintained between crude production and demand, and there was a retrenchment in refinery operations; however, the collapse of France and the closing of many markets in Europe resulted in a sharp reduction in refined exports and continued high inventories of gasoline, distillate, and lubricating oils. Stocks of domestic crude showed no material change, but stocks of refined products increased 10 million barrels.

During the fourth quarter of 1940 reduced exports and larger imports partly offset the increased demand for domestic oils caused by inauguration of the defense program; nevertheless, increasing industrial activity and employment did not exercise their full stimulus on oil demand until 1941. Comparatively mild weather combined with increasing imports from the Caribbean countries reduced fuel-oil requirements from domestic sources, but rising demands for gasoline reduced the seasonal build-up of gasoline stocks so that the relative position on March 31, 1941, was materially improved.

Total stocks of all oils rose from 525 million barrels at the close of 1939 to 564 million at the end of 1940. Total stocks of refinable and heavy crudes increased 24 million barrels, stocks of refined products gained 14 million, and stocks of natural gasoline rose over 1 million.

Total demand for all oils in the United States, 1931–40

[Millions of barrels]

Year	Domestic demand	Exports	Total demand	Year	Domestic demand	Exports	Total demand
1931	903.2	124.4	1,027.6	1936	1,092.7	132.0	1,224.7
1932	835.5	103.3	938.8	1937	1,169.7	172.8	1,342.5
1933	868.5	106.7	975.2	1938	1,137.1	193.7	1,330.8
1934	920.2	114.5	1,034.7	1939	1,231.1	188.9	1,420.0
1935	983.7	129.0	1,112.7	1940 [1]	1,323.4	130.6	1,454.0

[1] Subject to revision.

In view of increasing demand total stocks probably were close to economic levels at the end of 1940. During the year stocks of finished and unfinished gasoline increased over 1 million barrels, stocks of distillate fuel oil gained 9 million, and residual fuel-oil stocks decreased 3 million.

Salient statistics of crude petroleum, refined products, and natural gasoline in the United States, 1936–40

	1936	1937	1938	1939	1940 [1]
Crude petroleum:					
Domestic production ... thousands of barrels [2]	1,099,687	1,279,160	1,214,355	1,264,962	1,351,847
World production ... do	1,791,540	2,039,014	1,987,844	2,078,853	2,149,378
United States proportion of world production ... percent	61	63	61	61	63
Imports [3] ... thousands of barrels [2]	32,327	27,484	26,412	33,095	42,738
Exports [4] ... do	50,313	67,234	77,254	72,076	51,600
Stocks, end of period:					
Refinable crude ... do	[5] 288,579	[5] 306,826 [6] 305,833	274,958 [6] 274,165	239,978 [6] 238,910	264,079
California heavy crude ... do	[7]	14,505	16,467	13,330	11,906
Runs to stills ... do	1,068,570	1,183,440	1,165,015	1,237,840	1,294,283
Total value of domestic production at wells ... thousands of dollars	1,199,820	1,513,340	1,373,060	1,294,470	[8] 1,352,000
Average price per barrel at wells	$1.09	$1.18	$1.13	$1.02	[8] $1.00
Total producing oil wells in the United States, Dec. 31	349,450	363,030	369,640	380,390	[7]
Total oil wells completed in the United States during year	17,800	22,143	18,433	17,485	19,125
Refined products:					
Imports ... thousands of barrels [2]	24,777	29,673	27,896	25,965	40,178
Exports [4] ... do	81,681	105,600	116,474	116,883	78,989
Stocks, end of period ... do	[5] 226,595	[5] 253,413 [6] 239,632	259,665 [6] 272,241	268,109	282,265
Output of motor fuel ... do	516,266	571,727	569,162	611,043	616,359
Yield of gasoline ... percent	44.1	43.9	44.3	45.0	43.1
Completed refineries, end of year	572	551	538	547	556
Daily crude-oil capacity of refineries ... thousands of barrels [2]	4,295	4,351	4,509	4,629	4,719
Average tank-wagon price (excluding tax) of gasoline in 50 United States cities ... cents per gallon [9]	12.63	[10] 10.53	([10])10.04	[10] 9.58	[10] 9.08
Natural gasoline:					
Production ... thousands of barrels [2]	42,770	49,177	51,347	51,650	55,249
Stocks, end of period ... do	4,055	4,758	4,830	4,421	5,704

[1] Subject to revision.
[2] 42 gallons.
[3] As reported to the Bureau of Mines.
[4] Bureau of Foreign and Domestic Commerce; exports include shipments to noncontiguous Territories.
[5] California heavy crude and fuel oil included under refined products.
[6] For comparison with succeeding year.
[7] Figures not available.
[8] Estimated.
[9] American Petroleum Institute.
[10] Dealer's net; comparable tank-wagon prices no longer available.

During 1940 the total demand for motor fuel increased to almost 615 million barrels—a gain of less than 15 million over 1939 or only about 2½ percent. A gain of 34 million barrels in domestic demand

Supply and demand of all oils in the United States in 1940, by months

[Including wax, coke, asphalt, and still gas, in thousands of barrels]

	1940 [1]													1939 (total)
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
New supply:														
Domestic production:														
Crude petroleum	113,140	108,668	120,075	116,045	118,283	111,690	113,244	110,523	109,337	113,418	106,904	110,520	1,351,847	1,264,962
Natural gasoline	4,271	4,179	4,489	4,414	4,587	4,401	4,684	4,680	4,706	5,047	4,841	4,950	55,249	51,650
Benzol	272	231	237	228	247	263	279	271	263	290	282	298	3,161	2,498
Total production	117,683	113,078	124,801	120,687	123,117	116,354	118,207	115,474	114,306	118,755	112,027	115,768	1,410,257	1,319,110
Imports: [2]														
Crude petroleum	1,950	2,343	2,895	3,169	4,097	3,688	3,981	4,223	3,912	3,815	3,932	4,733	42,738	33,095
Refined products	2,762	4,284	5,098	3,037	2,337	2,998	2,581	3,606	2,710	3,853	3,016	3,896	40,178	25,965
Total new supply, all oils	122,395	119,705	132,794	126,893	129,551	123,040	124,769	123,303	120,928	126,423	118,975	124,397	1,493,173	1,378,170
Change in stocks, all oils	−4,324	+12,600	+10,797	+11,590	+8,361	+2,416	+7,147	+2,173	+1,289	−3,123	−6,872	−2,870	+39,184	−41,865
Demand:														
Total demand	126,719	107,105	121,997	115,303	121,190	120,624	117,622	121,130	119,639	129,546	125,847	127,267	1,453,989	1,420,035
Exports: [2]														
Crude petroleum	4,202	3,327	4,046	4,262	4,886	5,692	5,607	4,170	4,260	5,269	3,805	2,074	51,600	72,076
Refined products	6,726	5,765	7,583	7,585	7,541	8,516	6,219	6,760	5,288	6,005	6,084	4,917	78,989	116,883
Domestic demand:														
Motor fuel	40,370	37,557	44,607	47,683	52,946	55,459	53,865	55,346	52,297	53,807	49,074	46,413	589,424	555,509
Kerosene	7,642	6,263	6,273	5,621	5,297	3,952	4,257	4,114	5,173	5,608	6,768	7,808	68,776	60,503
Distillate fuel oil	22,462	17,623	16,187	11,849	9,738	7,028	7,223	8,362	10,439	13,358	16,848	19,702	160,819	134,973
Residual fuel oil	32,473	27,123	31,188	26,887	26,338	25,048	23,990	26,267	25,843	30,192	29,980	33,955	339,284	323,488
Lubricating oil	2,054	1,522	1,883	2,138	2,063	2,146	1,871	2,024	2,150	2,482	2,449	1,875	24,657	23,713
Miscellaneous	10,790	7,925	10,230	9,278	12,381	12,783	14,590	14,087	14,189	12,825	10,839	10,523	140,410	132,890
Total domestic demand	115,791	98,013	110,368	103,456	108,763	106,416	105,796	110,200	110,091	118,272	115,958	120,276	1,323,400	1,231,076
Stocks:														
Refinable crude petroleum in U. S.	239,794	244,417	251,120	258,066	261,839	261,971	263,498	264,252	263,124	263,856	263,163	264,079	264,079	239,978 [3] 238,910
Heavy crude petroleum in Calif.	13,385	13,408	13,485	13,516	13,265	13,334	13,204	12,798	12,562	12,353	12,257	11,906	11,906	13,330
Natural gasoline	4,476	4,757	5,393	6,112	6,514	7,000	7,584	7,702	7,038	6,569	6,102	5,704	5,704	4,421
Refined products	262,791	270,464	273,845	277,739	282,176	283,905	289,071	290,778	294,095	290,918	285,302	282,265	282,265	268,109
Total, all oils	520,446	533,046	543,843	555,433	563,794	566,210	573,357	575,530	576,819	573,696	566,824	563,954	563,954	525,838 [3] 524,770

[1] Subject to revision.
[2] Imports of crude petroleum as reported to Bureau of Mines; all other imports and exports from Bureau of Foreign and Domestic Commerce.
[3] For comparison with 1940.

was offset to a considerable extent by a decline of over 19 million in exports. The total demand for distillate fuel oil rose from 167 million barrels in 1939 to 180 million in 1940—a gain of 8 percent. Domestic demand increased by 26 million barrels while exports declined by 13 million. The total demand for residual fuel oils amounted to 355 million barrels in 1940 compared to 341 million in 1939—an increase of 4 percent. Domestic demand was 16 million barrels greater than in 1939, and exports decreased by about 1½ million. The total demand for lubricating oil in 1940 was about 35 million barrels—a slight decrease compared to 1939—as a gain of about 1 million barrels in domestic demand was offset by a slightly larger decline in exports.

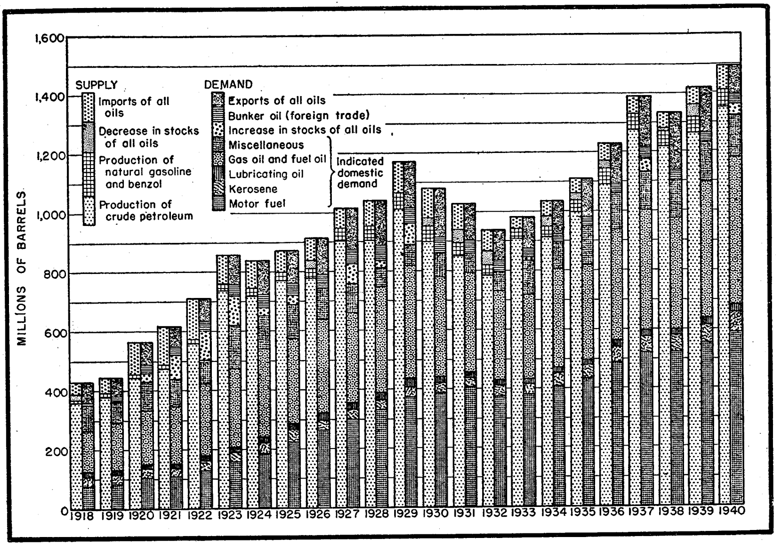

FIGURE 1.—Supply and demand of all oils in the United States, 1918–40.

The long-term trends in supply and demand are shown in figure 1. Rapid changes in the foreign situation and abnormally cold weather in the first quarter of the year resulted in a lack of adjustment between refinery production, seasonal stocks, and total demand for the various refined products during 1940, as shown by high gasoline stocks, by alternating periods of scarcity and overabundance of distillate fuel oil, and by large imports of residual fuel oil. Prospects for 1941 indicate that the domestic demand for all oils will substantially exceed all previous peaks in production and refinery operations. The expected gain in domestic demand probably will far exceed any further reduction in exports or the effects of any increase in imports.

RESERVES

Crude-oil reserves in sight or extractable by present methods and at approximately current prices reached a new peak on January 1, 1941. According to the American Petroleum Institute, the total reserve on that date was 19,025,000,000 barrels compared with 18,483,000,000 barrels on January 1, 1940. As production was about 1,352,000,000 barrels in 1940, it follows that the proved reserves discovered and developed in 1940 totaled 1,894,000,000 barrels.

Although the record-breaking total for proved reserves indicates at least no imminent danger of exhaustion, several aspects of the situation will bear watching. For example, in relation to total demand the reserves of January 1, 1941, represent about 13 years' supply, which is a drop from the number of years' supply in reserve the previous year. Furthermore, although the latest report of the American Petroleum Institute does not show the reserves of new fields separately, other surveys indicate a material decline in recent years in the proportion attributable to new fields as contrasted with the reserves added by extensions in the old fields.

Estimates of proved oil reserves in the United States on January 1, 1935, and 1937–41, by States [1]

[Millions of barrels]

State	1935 [2]	1937 [2]	1938 [2]	1939 [2]	1940 [2]	1941 [3]
Eastern States:						
Illinois	37	28	59	432	382	315
Indiana	5	3	7	6	14	14
Kentucky	50	39	38	49	44	41
Michigan	64	63	46	74	51	35
New York	75	66	45	40	35	65
Ohio	40	32	30	33	32	30
Pennsylvania	340	307	218	200	183	188
West Virginia	40	32	28	50	46	53
	651	570	471	884	787	741
Central and Southern States:						
Arkansas	103	87	171	332	320	306
Kansas	390	590	607	763	726	692
Louisiana	513	657	1, 049	1, 180	1, 173	1, 216
Mississippi					7	40
New Mexico	451	581	739	703	687	692
Oklahoma	1, 235	1, 384	1, 311	1, 206	1, 063	1, 002
Texas	6, 643	8, 343	9, 692	10, 180	9, 768	10, 624
	9, 335	11, 642	13, 569	14, 364	13, 744	14, 572
Mountain States:						
Colorado	16	19	19	22	20	23
Montana	102	115	109	99	94	89
Wyoming	267	260	280	327	306	305
	385	394	408	448	420	417
Pacific Coast States: California	3, 261	3, 251	3, 303	3, 710	3, 532	3, 291
Other States						4
Total United States	13, 632	15, 857	17, 751	19, 406	18, 483	19, 025

[1] From reports of Committee on Petroleum Reserves, American Petroleum Institute.
[2] Final revised estimates of the amount of crude oil which may be extracted by present methods from fields completely developed or sufficiently explored to permit reasonably accurate calculations.
[3] Subject to revision.

LEGISLATION AND PRORATION

The most important legislative proposal before Congress in 1940 was the Cole bill providing for Federal regulation of production. Hearings on the Cole bill were held early in the year, but final action was still pending at the close of the year. The national defense program affected the industry in many ways, such as in connection with the export-control act and procurement contracts.

The interstate compact functioned throughout the year but with no important changes in membership until the spring of 1941.

State allowables and Bureau of Mines estimates of market demand[1] *compared with actual production*[2] *in the United States, in 1940*

[Daily averages, in thousands of barrels]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Texas:												
State allowable[3]	1,403	1,430	1,557	1,539	1,443	1,283	1,272	1,235	1,355	1,413	1,348	1,316
Bureau of Mines estimate	1,411	1,371	1,331	1,332	1,344	1,345	1,339	1,326	1,320	1,305	1,291	1,277
Actual production	1,369	1,393	1,488	1,486	1,408	1,273	1,256	1,215	1,318	1,374	1,301	1,291
California:												
State allowable[4]	599	594	592	592	592	592	587	587	571	571	571	571
Bureau of Mines estimate	594	586	587	590	593	594	594	598	593	583	583	594
Actual production	612	608	602	613	614	618	617	621	613	611	608	604
Oklahoma:												
State allowable[5]	434	429	420	413	408	408	408	390	389	390	390	390
Bureau of Mines estimate	434	429	420	413	408	409	404	403	397	404	413	423
Actual production	424	436	440	439	434	425	429	425	413	415	415	418
Louisiana:												
State allowable[6]	268	273	277	284	293	280	280	275	275	270	280	287
Bureau of Mines estimate	254	253	253	257	265	275	278	276	275	274	274	280
Actual production	272	281	282	295	299	289	278	275	285	278	287	289
Kansas:												
State allowable[7]	161	165	170	151	158	178	178	171	190	188	190	192
Bureau of Mines estimate	161	156	154	151	158	159	159	167	171	179	186	188
Actual production	171	176	180	161	168	178	188	186	196	191	187	191
New Mexico:												
State allowable[8]	102	113	114	114	107	107	106	102	100	104	104	104
Bureau of Mines estimate	102	100	103	100	104	107	106	105	105	105	104	101
Actual production	112	116	115	109	109	103	105	105	102	103	101	100
Arkansas:												
State allowable[9]	70	70	70	70	70	71	73	73	73	69	70	70
Bureau of Mines estimate	60	60	66	65	65	67	67	65	70	71	71	66
Actual production	68	69	69	71	71	71	72	72	73	68	68	69
Other States:												
Bureau of Mines estimate	554	574	587	642	664	664	681	718	693	660	648	631
Actual production	622	668	697	694	713	766	708	666	645	619	597	603
United States:												
Bureau of Mines estimate	3,570	3,529	3,501	3,550	3,601	3,620	3,628	3,658	3,624	3,581	3,570	3,560
Actual production	3,650	3,747	3,873	3,868	3,816	3,723	3,653	3,565	3,645	3,659	3,564	3,565

[1] State figures are estimates of demand, hence in comparing demand data with actual production due regard should be given to changes in stocks by States of origin. (Changes in stocks and demand are given elsewhere in this chapter.)

[2] Comparisons of actual production with State allowables are complicated further by variations in the method of applying pipe-line deductions for B. S. and water. Thus it is believed that the allowables in Texas and California are on a 100-percent basis, in Oklahoma and Kansas on a 97-percent basis, in New Mexico on a 98-percent basis, and in Louisiana on a 99-percent basis. The bases used in reporting production to the Bureau of Mines are not definitely known, but indications are that the average for the United States is about 99 percent.

[3] Railroad Commission of Texas.

[4] Conservation Committee of California Oil Producers.

[5] Corporation Commission of Oklahoma. State allowable figures as shown do not include production permitted in accordance with "underage" and other special provisions of State orders.

[6] Department of Conservation, Louisiana. State allowable figures shown do not include production permitted under special orders of said Department.

[7] State Corporation Commission of Kansas.

[8] Oil Conservation Commission of New Mexico. State allowable figures as shown do not include production permitted in accordance with "underage" and other special provisions of State orders.

[9] Oil and Gas Commission.

EMPLOYMENT AND LABOR PRODUCTIVITY

The discussion of employment and productivity, which has been given here for several years, cannot be repeated for 1939 as the Bureau of Mines did not compile employment data for that year; however, complete information for 1939 was collected by the Bureau of the Census as part of its Decennial Census of Mines and Quarries (the first since 1919), and the results will probably be published before the end of 1941.

CRUDE PETROLEUM

SUPPLY AND DEMAND

The new supply of crude petroleum in 1940 was over 96 million barrels greater than in 1939—a gain of 87 million barrels in domestic production and an increase of over 9 million in imports; however, 24 million barrels were added to crude stocks compared with a reduction of 37 million in 1939. The total demand for crude petroleum was 1,371 million barrels in 1940—a gain of only 35 million barrels or less than 3 percent above the previous year. Exports of crude declined 20 million barrels while crude runs to stills increased 56 million.

Supply of and demand for crude petroleum in the United States, 1936–40

[Thousands of barrels]

	1936	1937	1938	1939	1940 [1]
Production	1,099,687	1,279,160	1,214,355	1,264,962	1,351,847
Imports [2]	32,327	27,484	26,412	33,095	42,738
Changes in stocks [3]	−26,276	+18,247	−28,913	−37,324	+23,745
Total demand	1,158,290	1,288,397	1,269,680	1,335,381	1,370,840
Runs to stills:					
Domestic	1,034,637	1,157,444	1,138,828	1,204,350	1,252,485
Foreign	33,933	25,996	26,187	33,490	41,798
Exports	50,313	67,234	77,254	72,076	51,600
Transfers to fuel-oil stocks	[4] 15,732	[4] 17,423	[4] 10,660	8,832	[5] 6,440
Consumed as fuel on producing properties [6]	1,664	1,308	1,452	1,452	1,538
Consumed as fuel in operation of pipe lines [6]	2,138	2,178	1,930	2,125	2,297
Other fuel and losses	19,873	16,814	13,369	13,056	14,682
Total demand	1,158,290	1,288,397	1,269,680	1,335,381	1,370,840

[1] Subject to revision. [2] As reported to Bureau of Mines.
[3] Exclusive of changes in stocks of heavy crude in California, 1936–37. [4] California only.
[5] Includes 2,091,000 barrels used for industrial purposes east of California, 279,000 barrels transferred to gas oil, etc., in California, and 4,070,000 barrels transferred to residual fuel oil in California.
[6] East of California.

PRODUCTION

As indicated in figure 2, the upward trend in production in 1939 was resumed in February 1940 and continued until June, July, and August, when there was a marked downward trend. A major influence was production in Illinois, which reached its peak in June.

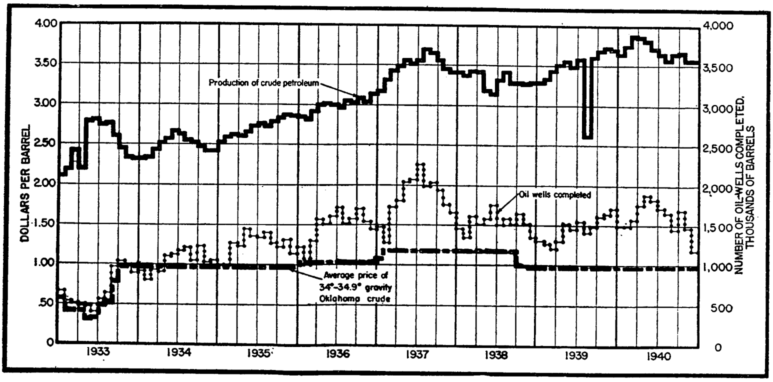

FIGURE 2.—Daily average production of crude petroleum, total number of oil wells completed, and average price per barrel of a selected grade of Oklahoma crude petroleum in the United States, 1933–40, by months.

The production of Pennsylvania Grade crude oil increased slightly in Ohio in 1940, but the output of this type of crude in each of the other three States—New York, Pennsylvania, and West Virginia—declined, and the total for the year fell from 27,220,000 barrels in 1939 to 26,972,000 in 1940.

The percentage of total crude petroleum produced by each of the three leading States—Texas, California, and Oklahoma—again decreased in 1940, and the three States combined produced less than two-thirds of the total for the first time in many years. The important gains were for Illinois, whose percentage rose from 7.5 in 1939 to 10.8 in 1940, and for "Other States," whose percentage rose from 3.8 in 1939 to 4.4 in 1940.

The relative rank of the producing States is shown graphically in figure 3.

The situation as to production by districts in 1940 was similar to that in 1939, with about half showing declines from the previous year but with the gain in Illinois–Southwest Indiana alone far outweighing all the decreases combined.

The rank of the first three leading producing fields—East Texas, Salem (Ill.), and Oklahoma City—remained unchanged in that order in 1940. The Midway-Sunset field of California ranks second to East Texas in cumulative production, but this is due mainly to its age—about 40 years—as it ranked only seventh in production in 1940.

Petroleum produced in the United States, 1936–40, and total 1859–1940, by States[1]

[Thousands of barrels]

	1936	1937	1938	1939	1940 [2]	1859–1940 (total)
Production:						
Arkansas	10, 469	11, 764	18, 180	21, 238	25, 583	506, 225
California	214, 773	238, 521	249, 749	224, 354	223, 881	5, 570, 078
Colorado	1, 650	1, 605	1, 412	1, 404	1, 350	39, 620
Illinois	4, 475	7, 499	24, 075	94, 912	146, 788	698, 813
Indiana	822	844	995	1, 711	4, 843	130, 975
Kansas	58, 317	70, 761	60, 064	60, 703	66, 270	[3] 1, 121, 064
Kentucky	5, 633	5, 484	5, 821	5, 621	5, 193	[4] 167, 166
Louisiana	80, 491	90, 924	95, 208	93, 646	103, 961	1, 060, 366
Michigan	11, 928	16, 628	18, 745	23, 462	19, 764	[5] 145, 117
Mississippi	------	------	------	107	4, 380	4, 487
Montana	5, 868	5, 805	4, 946	5, 960	6, 768	83, 532
New Mexico	27, 223	38, 854	35, 759	37, 637	39, 001	[6] 274, 631
New York	4, 663	5, 478	5, 045	5, 098	4, 999	[7] 118, 777
Ohio	3, 847	3, 559	3, 298	3, 156	3, 169	588, 387
Oklahoma	206, 555	228, 839	174, 994	159, 913	155, 952	[3] 4, 805, 911
Pennsylvania	17, 070	19, 189	17, 426	17, 382	17, 353	[7] 997, 068
Texas	427, 411	510, 318	475, 850	483, 528	493, 126	6, 579, 724
West Virginia	3, 847	3, 845	3, 684	3, 580	3, 444	410, 770
Wyoming	14, 582	19, 166	19, 022	21, 454	25, 683	500, 950
Other States [8]	63	77	82	96	339	[8] 1, 390
Total United States	1, 099, 687	1, 279, 160	1, 214, 355	1, 264, 962	1, 351, 847	23, 805, 051
Value at wells:						
Total (thousands of dollars)	1, 199, 820	1, 513, 340	1, 373, 060	1, 294, 470	1, 350, 000	28, 107, 939
Average per barrel	$1.09	$1.18	$1.13	$1.02	$1.00	$1.18

[1] For detailed figures by States, 1859–1935, see Minerals Yearbook 1937, p. 1008.
[2] Subject to revision.
[3] Oklahoma included with Kansas in 1905 and 1906.
[4] Includes Tennessee, 1883–1907.
[5] Figures represent 1925–40 production only; earlier years included under "Other States."
[6] Figures represent 1924–40 production only; earlier years included under "Other States."
[7] Early production in New York included with Pennsylvania.
[8] Includes Alaska, 1912–33; Arkansas, 1920; Michigan, 1900–1919; Missouri, 1889–1911, 1913–16, 1919–23, 1932–40; Nebraska, 1940; New Mexico, 1913, 1919–23; Tennessee, 1916–40; Utah, 1907–11, 1920, 1924–40.

Production of crude petroleum in the United States in 1940, by districts, States, and months

[Thousands of barrels]

District and State	1940[1] January	February	March	April	May	June	July	August	September	October	November	December	Total	1939 (total)
DISTRICT														
Pennsylvania Grade	2,294	2,328	2,346	2,428	2,445	2,105	2,247	2,172	2,088	2,234	2,055	2,230	26,972	27,220
Other Appalachian (including Kentucky)	494	536	557	582	585	557	603	596	587	619	546	567	6,829	7,087
Lima-Northeastern Indiana-Michigan	2,070	1,904	1,972	1,861	1,807	1,650	1,670	1,607	1,463	1,513	1,347	1,329	20,193	24,066
Illinois-Southwestern Indiana	11,691	11,960	13,907	13,212	14,156	15,539	14,182	12,523	11,439	11,376	10,698	10,924	151,607	96,599
North Louisiana and Arkansas	4,291	4,225	4,467	4,407	4,551	4,466	4,448	4,776	4,863	4,644	4,484	4,747	54,369	46,748
West Texas and Southeastern New Mexico	10,616	10,056	11,658	11,133	11,192	9,667	9,515	9,596	9,939	10,583	9,686	9,604	123,245	116,766
East Texas	12,571	11,869	12,616	12,558	11,925	10,549	12,620	11,595	11,055	11,563	11,042	11,060	141,023	144,615
Oklahoma, Kansas, North Texas, etc	30,203	29,475	32,542	30,844	31,392	29,236	30,175	30,025	30,695	32,265	29,869	31,157	367,878	357,595
Gulf Coast	17,270	16,232	18,662	18,083	18,312	16,543	15,675	15,171	15,788	16,780	16,172	17,124	201,812	190,766
Rocky Mountain	2,680	2,440	2,676	2,534	2,899	2,854	2,987	3,205	3,042	2,903	2,774	3,044	34,038	29,146
California	18,960	17,643	18,672	18,403	19,019	18,524	19,122	19,257	18,378	18,938	18,231	18,734	223,881	224,354
Total United States	113,140	108,668	120,075	116,045	118,283	111,690	113,244	110,523	109,337	113,418	106,904	110,520	1,351,847	1,264,962
STATE														
Arkansas	2,098	2,010	2,125	2,114	2,198	2,119	2,242	2,222	2,178	2,121	2,035	2,121	25,583	21,238
California	18,960	17,643	18,672	18,403	19,019	18,524	19,122	19,257	18,378	18,938	18,231	18,734	223,881	224,354
Colorado	93	85	88	122	127	121	136	123	98	112	125	120	1,350	1,404
Illinois	11,500	11,727	13,580	12,911	13,833	15,194	13,805	12,075	10,925	10,795	10,089	10,354	146,788	94,912
Indiana	193	235	329	303	325	347	379	450	516	583	611	572	4,843	1,711
Kansas	5,295	5,108	5,565	4,814	5,198	5,343	5,826	5,772	5,881	5,914	5,622	5,932	66,270	60,703
Kentucky	383	422	435	446	445	419	454	445	444	464	415	421	5,193	5,621
Louisiana	8,416	8,162	8,735	8,847	9,274	8,659	8,619	8,518	8,536	8,620	8,603	8,972	103,961	93,646
Michigan	2,048	1,870	1,935	1,819	1,771	1,614	1,628	1,563	1,425	1,474	1,317	1,300	19,764	23,462
Mississippi	117	189	235	231	252	317	276	578	761	480	428	516	4,380	107
Montana	532	518	539	530	616	613	562	583	577	567	547	584	6,768	5,960
New Mexico	3,458	3,365	3,552	3,282	3,370	3,094	3,251	3,239	3,046	3,199	3,034	3,111	39,001	37,637
New York	458	430	438	444	439	402	425	396	383	408	379	397	4,999	5,098
Ohio	207	234	246	274	280	260	286	287	272	296	248	279	3,169	3,156
Oklahoma	13,142	12,654	13,638	13,169	13,445	12,752	13,296	13,184	12,397	12,864	12,445	12,966	155,952	159,913
Pennsylvania	1,522	1,505	1,530	1,582	1,585	1,335	1,418	1,387	1,321	1,405	1,319	1,444	17,353	17,382
Texas	42,438	40,391	46,116	44,583	43,651	38,178	38,932	37,660	39,549	42,592	39,025	40,011	493,126	483,528
West Virginia	234	301	285	300	311	276	303	291	286	312	264	281	3,444	3,580
Wyoming	2,038	1,813	2,025	1,864	2,134	2,110	2,272	2,481	2,349	2,205	2,072	2,320	25,683	21,454
Other States[2]	8	6	7	7	10	13	12	12	15	69	95	85	339	96
Total United States: 1940	113,140	108,668	120,075	116,045	118,283	111,690	113,244	110,523	109,337	113,418	106,904	110,520	1,351,847	----------
1939	102,869	93,525	106,766	105,304	110,422	104,745	111,057	81,024	108,235	114,010	111,885	115,120	----------	1,264,962
Daily average, 1940	3,650	3,747	3,873	3,868	3,816	3,723	3,653	3,565	3,645	3,659	3,563	3,565	3,694	3,466

[1] Subject to revision.

[2] Missouri, Nebraska, Tennessee, and Utah.

Pennsylvania Grade crude oil produced, 1931–40, by States

[Thousands of barrels]

State	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940 [1]
New York	3,363	3,508	3,181	3,804	4,236	4,663	5,478	5,045	5,098	4,999
Pennsylvania	11,876	12,396	12,607	14,462	15,794	17,053	19,173	17,407	17,363	17,334
West Virginia	4,470	3,875	3,815	4,095	3,901	3,846	3,844	3,684	3,580	3,444
Central and eastern Ohio	2,184	1,741	1,594	1,597	1,547	1,510	1,367	1,180	1,179	1,195
	21,893	21,520	21,197	23,958	25,478	27,072	29,862	27,316	27,220	26,972

[1] Subject to revision.

Percentage of total crude petroleum produced in the United States, 1931–40, by principal States

State	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940 [1]
Texas	39.1	39.8	44.5	42.0	39.4	38.9	39.9	39.2	38.2	36.5
California	22.2	22.7	19.0	19.2	20.9	19.5	18.6	20.6	17.7	16.6
Oklahoma	21.2	19.5	20.1	19.9	18.6	18.8	17.9	14.4	12.7	11.5
Total, 3 States	82.5	82.0	83.6	81.1	78.9	77.2	76.4	74.2	68.6	64.6
Louisiana	2.6	2.8	2.8	3.6	5.0	7.3	7.1	7.8	7.4	7.7
Kansas	4.4	4.4	4.6	5.1	5.5	5.3	5.5	5.0	4.8	4.9
New Mexico	1.8	1.6	1.6	1.9	2.1	2.5	3.1	2.9	3.0	2.9
Illinois	.6	.6	.5	.5	.4	.4	.6	2.0	7.5	10.8
Michigan	.4	.9	.9	1.2	1.5	1.1	1.3	1.5	1.8	1.5
Arkansas	1.7	1.5	1.3	1.1	1.1	.9	.9	1.5	1.7	1.9
Pennsylvania	1.4	1.6	1.4	1.6	1.6	1.6	1.5	1.4	1.4	1.3
All other	4.6	4.6	3.3	3.9	3.9	3.7	3.6	3.7	3.8	4.4
Total United States	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Subject to revision.

Production of crude petroleum in leading fields and districts in the United States, 1939–40,[1] and total production since discovery

[Thousands of barrels]

Field	State	1939	1940	Total since discovery
East Texas [2]	Texas	[4] 144,600	[3] 141,000	1,571,000
Midway-Sunset	California	18,900	18,400	895,000
Seminole	Oklahoma	30,700	27,000	847,000
Long Beach	California	17,000	16,000	654,000
Oklahoma City [2]	Oklahoma	[4] 37,300	[3] 37,800	526,000
Santa Fe Springs	California	10,100	9,400	467,000
Bradford-Allegany	Pennsylvania-New York	18,100	17,700	439,000
Smackover	Arkansas	7,100	6,600	417,000
Coalinga	California	5,700	9,900	371,000
Cushing-Shamrock	Oklahoma	3,400	3,400	342,000
Yates district	Texas	[4] 8,600	7,600	344,000
Augusta-Eldorado district	Kansas	5,100	5,000	299,000
Salt Creek [2]	Wyoming	5,300	[3] 5,200	293,000
Huntington Beach	California	10,000	9,600	291,000
Wilmington	do	31,100	30,200	263,000
Kettleman Hills	do	19,600	16,700	239,000
Crane-Upton Counties	Texas	9,900	[2 3] 10,400	174,000
Gray County	do	10,900	12,000	170,000
Caddo [2]	Louisiana	2,700	[3] 2,900	155,000
Salem	Illinois	50,200	70,700	124,000
Conroe	Texas	9,200	9,900	117,000
Rodessa	Arkansas-Louisiana-Texas	20,400	14,200	117,000
Hobbs	New Mexico	4,400	3,800	101,000
Fitts	Oklahoma	9,200	6,200	90,000
Eunice	New Mexico	7,900	6,600	48,000
Louden	Illinois	18,400	26,600	47,000
Monument	New Mexico	8,200	6,900	39,000

[1] Oil and Gas Journal, except as noted.
[2] Bureau of Mines.
[3] Subject to revision.
[4] Revised figures.

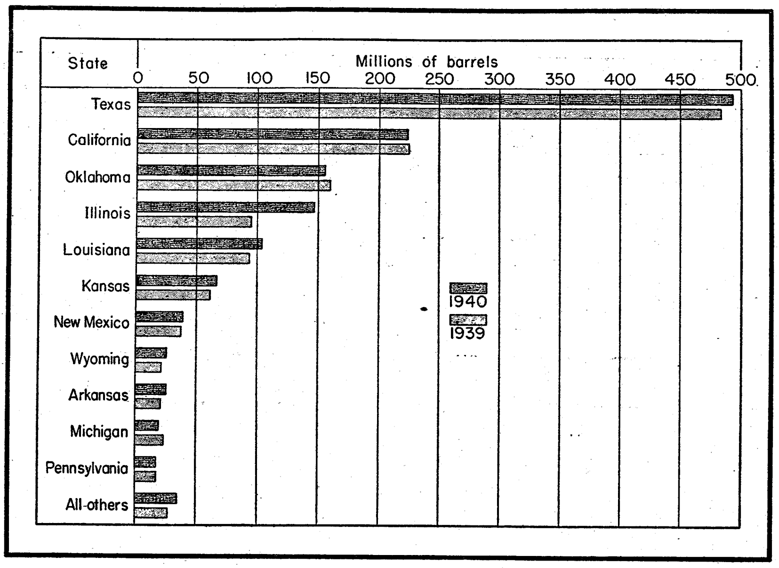

FIGURE 3.—Production of crude petroleum in the United States, 1939–40, by States.

Arkansas.—Production in Arkansas in 1940 was 25,583,000 barrels—about 20 percent higher than in 1939. The increase was largely attributable to gains in the comparatively new fields of Atlanta and Magnolia. Production at Magnolia rose from 3,639,000 barrels in 1939 to 7,383,000 in 1940; it is now the first-ranking field of the State in production.

Exploratory work and drilling in general declined in Arkansas in 1940, as only 114 oil wells were completed compared with 183 in 1939. One new field of promise was discovered; this was McKamie, a condensate field nearly 9,000 feet deep.

Production of crude petroleum in Arkansas, 1936–40, by fields

[Thousands of barrels]

Year	Atlanta	Buckner	Champagnolle	El Dorado	Irma	Magnolia	Rodessa	Schuler	Smackover	Urbana	Village	Other fields	Total
1936	-------	-------	900	811	383	-------	-------	-------	7,126	651	-------	598	10,469
1937	-------	21	522	747	433	-------	1,252	1,153	6,751	446	-------	439	11,764
1938	-------	340	452	709	578	68	2,317	6,359	6,406	422	119	410	18,180
1939	108	662	566	630	219	3,639	1,358	6,430	5,945	381	309	991	21,238
1940 [1]	721	815	581	591	199	7,383	711	6,547	5,500	468	422	[2] 1,645	25,583

[1] Subject to revision.
[2] Includes crude oil consumed on leases and net change in stocks held on leases for entire State.

California.—Production in California in 1940 held consistently just above the 600,000-barrel-a-day mark, and the total of 223,881,000 barrels was only about 500,000 below the total for 1939.

Drilling in 1940 also was a counterpart of that in the previous year, as 859 oil wells were completed in 1940 compared with 852 in 1939.

The average initial daily production in 1940 was 890.5 barrels compared with 909.2 in 1939. In the number of dry holes there was a material difference—156 in 1940 compared with 251 in 1939. This decrease in failures probably reflects the effort of the majors to maintain their total "allowable" in the face of a declining allotment to top wells.

Production of crude petroleum in California, 1936–40, by districts and fields [1]

[Thousands of barrels]

District and field	1936	1937	1938	1939	1940
San Joaquin Valley:					
Belridge	4,648	6,332	5,312	4,781	4,614
Canal		31	849	1,855	2,034
Coalinga	6,067	5,759	3,898	5,731	9,916
Coles Levee			10	336	1,330
Edison	2,023	1,577	1,102	838	868
Elk Hills	3,194	3,787	3,887	3,830	4,427
Fruitvale	2,903	3,246	3,078	2,377	2,072
Greeley		527	1,164	811	1,475
Kern River	5,163	5,639	4,590	4,133	4,082
Kettleman Hills	29,287	29,132	25,609	19,568	16,730
Lost Hills	1,347	1,414	1,297	1,222	1,405
McKittrick	777	1,308	1,289	1,326	1,317
Midway-Sunset	21,482	26,485	22,875	18,960	18,397
Mountain View	9,713	6,843	4,033	2,983	2,415
Mount Poso	6,747	6,677	6,235	4,314	3,425
Rio Bravo		128	1,945	2,875	3,304
Round Mountain	3,955	4,835	5,474	3,528	2,691
Ten Section		932	2,473	3,247	3,518
Tupman			2	190	1,259
Other San Joaquin Valley	321	120	273	1,152	2,003
Total San Joaquin Valley	97,627	104,772	95,395	84,057	87,282
Coastal District:					
Capitan	571	918	1,067	876	651
Elwood	4,479	3,203	2,247	1,545	1,286
Rincon	754	1,058	1,395	1,238	1,609
San Miguelito	580	1,147	1,044	952	1,163
Santa Maria	1,668	3,893	6,128	6,305	8,312
Ventura Avenue	12,610	12,685	12,926	12,935	12,570
Other Coastal	2,239	2,113	2,089	2,449	2,967
Total Coastal	22,901	25,017	26,896	26,300	28,558
Los Angeles Basin:					
Brea Olinda	2,961	2,659	2,125	2,063	2,070
Coyote	3,944	4,269	4,354	4,013	4,053
Dominquez	9,712	9,839	9,756	7,131	7,665
El Segundo	149	3,632	3,872	1,168	785
Huntington Beach	13,247	13,255	11,917	9,983	9,592
Inglewood	4,547	5,530	5,337	4,605	4,366
Long Beach	24,994	21,872	20,599	17,004	16,010
Montebello	3,205	3,167	4,147	7,455	7,240
Playa del Rey	4,644	3,181	2,305	1,801	1,498
Richfield	2,443	3,158	3,333	3,134	3,228
Rosecrans	804	1,259	3,732	4,459	4,259
Santa Fe Springs	16,460	15,745	12,630	10,050	9,438
Seal Beach	3,463	3,416	3,198	2,641	2,557
Torrance	2,860	2,833	5,203	6,418	4,007
Wilmington		14,186	34,168	31,100	30,195
Other Los Angeles Basin	812	731	782	972	1,078
Total Los Angeles Basin	94,245	108,732	127,458	113,997	108,041
Total California	214,773	238,521	249,749	224,354	223,881

[1] American Petroleum Institute

Of the three major districts, San Joaquin Valley and Coastal increased in 1940 over 1939, but Los Angeles Basin declined. Wilmington, with a total output of 30,195,000 barrels, was again the leading field, but the old Midway-Sunset field displaced Kettleman

Hills in second place. Important gains in production in 1940 were made in the old Coalinga field, in the comparatively new fields of Coles Levee and Tupman, and at Santa Maria. In general, the increases were in fields where deep zones have been discovered in recent years.

New discoveries occurred in California in 1940; but only one new field—Del Valle, in the Coastal district—appears of importance. The Midway-Sunset, Rosecrans, and Coyote fields had notable extensions. According to the Oil and Gas Journal crude-oil reserves increased slightly in California in 1940, but nearly all the additions comprised extensions in old fields.

Colorado.—Although the preliminary figure of 1,350,000 barrels for production in 1940 indicates a decline for Colorado, the final figure probably will be about 1,550,000 barrels or nearly 150,000 barrels above the total in 1939. The increase followed development of an extension in the Wilson Creek field, which was the only field development of importance in another quiet year.

Production of crude petroleum in Colorado, 1936–40, by fields

[Thousands of barrels]

Year	Florence [1]	Fort Collins [2]	Iles	Moffat	Price	Tow Creek	Other fields	Total
1936	73	119	1,176	161	----------	65	56	1,650
1937	57	90	1,040	149	173	57	39	1,605
1938	64	109	819	126	185	56	53	1,412
1939	62	116	724	112	289	53	48	1,404
1940 [3]	56	128	581	111	317	52	[4] 105	1,350

[1] Includes Canon City.
[2] Includes Wellington.
[3] Subject to revision.
[4] Includes crude oil consumed on leases and net change in stocks held on leases for entire State.

Illinois.—The year 1939 had been outstanding in Illinois oil history, but even that was eclipsed by developments in 1940, as the total production was 146,788,000 barrels—56 percent above 1939.

Although the number of oil wells completed in 1940 was only moderately higher than in 1939 (3,049 compared with 2,943) the total daily initial production in 1940 was more than twice as large. In 1940 Illinois ranked second only to Texas in total initial and had nearly double that of California and Oklahoma combined. However, the major part of the initial in Illinois was from the Devonian lime, which because of its high porosity-permeability factor gives wells of large initial but no staying power. The peak daily production was just over 500,000 barrels in June; by the end of the year the State was down to about 333,000 barrels daily.

The Salem field maintained its place as second only to East Texas among the producing fields of the United States. In 1941 it is due to decrease sharply from its 1940 figure of 70,734,000 barrels but probably will retain second place. The Louden field was the second-ranking field in Illinois in 1940, with Centralia third.

Because of the size of the area and the number of producing formations, discoveries and extensions continued numerous in Illinois in 1940. Even the so-called Central Basin area of Clay, Richland, and Wayne Counties, where the hectic development of recent years began in 1937, yielded a number of new discoveries in 1940. Deep tests to the Devonian and Trenton limes and to the St. Peter sandstone were generally disappointing. Commercial Devonian production appears confined to the Du Quoin anticline in the general Centralia district. Trenton production was found in the Salem field, but its development does not appear promising economically. The St. Peter was barren in the few tests made.

Production of crude petroleum in Illinois, 1936–40, by fields

[Thousands of barrels]

Field	1936 [1]	1937 [1]	1938 [1]	1939 [2]	1940 [2]
Aden-North	------	------	305	736	908
Albion	------	------	------	------	1,095
Boyleston	------	------	------	169	1,306
Calvin	------	------	------	5	591
Centralia	------	5	3,022	2,265	10,642
Cisne	------	21	------	1,224	479
Clay City	------	1,556	4,004	6,781	3,866
Dundas	------	------	------	209	2,027
Enterprise	------	------	------	784	2,951
Griffin	------	------	------	181	1,194
Hoodville	------	------	------	------	353
Iron	------	------	------	------	1,120
Irvington	------	------	------	------	509
Keensburg	------	------	------	806	1,615
Louden	------	------	1,892	18,351	26,596
Noble	------	947	4,232	1,644	2,744
North Boos	------	------	------	------	249
Patoka	------	425	742	492	419
Salem	------	------	2,895	50,179	70,734
Sandoval	------	------	------	660	704
St. James	------	------	48	439	1,713
Storms	------	------	------	42	1,514
Tonti	------	------	------	835	2,556
West Liberty	------	------	------	------	268
Old fields	4,445	4,469	4,304	3,177	3,516
Other fields	------	3	2,485	2,818	6,782
	4,445	7,426	23,929	91,797	146,451

[1] American Institute of Mining and Metallurgical Engineers.
[2] Oil and Gas Journal.

Indiana.—Indiana continued to profit from the overflow of developments in Illinois, and in 1940 its production reached 4,843,000 barrels—the highest since 1907 and more than three times larger than that in 1939. The gain was due to increases in the Griffin and New Harmony fields. During 1940, 231 oil wells were brought in, compared with 176 in 1939. No important discoveries were made in Indiana in 1940, and the output in 1941 may show a decline.

Production of crude petroleum in Indiana, 1936–40, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1936	61	54	68	68	71	76	76	69	72	73	63	71	822
1937	60	65	69	69	72	75	75	75	72	70	67	75	844
1938	68	72	75	75	80	88	90	94	90	88	85	90	995
1939	59	59	59	65	87	114	135	166	176	230	262	299	1,711
1940 [1]	193	235	329	303	325	347	379	450	516	583	611	572	4,843

[1] Subject to revision.

Kansas.—In 1940 Kansas recovered from the slump induced by the Illinois development, and production rose to 66,270,000 barrels from 60,723,000 in 1939; however, output in 1940 fell short of the record (70,761,000 barrels) of 1937.

Routine drilling, which slumped in 1939, rose materially in 1940; 1,410 oil wells of 460 barrels average daily initial were brought in during 1940 compared with 977 wells averaging 432 barrels initial in 1939. Barton, Ellis, McPherson, Rice, and Russell Counties shared the major part of the drilling in 1940.

Production of crude petroleum in Kansas, 1936–40, by counties and selected fields [1]

[Thousands of barrels]

County and field	1936	1937	1938	1939	1940
Barton	1,195	3,519	3,490	3,490	3,468
Butler:					
Eldorado	3,508	3,340	3,023	2,710	2,651
Other fields	2,656	2,649	2,668	2,354	2,394
Cowley	1,804	1,973	2,318	3,264	2,670
Ellis:					
Bemis-Walters	758	1,761	2,241	2,379	3,652
Other fields		868	875	1,089	2,086
Ellsworth	3,014	2,121	1,248	1,124	1,576
Greenwood-Woodson	4,001	4,007	3,834	3,578	3,425
Harvey:					
Hollow-Nikkel	1,480	1,112	773	738	511
Other fields	112	447	308	243	175
McPherson:					
Bornholdt-Welsh				61	1,036
Graber-Hesston	442	1,233	1,082	965	947
Ritz Canton	2,346	1,872	1,650	1,753	1,373
Voshell	1,104	931	765	574	562
Other fields	572	415	343	376	400
Reno:					
Burrton	5,248	5,384	3,521	3,187	2,625
Other fields	737	1,428	766	771	634
Rice:					
Silica-Raymond	4,918	7,322	4,570	3,990	5,740
Other fields	6,509	8,165	6,059	6,526	5,817
Russell:					
Trapp-Sellens	747	3,780	3,393	3,803	5,538
Other fields	6,327	7,599	6,053	6,019	6,418
Sedgwick	2,002	1,545	1,418	1,247	1,156
Stafford	746	1,098	1,271	2,368	3,198
Sumner	3,231	2,342	1,698	1,495	1,220
Eastern counties	2,623	2,555	2,515	2,772	3,101
Other counties	1,004	1,692	2,252	2,287	2,572
	57,084	69,158	58,134	59,163	64,945

[1] Oil and Gas Journal.

Because of the tendency of the "shoestring" pools of Kansas to merge it is difficult to maintain comparable figures on production by fields; however, the production and potential figures for 1940 indicate that the enlarged Silica and Trapp fields are the two most important in the State. The old shallow fields in the eastern counties continued a "come-back" originating in the widespread application of water-flooding several years ago.

As usual, new discoveries and extensions in Kansas in 1940 were too numerous to mention separately. Trade-journal figures indicate, however, that the total new reserve added in 1940 was materially below that found in 1939.

Kentucky.—Drilling declined in Kentucky in 1940, and production fell to 5,193,000 barrels—the lowest since 1934. A wildcatting campaign in western Kentucky, which had been inaugurated largely because of developments in Indiana and Illinois, yielded one small field in 1940—Hebbardsville in Henderson County. Drilling in the eastern part of the State was confined largely to gas, with some success.

Production of crude petroleum in Kentucky, 1936–40, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1936	410	391	483	459	457	463	492	485	504	521	475	493	5,633
1937	400	409	494	476	491	498	487	472	448	436	436	437	5,484
1938	411	406	457	432	459	487	506	553	547	526	514	523	5,821
1939	536	380	437	418	494	527	503	539	423	443	472	449	5,621
1940 [1]	383	422	435	446	445	419	454	445	444	464	415	421	5,193

[1] Subject to revision.

Louisiana.—Production in Louisiana in 1940 reached a new record of 103,961,000 barrels—the first time the output has exceeded the 100-million mark. The gain was entirely in the coastal district, as the decline at Rodessa was too great to be overcome by gains in other fields of north and north central Louisiana.

The output of the northern fields in 1940 was 24,406,000 barrels or about a million barrels less than in 1939. The important event of the year in the district in 1940 was the discovery of the Olla field in La Salle Parish. The production, which is from a sand in the Wilcox formation, totaled nearly 1,000,000 barrels in 1940. It opened up a vast area for exploration and greatly enhanced the possibilities of central Louisiana. Deep tests at Cotton Valley and Lisbon were successful, but the others were generally disappointing. There were 448 oil wells completed in 1940 compared with 289 in 1939, but the total initial declined.

As indicated above, the coastal district established a new record for production in 1940. The output of most of the old fields (like Jennings, Iowa, and Caillou Island) declined, but large increases were made at Eola, Golden Meadows, University, and other fields. The most active fields in drilling were Golden Meadows, Ville Platte, and Eola in that order.

The important Wilcox discovery at Eola in 1939 was actively followed up in 1940 but yielded only one small field—Neale in Beauregard Parish. Several domes were proved for production, but most of the new reserves probably came from flank extensions and new sands, as in the Anse La Butte field. Frio production was found by deeper drilling in the Iowa field. Several of the new discoveries were located offshore, and about half a dozen were over 10,000 feet in depth; both factors added materially to drilling costs.

Michigan.—Production in Michigan in 1940 was 19,764,000 barrels—a 16-percent decline from the peak of 1939. This pronounced drop in output was due to a material falling off in drilling and to the fact that no major discoveries were made. There were 536 oil wells brought in (compared with 813 in 1939), but the average initial was only 215 barrels daily against 535 in 1939. The number of dry holes (518) almost equaled the number of oil wells.

The Walker field, Kent County, was the leading producer in 1940, although it experienced a very rapid decline during the year, even speedier than the usual Traverse lime production. On the other hand, the old Porter field, producing from the Dundee sand, showed very little decrease in 1940.

A deep test near Bay City, which reached 7,776 feet at the close of the year, was closely watched. It was by far the deepest test ever drilled in the State. It only made about 50 barrels daily of light oil when tested, but the results were generally encouraging.

Production of crude petroleum in Louisiana, 1936–40, by districts and fields

[Thousands of barrels]

District and field	1936	1937	1938	1939	1940 [1]
Gulf Coast:					
Black Bayou	1,087	1,313	1,285	1,048	1,007
Bosco	4,661	3,020	2,085	1,737	1,718
Caillou Island	5,504	6,402	6,249	4,078	2,493
Cameron Meadows	1,848	1,490	1,279	782	665
Charenton	17	236	1,085	2,425	2,724
Darrow	526	717	1,015	1,022	750
English Bayou	2,511	2,871	2,176	1,613	1,186
Eola	------	------	------	943	3,935
Gibson	------	453	984	1,128	1,335
Garden Island	307	606	828	591	1,106
Golden Meadows	------	------	1	739	4,074
Grand Bay	------	------	50	496	1,168
Grand Lake	------	------	------	130	923
Hackberry	3,125	4,592	3,728	3,216	3,312
Iowa	6,626	6,383	5,641	4,436	3,475
Jeanerette	985	2,277	2,485	1,772	1,203
Jennings	754	2,996	7,537	8,119	5,505
Lafitte	2,709	4,136	5,862	4,745	4,602
Lake Barre	2,532	1,368	657	347	317
Leeville	4,679	2,629	1,867	1,303	1,135
New Iberia	2,191	6,231	5,339	4,204	3,076
North Crowley	------	30	362	827	1,602
Port Barre	797	600	612	681	810
Quarantine Bay	------	1	261	901	1,585
Roanoke	2,282	1,890	1,339	1,076	965
Sulphur	1,793	1,414	1,244	1,381	970
Sweet Lake	350	294	307	385	532
Tepetate	1,456	2,158	1,985	2,033	1,656
University	------	------	170	1,444	3,496
Valentine	------	968	1,691	1,127	877
Ville Platte	------	3	850	3,352	4,493
White Castle	336	490	593	628	806
Other Gulf Coast	6,498	6,473	7,063	9,534	[2] 16,054
Total Gulf Coast	53,574	62,041	66,630	68,243	79,555
Northern:					
Caddo	2,554	2,353	2,659	2,663	2,912
Cotton Valley	207	1,151	3,527	4,384	5,189
Cross Lake	------	------	131	1,840	1,555
Haynesville	1,216	1,143	1,107	1,064	987
Homer	950	932	952	988	1,041
Lisbon	------	2,490	3,368	1,693	1,482
Rodessa	19,220	18,050	13,443	9,042	6,859
Urania	1,060	1,085	1,003	974	869
Zwolle	393	266	752	944	609
Other Northern	1,317	1,413	1,636	1,811	[2] 2,903
Total Northern	26,917	28,883	28,578	25,403	24,406
Total Louisiana	80,491	90,924	95,208	93,646	103,961

[1] Subject to revision.
[2] Includes crude oil consumed on leases and net change in stocks held on leases for entire district.

Production of crude petroleum in Michigan, 1936–40, by fields [1]

[Thousands of barrels]

Year	Blooming-dale	Buck-eye	Clay-ton	Crys-tal	Mount Pleas-ant	Porter	Red-ding	Sher-man	Walk-er	Yost-Jasper	Other fields	Total
1936	------	10	58	2,449	880	4,620	------	32	------	1,625	2,254	11,928
1937	------	6,428	1,030	573	801	2,707	------	1,532	------	1,158	2,399	16,628
1938	514	7,385	1,071	238	583	1,798	874	1,152	1	833	4,296	18,745
1939	3,371	2,502	638	123	474	1,331	3,083	433	2,821	595	8,091	23,462
1940	1,001	1,004	410	83	409	1,234	3,986	461	4,218	510	6,448	19,764

[1] Data from Department of Conservation, Michigan.

Mississippi.—In one year (1940) Mississippi rose to rank as a substantial producer, ahead of such oldtime States as West Virginia, Ohio, and Colorado. The rise was due almost solely to developments in the Tinsley field, which was proved to be of substantial size and importance. However, wildcatting in 1940 was generally disappointing, yielding but one small field—Pickens, in eastern Yazoo County.

Missouri.—Although interest in northwest Missouri continued as the result of developments in the Falls City (Nebr.) pool, no new oil fields were found, and production continued to be limited to the stripper area in and around Cass County. One new gas field was reported discovered in 1940.

Montana.—Production in Montana increased from 5,960,000 barrels in 1939 to 6,768,000 in 1940. Although this gain indicates a material growth in discovery it was due almost solely to drilling inside locations in the Cut Bank and Kevin-Sunburst fields, and no new fields or deeper horizons were found. There were 155 oil wells completed compared with 114 in 1939. The Cut Bank field produced 4,106,000 barrels in 1940, or just over 60 percent of the State total. The Frannie field of Wyoming was extended into Montana as perhaps the most noteworthy new development.

Production of crude petroleum in Montana, 1936–40, by fields

[Thousands of barrels]

Year	Border	Cat Creek	Cut Bank	Dry Creek	Elk Basin	Kevin-Sunburst	Lake Basin	Pondera	Other fields	Total
1936	43	258	3,332	214	12	1,543	(1)	433	33	5,868
1937	41	227	3,332	102	12	1,634	(1)	418	39	5,805
1938	23	211	2,809	365	8	1,290	18	210	12	4,946
1939	(1)	196	3,545	319	14	1,576	18	276	16	5,960
1940 [2]	(1)	182	4,106	175	16	1,945	19	302	[3] 23	6,768

1 Included under "Other districts."
2 Subject to revision.
3 Includes crude oil consumed on leases and net change in stocks held on leases for entire State.

Nebraska.—The Falls City pool, discovered late in 1939, was proved as a field of some importance and in 1940 yielded 254,000 barrels compared with only 2,000 in 1939. There were 32 oil wells completed in the field in 1940; at the close of the year these were producing about 3,000 barrels daily, all from the Hunton lime.

The success at Falls City (the first discovery of the State) enhanced interest in Nebraska as oil territory, and wildcatting became fairly widespread; however, no further discoveries of importance were made.

New Mexico.—Production in New Mexico in 1940 rose to 39,001,000 barrels, which is slightly higher than the previous record (that of 1937). The number of oil wells completed and the total initial declined, but the output continued to be limited by proration in the southeastern fields. Production in the northwest corner of the State continued to fall parallel with the decline at Rattlesnake, the principal field. Monument and Eunice remained the leading producing fields, but Loco Hills and Vacuum made greater progress in relative importance. There were several new discoveries, of which Dayton, in Eddy County, and extensions at High Lonesome and Maljamar appeared most important.

Production of crude petroleum in New Mexico, 1936–40, by districts and fields [1]

[Thousands of barrels]

Year	Northwest			Southeast						Total
	Hogback	Rattlesnake	Other Northwest	Artesia [2]	Eunice	Hobbs	Monument	Vacuum	Other Southeast	
1936	84	260	34	1,079	8,140	9,043	3,576	--------	4,431	26,647
1937	70	283	31	1,986	11,043	7,310	10,968	7	6,740	38,438
1938	70	245	29	2,188	8,966	5,040	9,451	886	9,134	36,009
1939	69	204	30	1,981	7,863	4,401	8,206	3,028	11,886	37,668
1940	74	143	37	2,686	6,561	3,785	6,887	4,738	13,846	38,757

[1] Oil and Gas Journal.
[2] Includes Grayburg, Jackson, and Maljamar.

New York.—The price of crude did not hold all the gains of 1939, and after an auspicious start in 1940 production declined so that the total fell to 4,999,000 barrels from 5,098,000 in 1939. New discoveries were limited to gas, for which there is brisk demand.

Production of crude petroleum in New York, 1936–40, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1936	364	340	376	379	386	380	391	392	396	419	394	446	4,663
1937	440	408	467	455	461	481	484	469	453	444	453	463	5,478
1938	444	409	455	429	447	418	404	429	406	404	391	409	5,045
1939	402	363	418	406	439	435	416	441	434	448	453	443	5,098
1940 [1]	458	430	438	444	439	402	425	396	383	408	379	397	4,999

[1] Subject to revision.

Ohio.—Drilling again increased in Ohio, and the decline in production, starting in 1928, was arrested; the output in 1940 was 3,169,000 barrels compared with 3,156,000 in 1939. More than the usual amount of wildcatting was carried on; but the results, particularly in the deeper zones, were disappointing. The Clayton pool in Perry County was the outstanding Clinton-sand development.

Production of crude petroleum in Ohio, 1936–40, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1936	279	246	359	349	341	347	338	325	326	329	285	323	3,847
1937	255	282	316	304	308	317	314	312	332	262	272	285	3,559
1938	248	258	301	274	281	286	266	301	277	278	257	271	3,298
1939	252	236	274	255	288	272	269	266	247	276	260	261	3,156
1940 [1]	207	234	246	274	280	260	286	287	272	296	248	279	3,169

[1] Subject to revision.

Oklahoma.—Although drilling and new discoveries increased in Oklahoma in 1940, the decline in production that began in 1938 was continued, and the output was 155,952,000 barrels compared with 159,913,000 in 1939. Except for the depression year 1932, the 1940 total was the lowest since 1922.

Drilling in 1940 resulted in more completions than in 1939, but there were fewer oil wells and more gas wells and dry holes. The total initial of the oil wells in 1940 (204,000 barrels daily) was virtually the same as in 1939.

The Oklahoma City pool was far ahead as the leading field in 1940, and its performance in showing a slight increase in output (from 35,728,000 barrels in 1939 to 35,970,000 in 1940) was notable. The Seminole district failed to maintain the come-back of 1939, and production dropped to the lowest since 1926, when the first well came in.

Production of crude petroleum in Oklahoma, 1936–40, by fields [1]

[Thousands of barrels]

Field	1936	1937	1938	1939	1940
Allen	3, 076	2, 511	2, 475	2, 289	2, 066
Beebe	1, 040	928	1, 017	1, 005	1, 828
Billings	204	2, 349	2, 108	2, 178	2, 209
Bristow	3, 186	2, 790	2, 389	2, 403	2, 213
Burbank	2, 827	2, 871	2, 814	2, 689	2, 838
Cement	634	782	1, 336	1, 826	2, 469
Crescent	2, 301	3, 851	1, 687	983	769
Cromwell	1, 337	1, 265	1, 288	1, 175	1, 357
Cushing-Shamrock	4, 129	3, 908	3, 848	3, 446	3, 353
Edmond	4, 370	5, 884	2, 030	1, 675	1, 488
Fish	3, 114	2, 077	1, 224	1, 376	1, 153
Fitts	19, 908	30, 977	16, 655	9, 120	6, 246
Healdton	3, 436	3, 654	3, 401	3, 236	3, 177
Keokuk	2, 113	2, 979	1, 713	1, 176	1, 091
Lucien	4, 542	5, 047	3, 524	3, 017	2, 750
Nowata County	3, 179	3, 450	4, 390	4, 348	4, 306
Oklahoma City	51, 232	54, 776	38, 796	35, 728	35, 970
Olympic	2, 711	4, 315	1, 889	1, 034	739
Osage (outside Burbank-South Burbank)	8, 293	7, 626	6, 438	6, 063	5, 904
Ramsey			528	1, 489	1, 377
Seminole field:					
Bowlegs	4, 335	4, 178	3, 200	2, 678	2, 464
Carr City	2, 216	1, 973	1, 294	922	840
Earlsboro	6, 601	5, 596	3, 751	3, 590	3, 730
Little River	5, 068	4, 222	3, 040	2, 865	2, 875
St. Louis-Pearson	8, 543	7, 528	7, 766	11, 303	9, 331
Seminole City	3, 810	3, 428	2, 842	2, 618	2, 501
Other Seminole districts	4, 150	3, 779	6, 180	6, 724	5, 248
Total Seminole field	34, 723	30, 704	28, 073	30, 700	26, 989
Sholem-Alechem-Tatums	2, 561	3. 129	1, 691	1, 553	1, 668
South Burbank	5, 390	5, 579	3, 938	3, 150	2, 927
Other fields	36, 575	41, 655	36, 055	31, 755	34, 710
Total Oklahoma	200, 881	223, 107	169, 307	153, 414	149, 597

[1] Oil and Gas Journal.

Wildcatting was more successful in 1940 than in 1939. Most of the new finds were small; but one major field—Cumberland on the border of Marshall and Bryan Counties—was found. The principal zone at Cumberland is the Tulip Creek sand at about 5,000 feet. Other discoveries included extensions at Dill, Hewitt, and Cromwell and the Hunton-lime development in the Coyle and Ramsey fields. Okfuskee County led in new discoveries exclusive of Cumberland. The deepest wildcat ever drilled east of California—Continental's 1 Proctor in Washita County—was abandoned as a dry hole at 14,582 feet.

Pennsylvania.—In spite of higher average prices for crude oil, production in Pennsylvania declined slightly—from 17,382,000 barrels in 1939 to 17,353,000 in 1940. Of the 1940 total the Bradford field supplied 14,340,000 barrels (83 percent). Routine drilling continued, but discoveries were negligible.

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Production of crude petroleum in Pennsylvania, 1936–40, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1936	1,323	1,220	1,382	1,387	1,409	1,447	1,474	1,455	1,479	1,547	1,414	1,533	17,070
1937	1,497	1,390	1,584	1,554	1,581	1,613	1,689	1,703	1,678	1,652	1,608	1,640	19,189
1938	1,566	1,466	1,653	1,497	1,517	1,432	1,385	1,460	1,377	1,383	1,318	1,372	17,426
1939	1,346	1,255	1,437	1,411	1,558	1,437	1,405	1,479	1,414	1,570	1,532	1,538	17,382
1940 [1]	1,522	1,505	1,530	1,582	1,585	1,335	1,418	1,387	1,321	1,405	1,319	1,444	17,353

[1] Subject to revision.

Tennessee.—Tennessee passed another quiet year, and the production, largely estimated, was only 50,000 barrels.

Texas.—Both the East Texas field proper and the Coastal district—the leading producing areas in Texas—declined in output in 1940; but this was more than made up in the rest of the State, and the total production rose to a new peak of 493,126,000 barrels compared with 483,528,000 in 1939. However, if the shut-down of August 1939 had not occurred there would probably have been a decrease in 1940.

Production in the South Texas district, which on January 1, 1941, was enlarged by the transfer of Kleberg, Kenedy, Willacy, and Cameron Counties from the Coastal district, increased from 29,392,000 barrels in 1939 to 32,320,000 in 1940. The most important source of new production was the Rincon field in Starr County. A number of new discoveries were made, including the Willamar field in Willacy County.

Nothing of importance occurred in the Central Texas district, which includes chiefly the Balcones fault-line pools, and production declined from 11,669,000 barrels in 1939 to 10,363,000 in 1940.

The come-back of the North Texas district was continued in 1940, when production was 48,148,000 barrels compared with 40,371,000 in 1939. Drilling, both routine and exploratory, increased. A number of discoveries were made, a large part of them in the so-called Fort Worth basin. Among these were the Bonita and Ringgold fields of Montague County. The Fargo field, farther west in Wilbarger County, was also considered an important discovery. The discovery of the Hults-Owen field in Montague County at just over 6,000 feet set a deep production record for the district. Deeper pays were found in the K-M-A and Hull-Silk pools. Wildcatting in the southern tier of Counties was confined largely to the search for new Palo Pinto lime pools, but the results were generally disappointing.

Production in the other fields of the East Texas district dropped from 31,340,000 barrels in 1939 to 27,837,000 in 1940. This loss was due mainly to the decrease at Rodessa; the only important gain was made at Cayuga.

Although output declined in the East Texas district in 1940 interest was high because of the deep discoveries at Chapel Hill and the finding of the important Hawkins field in Wood County in December. The Hawkins field touched off a lively drilling campaign in an area that had been disappointing since the East Texas field proper was discovered.

Production in the East Texas field proper under the rigid curtailment program totaled 141,023,000 barrels in 1940 compared with 144,615,000 in 1939. The field, which was 10 years old in October 1940, had produced about 1,571,000,000 barrels up to January 1, 1941.

Production of crude petroleum in Texas, 1936–40, by districts and fields

[Thousands of barrels]

District and field	1936	1937	1938	1939	1940[1]
Gulf Coast:					
Anahuac	2,606	4,318	2,887	2,604	2,683
Barbers Hill	5,461	4,366	3,413	3,165	3,180
Conroe	15,229	15,191	11,606	9,320	9,303
Dickinson	719	1,432	2,227	2,946	2,404
Fairbanks			839	2,668	2,460
Flour Bluff	93	1,607	1,736	1,362	1,151
Friendswood		88	1,078	2,323	2,542
Goose Creek	1,038	860	596	619	571
Greta	5,481	6,635	4,190	1,993	1,493
Hardin	135	241	1,621	2,180	1,646
Hastings	2,408	5,835	6,940	6,354	5,421
Heyser	120	1,515	3,051	3,470	3,399
High Island	2,069	1,183	900	866	966
Hull	1,950	2,492	2,899	2,077	2,005
Humble	1,163	1,217	1,202	1,041	957
Lovell's Lake			51	245	882
Luby		80	1,578	2,472	1,459
Manvel	3,014	3,458	3,222	2,718	2,627
Old Ocean	159	447	1,782	3,209	4,165
Orange	250	248	483	887	889
Pierce Junction	1,298	1,243	1,117	897	628
Placedo	1,393	3,082	3,088	2,298	1,882
Plymouth	3,400	5,056	4,467	3,706	2,145
Raccoon Bend	1,922	2,002	1,206	1,034	1,232
Refugio	3,228	2,307	2,093	2,097	2,111
Saxet-Saxet Heights	7,245	15,763	13,130	8,953	5,634
Segno		472	708	958	1,606
Spindletop	858	912	837	782	609
Sugarland	1,715	1,322	1,222	1,242	1,354
Thompsons	3,523	4,147	3,998	4,617	4,384
Tomball	2,611	3,060	2,635	2,630	2,675
West Beaumont	(2)	(2)	571	1,033	1,149
West Columbia	773	825	1,600	2,261	2,353
West Ranch			19	280	2,077
White Point	3	20	387	2,089	3,054
Withers	229	570	925	1,330	1,712
Other Gulf Coast	16,895	22,708	25,283	33,797	[3] 37,449
Total Gulf Coast	86,988	114,702	115,587	122,523	122,257
East Texas:					
East Texas proper [4]	167,512	170,673	152,116	144,615	141,023
Cayuga	2,137	3,195	3,191	3,472	4,432
Long Lake	374	549	721	867	828
Rodessa	3,144	12,626	11,373	9,785	6,607
Sulphur Bluff		1,627	1,653	1,536	1,522
Talco	1,344	9,720	9,593	9,609	8,818
Van	12,508	11,346	5,630	5,333	4,512
Other East Texas	726	589	611	738	1,118
Total East Texas	187,745	210,325	184,888	175,955	168,860
Central Texas:					
Darst Creek	3,201	2,802	2,816	2,707	2,178
Luling	2,154	2,260	2,497	2,443	2,256
Lytton Springs	328	120	1,057	867	649
Mexia [5]	1,847	1,678	1,635	1,494	1,418
Pettus	3,465	3,135	2,088	1,515	1,276
Salt Flat (Bruner)	1,448	1,586	1,419	1,594	1,512
Other Central Texas	1,431	1,990	1,175	1,049	1,074
Total Central Texas	13,874	13,571	12,687	11,669	10,363
North Texas [6]	33,041	37,580	36,823	40,371	[7] 48,148
Panhandle [8]	22,357	27,617	23,556	24,165	26,700
South Texas [9]	21,367	30,780	29,597	29,392	32,320

[1] Subject to revision.
[2] Included under "Other Gulf Coast."
[3] Includes crude oil consumed on leases and net change in stocks held on leases for entire district.
[4] Joiner, Kilgore, Lathrop and other pools in Cherokee, Gregg, Rusk, Smith, and Upshur Counties.
[5] Includes other fields in Falls, Freestone, Limestone, and Navarro Counties.
[6] Includes the fields in and between Wilbarger, Wichita, Clay, Montague, and Cooke Counties on the north and Runnels, Coleman, Brown, and Comanche Counties on the south.
[7] Includes crude oil consumed on leases and net change in stocks held on leases for East Texas, exclusive of East Texas proper, Central, North, and South Texas.
[8] Carson, Gray, Hutchinson, Moore, Potter, and Wheeler Counties.
[9] Includes fields in Duval, Hidalgo, Jim Hogg, Jim Wells, Starr, Webb, and Zapata Counties.

Production of crude petroleum in Texas, 1936–40, by districts and fields—Continued

District and field	1936	1937	1938	1939	1940 [1]
West Texas:					
Andrews County	857	1,318	1,309	1,587	1,506
Big Lake	2,859	2,648	2,381	2,275	2,075
Chalk-Roberts [10]	9,345	8,663	8,030	8,128	7,899
Crane-Upton Counties	7,843	10,078	9,938	9,582	10,389
Ector County	5,759	10,121	14,817	18,618	20,142
Fisher	1,640	1,164	1,208	1,059	835
Gaines-Yoakum Counties	10	272	3,097	6,131	12,045
Hendricks	9,801	15,411	13,361	12,056	10,324
Pecos County	13,849	12,357	8,590	10,661	9,593
Ward County	8,992	12,561	8,878	7,795	7,580
Other West Texas	1,084	1,150	1,103	1,561	2,090
Total West Texas	62,039	75,743	72,712	79,453	84,478
Total Texas	427,411	510,318	475,850	483,528	493,126

[10] Includes Westbrook and other fields in Glasscock, Howard, and Mitchell Counties.

Drilling continued routine, with oil-well completions averaging less than one a day. The field had about 25,800 producing wells on December 31, 1940, a slight decrease for the year. The average bottom-hole pressure was 1,061.35 pounds on January 8, 1940, and 1,051.73 on January 8, 1941; this was by far the smallest annual decline ever recorded.

The Panhandle passed a rather quiet year in 1940. Drilling increased, and with higher allowables the yield was 26,700,000 barrels compared with 24,165,000 in 1939. New discoveries were few, but several important extensions were made.

Although drilling in the West Texas district during 1940 was about on a par with that in 1939, production and new discoveries increased. The output was a new record of 84,478,000 barrels compared with 79,453,000 in 1939.

Because the fields in this district tend to merge it is difficult to segregate production figures by individual pools. Gaines and Yoakum Counties were largely responsible for the gain in output in 1940, with the large Wasson pool the major factor.

The discoveries in West Texas in 1940 were important both from the standpoint of reserves and geologically. Deep production, or production below the prevailing Permian pays, was found in the Pennsylvanian, Silurian, and Ordovician. The Silurian strike, reportedly the first in Texas, opened up many possibilities for deeper production in many old fields.

In 1940, for the first time in a number of years, production in the coastal district declined, dropping to 122,257,000 barrels compared with 122,523,000 in 1939.

Drilling decreased for the second successive year; 1,072 oil wells of 276 barrels average initial were completed compared with 1,663 wells of 256 barrels initial in 1939.

The output for most of the fields in the Gulf Coast district was less in 1940 than in 1939, but some (like Old Ocean, West Ranch, and White Point) made material gains. The number of producing fields in this district has been increasing at the rate of a dozen or more for some years; hence, total yield can be maintained, even though that in most of the larger fields declines. Conroe continued to be the leading field, its output of 9,303,000 barrels in 1940 being only slightly below that of 1939.

Exploration revealed about 15 new fields in 1940, but less than half a dozen appeared important. Wildcatting on the Frio trend in Jackson County uncovered the Lolita, Texana, and Ganado fields, all of which looked promising. The Wilcox trend recovered from a number of disappointments and was extended westward by discovery of the Sheridan field in Colorado County. Offshore drilling, particularly in Galveston Bay, was continued with moderate success.

Utah.—Drilling in Utah in 1940 was confined to gas, and crude-oil production was only 3,000 barrels for the year.

West Virginia.—Production continued to decline in West Virginia during 1940, as the price improvement did not induce operators to clean out the wells. The total output in 1940 was 3,444,000 barrels compared with 3,580,000 in 1939. Virtually all the exploratory work was confined to gas, and the new reserves found were negligible.

Production of crude petroleum in West Virginia, 1936–40, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1936	296	296	320	336	323	333	337	313	328	336	289	340	3,847
1937	289	292	340	330	325	333	329	323	327	324	307	326	3,845
1938	290	294	337	317	322	326	304	325	315	320	257	277	3,684
1939	279	282	312	288	320	309	288	310	290	309	282	311	3,580
1940 [1]	234	301	285	300	311	276	303	291	286	312	264	281	3,444

[1] Subject to revision.

Wyoming.—Production in Wyoming again increased in 1940, with Lance Creek once more largely responsible for the gain. Production at Lance Creek in 1940 was 9,066,000 barrels (nearly 2,200,000 barrels above 1939) whereas the State output rose to 25,683,000 barrels (about 4,200,000 barrels above the total in 1939). The remainder of the gain came mainly from Oregon Basin and other heavy-oil fields.

Production of crude petroleum in Wyoming, 1936–40, by fields

[Thousands of barrels]

Year	Big Muddy	Byron-Garland	Elk Basin	Frannie	Grass Creek	Hamilton Dome-Warm Springs	La Barge	Lance Creek	Lander-Dallas-Derby Dome	Lost Soldier-Ferris
1936	522	318	159	310	559	426	471	1,892	330	471
1937	484	1,248	104	358	654	437	423	4,247	329	511
1938	441	836	94	419	513	346	395	4,846	306	1,037
1939	435	867	203	496	844	240	379	6,884	278	1,592
1940 [1]	429	1,411	190	812	718	353	585	9,066	290	2,070

Year	Medicine Bow	Oregon Basin	Osage	Poison Spider-South Casper	Quealy	Rock Creek	Salt Creek	Other fields	Total
1936	167	1,733	143	206	----------	622	6,070	183	14,582
1937	1,344	1,407	261	230	268	748	5,874	239	19,166
1938	1,040	1,648	116	196	271	640	5,705	173	19,022
1939	544	1,848	132	26	225	1,008	5,331	122	21,454
1940 [1]	251	2,725	59	238	172	928	5,211	[2] 175	25,683

[1] Subject to revision.
[2] Includes crude oil consumed on leases and net change in stocks held on leases for entire State.

Drilling, both routine and exploratory, increased in Wyoming in 1940. The most important new discovery was the Shannon (sand) output in the Cole Creek field. Deeper pays and extensions were found in a number of fields; the La Barge field led in these developments.

WELLS

Drilling increased in the spring of 1940, but beginning in June the rate was retarded by a number of factors such as accumulations of crude-oil stocks and the adoption of more conservative development policies in Illinois. The number of oil wells brought in during December 1940 (1,178) was the lowest since February 1936; however, the total for the year—19,125—was 9 percent above 1939 (fig. 4).

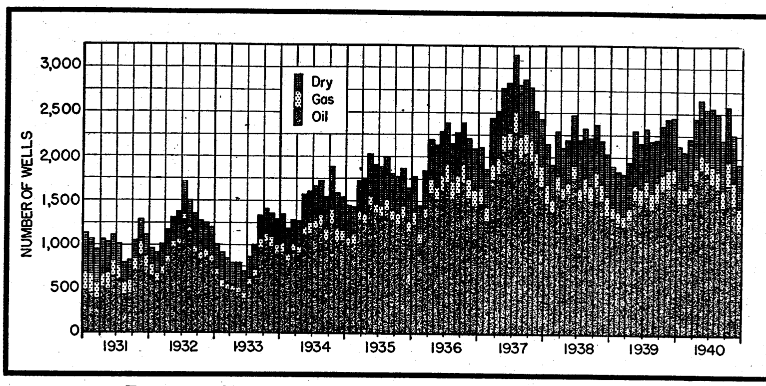

FIGURE 4.—Wells drilled in the United States, 1931–40, by months.

The percentage of dry holes declined from 24.6 percent in 1939 to 23.5 percent in 1940, probably because the percentage in Illinois (an active area in 1940) was considerably below the average.

There were 380,390 producing oil wells on December 31, 1939, 10,750 more than at the first of the year. These data indicate 6,735 abandonments in 1939, or considerably less than in 1938. The average production per well per day increased from 9.1 barrels in 1938 to 9.2 in 1939.

Wells drilled for oil and gas in the United States, 1939–40, by months [1]

Wells	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
													Number	Percent
1939														
Oil	1, 311	1, 263	1, 204	1, 302	1, 520	1, 467	1, 550	1, 411	1, 498	1, 610	1, 641	1, 708	17, 485	67. 5
Gas	135	133	137	133	168	180	183	183	219	195	215	165	[2] 2,046	7. 9
Dry	447	444	473	505	614	505	595	592	481	551	583	567	6, 357	24. 6
	1, 893	1, 840	1, 814	1, 940	2, 302	2, 152	2, 328	2, 186	2, 198	2, 356	2, 439	2, 440	25, 888	100. 0
1940														
Oil	1, 489	1, 489	1, 566	1, 749	1, 872	1, 817	1, 709	1, 654	1, 453	1, 689	1, 460	1, 178	19, 125	68. 1
Gas	166	149	145	145	166	162	203	210	196	265	268	277	[2] 2,352	8. 4
Dry	482	417	508	547	612	574	646	636	552	618	533	492	6, 617	23. 5
	2, 137	2, 055	2, 219	2, 441	2, 650	2, 553	2, 558	2, 500	2, 201	2, 572	2, 261	1, 947	28, 094	100. 0

[1] Oil and Gas Journal east of California; American Petroleum Institute in California.
[2] Total by months does not agree with total by States published elsewhere, as latter has been revised on basis of annual data from State officials.

Wells drilled in the United States and estimated average daily initial oil production per well, 1939–40, by States and districts [1]

State and district	1939					1940				
	Oil		Gas	Dry	Total	Oil		Gas	Dry	Total
	Number	Average initial (barrels)				Number	Average initial (barrels)			
Arkansas	183	483	6	65	254	114	881	13	60	187
California [2]	852	909	15	251	1,118	859	891	15	156	1,030
Colorado	7	128	1	17	25	10	130	1	8	19
Illinois	2,943	285	18	621	3,582	3,049	620	15	750	3,814
Indiana	176	156	44	156	376	231	139	77	220	528
Kansas	977	432	150	309	1,436	1,410	460	130	342	1,882
Kentucky	275	54	110	312	697	224	61	128	231	583
Louisiana:										
Gulf Coast	582	317	11	242	835	741	307	17	236	994
Northern	289	236	87	161	537	448	114	82	143	673
Total, Louisiana	871	290	98	403	1,372	1,189	234	99	379	1,667
Michigan	813	534	52	527	1,392	536	215	59	518	1,113
Mississippi	9	622	1	22	32	107	554	1	102	210
Montana	114	85	26	37	177	155	113	49	38	242
New Mexico	525	385	18	63	606	479	345	19	113	611
Ohio	216	16	497	319	1,032	659	12	491	489	1,639
Oklahoma	1,045	197	151	603	1,799	1,011	204	176	657	1,844
Pennsylvania and New York	1,586	25	200	148	1,934	2,184	3	293	137	2,614
Texas:										
Gulf Coast	1,663	256	105	300	2,068	1,072	276	37	258	1,367
East Texas proper	365	1,167	-------	20	385	291	1,035	5	14	310
West Texas	1,703	860	4	163	1,870	1,717	891	11	121	1,849
Rest of State	2,952	348	205	1,845	5,002	3,552	308	236	1,780	5,568
Total, Texas	6,683	500	314	2,328	9,325	6,632	486	289	2,173	9,094
West Virginia	110	18	419	90	619	120	8	487	118	725
Wyoming	99	874	10	41	150	124	727	8	47	179
Other States	1	132	15	45	61	32	396	32	79	143
Total, United States	17,485	386	[3] 2,145	6,357	25,987	19,125	396	[3] 2,382	6,617	28,124

[1] Oil and Gas Journal, except California.
[2] American Petroleum Institute.
[3] Total by States does not agree with total by months published elsewhere in the Yearbook, as former has been revised upon basis of annual data from State officials.

Producing oil wells in the United States and average production per day in 1939, by States and districts [1]

State and district	Producing oil wells		State and district	Producing oil wells	
	Approximate number, Dec. 31	Average production per well per day (barrels)		Approximate number, Dec. 31	Average production per well per day (barrels)
Arkansas	2,980	20.1	Ohio	26,400	0.3
California [2]	14,670	43.0	Oklahoma	54,500	8.0
Colorado	200	19.2	Pennsylvania	81,970	.6
Illinois	17,980	15.4	Texas:		
Indiana	1,380	3.6	Gulf Coast	10,700	33.2
Kansas	21,400	7.9	East Texas proper	26,000	15.3
Kentucky	14,100	1.1	West Texas	10,800	21.7
Louisiana:			Rest of State	42,600	9.0
Gulf Coast	1,920	112.6	Total, Texas	90,100	15.1
Northern	3,380	20.2	West Virginia	18,400	.5
Total, Louisiana	5,300	50.3	Wyoming	3,400	17.5
Michigan	2,680	26.7	Other States [3]	140	4.0
Montana	1,720	9.8			
New Mexico	2,920	38.8			
New York	20,150	.7	Total wells	380,390	9.2

[1] Figures for 1940 not yet available.
[2] American Petroleum Institute.
[3] Mississippi, Missouri, Tennessee, and Utah.

STOCKS

Crude-oil stocks increased about 24 million barrels in 1940. The major increase occurred in the first 5 months of the year, in a period of abnormal winter demand for heating oils and before spread of the war in Europe had cut off the exports of oil to France and Italy. Stocks of refinable grades increased by over 25 million barrels, or from 238,910,000 barrels on January 1 to 264,079,000 on December 31, while stocks of California heavy crude declined from 13,330,000 barrels to 11,906,000. Refinable grades of pipe-line and tank-farm stocks increased over 22 million barrels, stocks at refineries gained about 3 million, and producers' stocks showed a small decline.

Stocks of crude petroleum, natural gasoline, and refined products in the United States at end of year, 1936–40

[Thousands of barrels]

Product	1936	1937	1938	1939	1940 [1]
Crude petroleum (refinable):					
At refineries	46,846	51,041	51,551	49,215	52,448
Pipe line and tank farm	230,499	244,545 [2] 243,552	211,931 [2] 211,138	178,810	200,726
Producers	11,234	11,240	11,476	11,953	10,905
Total refinable	288,579	306,826 [2] 305,833	274,958 [2] 274,165	239,978 [2] 238,910	264,079
California heavy crude [3]	(3)	14,505	16,467	13,330	11,906
Total crude petroleum	288,579	306,826 [2] 320,338	291,425 [2] 290,632	253,308 [2] 252,240	275,985
Natural gasoline	4,055	4,758	4,830	4,421	5,704
Refined products [4]	226,595	253,413 [2] 239,901	259,665 [2] 272,241	268,109	282,265
Grand total	519,229	564,997	555,920 [2] 567,703	525,838 [2] 524,770	563,954

[1] Subject to revision.
[2] For comparison with succeeding year.
[3] California heavy crude included under refined products as residual fuel oil to end of 1937.
[4] Includes also equivalents for wax, coke, and asphalt in barrels.

The data on stocks of crude oil by States of origin for 1940 show that the largest increases were 12.5 million barrels for Texas, 3.4 million for Illinois, 3.4 million for Louisiana and Mississippi, 3.1 million for Oklahoma, 1.8 million for Kansas and Nebraska, 1.7 million for New Mexico, and 0.8 million for Arkansas. An increase of 0.4 million barrels in California refinable crude stocks was more than offset by a decrease of 1.4 million in stocks of heavy crude. The continued liquidation of old stocks of Wyoming origin resulted in a decrease of 1.8 million barrels during the year. Stocks of Michigan origin declined about 0.5 million barrels, while stocks of Pennsylvania Grade declined by about 0.3 million barrels.

Total stocks of all crude oils were 290 million barrels at the end of 1938, fell to 252 million at the end of 1939, and rose to 276 million at the end of 1940. In view of increasing demand, and measured in terms of days' supply, the stocks at the end of 1940 probably were close to the reasonably economic level required by industry operations.

Stocks of refinable crude petroleum [1] *in the United States in 1940 by States of location and origin and by months* [2]

[Thousands of barrels]

State	Jan. 1	Jan. 31	Feb. 29	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
LOCATION													
Arkansas	1,907	2,049	1,934	1,969	2,035	2,080	1,907	1,812	1,879	2,048	2,007	2,172	2,197
California [3]	35,298	35,443	35,990	35,813	35,840	35,700	35,173	36,104	36,360	35,338	35,385	34,916	35,695
Illinois [4]	12,983	13,473	13,630	13,699	14,032	14,187	13,568	14,067	14,292	13,869	13,716	14,175	13,944
Indiana	3,698	3,795	3,664	4,142	4,145	4,088	3,678	3,658	3,703	3,453	3,222	3,491	3,393
Kansas [5]	9,091	9,132	9,482	10,051	9,837	9,766	9,852	10,011	10,019	10,158	10,247	10,002	10,166
Louisiana, Alabama, and Mississippi	9,295	9,353	9,604	9,790	11,130	11,467	11,137	11,261	12,057	12,572	12,649	11,850	11,497
Maryland [6]	2,683	2,533	2,477	2,290	2,548	2,793	2,827	2,954	3,045	2,796	2,866	2,757	2,474
Michigan and Kentucky	2,861	2,815	2,722	2,722	2,690	2,955	2,921	3,105	3,087	2,994	2,956	2,908	2,873
Missouri [7]	3,941	3,640	3,803	3,701	3,928	3,779	3,654	3,746	3,676	3,742	3,710	3,610	3,831
Montana and Colorado	1,868	1,800	1,865	1,849	1,931	1,842	1,983	1,906	1,764	1,584	1,743	1,657	1,688
New Jersey	5,208	5,197	4,819	5,132	5,676	6,784	8,349	8,661	8,113	7,339	6,779	6,602	6,735
New Mexico	1,453	1,248	1,257	1,222	1,210	1,127	1,248	1,252	1,113	1,166	1,200	1,117	1,229
New York	1,106	1,036	1,013	1,025	1,030	1,258	1,254	1,290	1,258	1,114	1,001	1,221	1,111
Ohio	8,292	8,581	9,060	9,461	9,739	9,986	10,015	9,943	9,721	9,871	9,711	9,694	9,518
Oklahoma	44,436	45,659	46,825	48,186	49,648	50,050	50,473	49,876	48,709	48,268	47,928	47,799	48,838
Pennsylvania	6,580	6,384	6,661	6,412	6,535	7,463	7,922	7,654	7,101	6,582	6,338	6,386	6,586
Texas	70,683	70,012	72,454	76,808	79,763	80,467	80,043	80,087	82,229	84,192	86,557	87,122	86,689
West Virginia	2,053	1,964	1,980	1,885	1,926	2,020	2,050	1,974	1,998	1,969	1,974	1,944	1,927
Wyoming [8]	15,474	15,680	15,177	14,963	14,423	14,027	13,917	14,137	14,128	14,069	13,867	13,740	13,688
Total United States	238,910	239,794	244,417	251,120	258,066	261,839	261,971	263,498	264,252	263,124	263,856	263,163	264,079
ORIGIN													
Arkansas	2,846	2,873	3,097	2,944	3,325	3,475	3,404	3,301	3,150	3,494	3,652	3,802	3,629
California	35,478	35,555	36,092	35,924	35,990	35,777	35,362	36,182	36,493	35,460	35,422	35,043	35,852
Illinois and Indiana	16,932	17,270	18,098	19,390	20,391	21,075	21,666	21,499	20,861	19,865	19,672	20,247	20,790
Kansas and Nebraska	6,831	7,567	7,817	8,451	8,120	8,003	7,780	7,929	7,905	8,094	8,344	8,123	8,654
Louisiana and Mississippi	10,826	11,099	11,494	11,181	11,311	12,313	12,505	12,594	13,972	14,336	14,276	14,022	14,235
Michigan and Kentucky	2,501	2,385	2,450	2,417	2,222	2,359	2,284	2,383	2,378	2,285	2,299	2,178	2,115
Montana and Colorado	1,721	1,674	1,756	1,653	1,703	1,653	1,752	1,695	1,543	1,332	1,440	1,342	1,385
New Mexico	5,841	6,210	6,601	6,552	7,055	7,019	7,053	6,954	6,976	7,179	7,747	7,586	7,570
Ohio	670	605	551	584	685	701	680	735	732	753	779	665	665
Oklahoma	60,493	60,367	61,510	62,173	63,749	63,996	64,995	65,907	65,744	65,164	63,868	63,674	63,574
Pennsylvania, New York, and West Virginia	4,430	4,344	4,280	4,161	4,296	4,395	4,308	4,472	4,484	4,438	4,399	4,201	4,157
Texas	71,453	71,862	73,058	77,686	81,753	83,256	82,805	81,929	82,350	83,055	85,304	85,370	83,908
Wyoming	16,073	16,132	15,685	15,589	15,042	14,711	14,325	14,481	14,462	14,457	14,348	14,160	14,314
Foreign	2,815	1,851	1,928	2,415	2,424	3,106	3,052	3,437	3,202	3,212	2,306	2,750	3,231
Total United States	238,910	239,794	244,417	251,120	258,066	261,839	261,971	263,498	264,252	263,124	263,856	263,163	264,079

[1] Excludes stocks of California heavy crude. [2] Subject to revision. [3] Includes Washington. [4] Includes Minnesota and Wisconsin. [5] Includes Nebraska lease. [6] Includes Georgia, Massachusetts, Rhode Island, South Carolina, and Virginia. [7] Includes Iowa. [8] Includes Idaho, South Dakota, Utah, and Nebraska refinery and pipe line.

Stocks of refinable crude petroleum [1] in the United States in 1940 by districts and months [2]

[Thousands of barrels]

District	Jan. 1	Jan. 31	Feb. 29	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
At refineries, by fields of origin:													
Appalachian:													
Pennsylvania Grade	448	492	489	438	495	489	421	485	440	458	493	504	514
Other Appalachian (including Kentucky)	498	360	392	332	378	397	383	374	428	352	399	425	342
Lima-Northeastern Indiana-Michigan	640	620	642	639	409	451	457	491	518	525	562	493	418
Illinois-Southwestern Indiana	2,436	2,211	2,581	3,022	2,774	3,205	3,477	3,618	3,505	3,210	3,074	2,933	3,397
North Louisiana, Arkansas, and Mississippi	2,039	1,784	2,147	2,503	2,557	2,997	3,488	3,798	3,630	3,302	3,500	3,665	3,588
West Texas and Southeastern New Mexico	4,590	5,245	4,687	4,800	5,450	6,130	7,459	7,109	6,786	6,367	6,005	5,746	4,976
East Texas	3,834	3,888	3,410	3,228	4,212	4,491	4,129	4,495	4,397	3,558	3,961	4,028	3,476
Oklahoma, Kansas, North Texas, etc.	11,302	11,600	12,709	12,326	12,377	11,527	12,229	11,975	13,096	11,934	12,358	12,177	11,364
Gulf Coast	9,287	9,159	9,231	9,177	9,242	10,519	10,452	10,178	10,011	9,879	10,062	10,180	10,309
Rocky Mountain	2,144	1,952	1,996	1,991	1,801	1,871	1,978	1,999	1,924	1,981	2,054	1,972	2,152
California	9,182	9,627	9,333	9,323	9,367	8,877	8,979	8,838	8,938	8,785	7,952	8,089	8,681
Foreign	2,815	1,851	1,928	2,415	2,424	3,106	3,052	3,437	3,202	3,212	2,306	2,750	3,231
Total at refineries	49,215	48,789	49,545	50,194	51,486	54,060	56,504	56,797	56,875	53,563	52,726	52,962	52,448
Pipe-line and tank-farm stocks, by fields of origin:													
Appalachian:													
Pennsylvania Grade	3,871	3,687	3,610	3,572	3,658	3,754	3,739	3,827	3,914	3,851	3,796	3,560	3,520
Other Appalachian (including Kentucky)	812	784	794	741	808	838	878	1,041	935	945	946	879	1,024
Lima-Northeastern Indiana-Michigan	842	901	846	930	945	1,021	874	857	834	820	756	663	604
Illinois-Southwestern Indiana	14,135	14,694	15,140	15,998	17,247	17,490	17,759	17,456	16,936	16,215	16,168	16,874	16,958
North Louisiana and Arkansas	3,877	4,022	4,264	3,947	4,321	4,268	3,850	3,731	4,139	5,472	5,515	5,153	5,063
West Texas and Southeastern New Mexico	15,843	15,875	16,389	17,898	19,075	18,666	17,685	16,957	17,296	18,178	19,391	19,426	19,672
East Texas	10,849	10,470	12,327	13,458	14,390	14,000	13,770	14,125	15,169	14,962	14,383	14,532	14,374
Oklahoma, Kansas, North Texas, etc.	75,224	75,326	76,641	78,923	81,068	82,135	82,390	83,567	82,228	83,809	83,910	83,699	84,823
Gulf Coast	15,133	16,073	15,486	16,280	16,182	17,069	16,906	16,574	17,220	17,835	17,949	17,890	18,097
Rocky Mountain	15,217	15,413	14,995	14,789	14,508	14,068	13,622	13,702	13,613	13,332	13,308	13,096	13,129
California	22,743	22,261	23,139	22,877	22,941	23,119	22,387	23,651	23,631	22,879	23,834	23,291	23,462
Total pipe line and tank farm	178,546	179,506	183,631	189,413	195,143	196,428	193,860	195,488	195,915	198,298	199,956	199,063	200,726
Producers' stocks	11,149	11,499	11,241	11,513	11,437	11,351	11,607	11,213	11,462	11,263	11,174	11,138	10,905
Total United States: 1940	238,910	239,794	244,417	251,120	258,066	261,839	261,971	263,498	264,252	263,124	263,856	263,163	264,079
1939 [3]	274,165	272,931	274,003	276,913	279,142	278,773	274,100	271,229	239,313	235,563	231,852	235,291	239,978 [4] 238,910

[1] Excludes stocks of California heavy crude. [2] Subject to revision.

[3] Figuresf or 1939 (Minerals Yearbook, 1940, p. 973) are as follows (thousands of barrels): Pipe-line stocks: Illinois-Southwestern Indiana—January 31, 11,081; February 28, 11,459; March 31, 11,561; April 30, 11,770; May 31, 12,528; June 30, 12,969; August 31, 14,396; September 30, 14,698; October 31, 14,936; November 30, 14,612; December 31, 14,501. Rocky Mountain—January 31, 18,776; February 28, 18,784; March 31, 18,530; April 30, 18,138; May 31, 17,598; June 30, 17,025; July 31, 16,717; August 31, 16,342; September 30, 15,671; October 31, 15,251; November 30, 15,282; December 31, 15,115. Producers' stocks—January 31, 12,073; February 28, 11,778; March 31, 11,767; April 30, 11,830; May 31, 11,999; June 30, 12,017; July 31, 12,883; August 31, 11,730; September 30, 12,210; October 31, 12,205; November 30, 12,132; December 31, 11,953.

[4] For comparison with succeeding year.

CONSUMPTION AND DISTRIBUTION

Runs to stills.—Crude run to stills set a new record in 1940 of 1,294 million barrels—an increase of 56 million, or 4.6 percent on a daily average basis over 1939. Foreign crude runs, representing about 3 percent of the total, increased by over 8 million barrels, and domestic crude runs gained 48 million.

Refinery operations exceeded demand, as indicated by an increase of 14 million barrels in stocks of refined oils. As exports of refined oils slumped from 117 million barrels to 79 million the increase in the demand for refined products was due entirely to gains in the domestic market.

The rise in domestic demand and the decline in exports were reflected in the changes in refinery operations by districts. Crude runs in the Illinois-Indiana district rose from 192 million barrels in 1939 to 226 million in 1940—a gain of 34 million—the increase showing not only the strength of the domestic market but also the large local supply of cheap crude resulting from the expansion of Illinois production.

Crude runs in Texas and Louisiana were decreased owing to the weak export market and the increased competition of other districts. In the Texas Gulf Coast district runs increased from 334 million barrels to 338 million, but this gain was offset by an almost equal decline in the Texas Inland district. In Louisiana crude runs declined from 63 million barrels in 1939 to less than 59 million in 1940. Crude runs increased 12 million barrels in the East Coast district, over 4 million in the Appalachian district, almost 4 million in the Rocky Mountain district, and only about 2 million in California. The small gain in California was due to reduced exports and the liquidation of excess stocks of residual fuel oil.

Distribution.—Receipts of domestic and foreign crude petroleum at refineries in the United States totaled 1,237 million barrels in 1939 and 1,299 million in 1940. In 1940 receipts of foreign crude were 43 million barrels (3 percent of the total)—a fractional increase from 1939; interstate receipts of domestic crude were 487 million barrels (almost 38 percent of the total) compared to 36 percent in 1939; and intrastate receipts were 769 million barrels (59 percent of the total) compared to 61 percent in 1939.

Refinery receipts of crude in 1940, by methods of transportation, indicated that 72 percent of the total was delivered by pipe lines compared to 73 percent in 1939; that 25 percent was delivered by boat—a gain of 1 percent from 1939; and that 3 percent was delivered by tank car and truck.

The total demand for domestic crude in 1940 approximated 1,328 million barrels—a gain of about 27 million over 1939 or a little more than 2 percent. Domestic crude run to stills amounted to 1,252 million barrels—an increase of 48 million; crude exports declined from 72 million barrels in 1939 to less than 52 million in 1940; and crude used for fuel and losses totaled over 24 million barrels—a small decrease.

The most important changes in market demand by States of origin (computed from production and changes in crude stocks by origin) in 1940 compared to 1939 were an increase of over 54 million barrels in the demand for Illinois crude and declines of 23 and 17 million, respectively, for Texas and Oklahoma.

Runs to stills of crude petroleum in the United States in 1940, by districts and months [1]

[Thousands of barrels]

District	January	February	March	April	May	June	July	August	September	October	November	December	Total
East Coast:													
Domestic	14,770	13,807	15,877	14,516	14,554	13,872	13,755	14,517	13,786	14,089	13,358	14,401	171,302
Foreign	2,482	1,937	1,946	2,529	2,724	3,051	2,861	3,602	2,917	3,321	2,644	3,274	33,288
Total East Coast	17,252	15,744	17,823	17,045	17,278	16,923	16,616	18,119	16,703	17,410	16,002	17,675	204,590
Appalachian	4,105	3,906	4,146	3,890	4,060	3,951	3,970	4,133	3,972	4,089	3,793	4,210	48,225
Indiana, Illinois, Kentucky, etc	17,210	17,643	18,677	17,632	19,415	19,196	19,758	19,669	19,242	19,927	18,492	18,986	225,847
Oklahoma, Kansas, and Missouri	9,070	8,994	9,695	9,812	10,456	10,014	9,680	9,775	9,777	9,315	9,079	9,180	114,847
Texas Inland	5,053	5,067	5,165	5,345	5,434	5,153	5,105	5,095	4,921	5,272	5,090	5,102	61,802
Texas Gulf Coast:													
Domestic	28,631	27,079	28,824	27,838	28,657	27,213	27,888	25,048	26,491	27,379	27,040	28,377	330,465
Foreign	306	138	402	518	592	652	606	684	819	1,060	740	941	7,458
Total Texas Gulf Coast	28,937	27,217	29,226	28,356	29,249	27,865	28,494	25,732	27,310	28,439	27,780	29,318	337,923
Louisiana Gulf Coast:													
Domestic	3,817	3,646	4,036	3,833	3,817	3,816	3,573	3,313	3,385	3,122	3,672	4,000	44,030
Foreign	63	91	----------	87	68	24	105	132	144	236	71	31	1,052
Total Louisiana Gulf Coast	3,880	3,737	4,036	3,920	3,885	3,840	3,678	3,445	3,529	3,358	3,743	4,031	45,082
Arkansas and Louisiana Inland	2,037	2,004	2,011	1,934	2,106	2,060	1,982	2,174	2,104	2,122	2,064	2,190	24,788
Rocky Mountain	2,402	2,206	2,475	2,321	2,771	2,479	2,535	2,920	2,812	2,430	2,486	2,319	30,156
California	16,584	15,248	16,825	16,724	17,163	16,756	16,084	17,694	17,386	17,032	16,835	16,692	201,023
Total domestic	103,679	99,600	107,731	103,845	108,433	104,510	104,330	104,338	103,876	104,777	101,909	105,457	1,252,485
Total foreign	2,851	2,166	2,348	3,134	3,384	3,727	3,572	4,418	3,880	4,617	3,455	4,246	41,798
Total United States	106,530	101,766	110,079	106,979	111,817	108,237	107,902	108,756	107,756	109,394	105,364	109,703	1,294,283
Daily average	3,436	3,509	3,551	3,566	3,607	3,608	3,481	3,508	3,592	3,529	3,512	3,539	3,536

[1] Subject to revision.

Data on receipts of crude petroleum at refineries represent one of the principal bases for determining the trends of distribution of the market demand by States of origin. In 1940, seven States—Texas, California, Oklahoma, Illinois, Louisiana, Kansas, and New Mexico—supplied 90 percent of the total refinery receipts of domestic crude compared to 91 percent in 1939.

The total demand for Texas crude was about 481 million barrels in 1940—23 million barrels less than 1939. This loss of market was due to the war and to the increased production in other States. The decrease in demand was so abrupt that production exceeded market demand, as indicated by an increase of over 12 million barrels in crude stocks of Texas origin in 1940. Exports declined by almost 17 million barrels owing to the closing of foreign markets as a result of the war. Deliveries to refineries decreased about 4 million barrels, the decline being attributable to intrastate shipments, as there was virtually no change in interstate deliveries.

The total demand for California crude in 1940 was 225 million barrels—a decrease of over 3 million from the previous year. Intrastate deliveries increased 3 million barrels to 200 million, interstate shipments to the East Coast remained at less than 1 million, and exports declined by 4 million to 18 million barrels. Production of crude remained about the same as in 1939, but a smaller decrease in crude stocks and a large decrease in residual fuel-oil stocks occurred.

The total demand for Oklahoma crude in 1940 was 153 million barrels—a decrease of 17 million barrels from 1939. Production exceeded market demand, as shown by an increase of 3 million barrels in crude stocks of Oklahoma origin. Interstate deliveries to refineries decreased 13 million barrels, the principal factor being declines of about 6 million barrels each in shipments to refineries in Indiana and Texas. There was a small decrease in intrastate deliveries and a further displacement of exports to Canada by crude from Illinois.

The total demand for Illinois crude increased from 89 million barrels in 1939 to over 143 million in 1940—a gain of about 54 million barrels. Production of crude exceeded demand, as indicated by an increase of about 3 million barrels in stocks of Illinois origin. Deliveries of crude to refineries in other States gained almost 36 million barrels, which includes an increase of about 24 million barrels in shipments to refineries in western Ohio, Indiana, Kentucky, and Michigan—an increase of 7 million barrels to Appalachian refineries and a gain of over 4 million barrels to East Coast refineries.

The total demand for Louisiana crude was almost 102 million barrels in 1940—5 million barrels greater than in 1939. Deliveries to refineries in the East Coast district increased by only 2 million barrels, while increased shipments to Texas were largely offset by declines in intrastate deliveries and crude exports.

The market demand for Kansas crude was about 65 million barrels in 1940—an increase of about 4 million; the major change was in

Distribution of crude petroleum in the United States in 1940, by States [1]

[Thousands of barrels]

	Production	Imports	Refinery receipts							Runs to stills	Exports	Transfers to fuel
			Illinois	Kansas	Louisiana	New Mexico	Oklahoma	Texas	Other			
Arkansas	25,583	-----	-----	-----	-----	-----	-----	-----	11,163	11,257	-----	257
California	223,881	-----	-----	-----	-----	-----	-----	-----	200,689	[2] 201,023	18,013	4,349
Colorado	1,350	-----	-----	-----	-----	-----	-----	-----	3,090	3,120	-----	47
Georgia [3]	-----	1,724	-----	-----	-----	-----	-----	-----	649	2,597	-----	-----
Illinois	146,788	-----	51,030	2,208	217	4,507	9,018	6,031	807	[4] 73,422	15,184	688
Indiana	4,843	-----	13,154	17,996	-----	521	33,396	5,642	4,146	75,454	-----	-----
Kansas	66,270	-----	-----	38,633	-----	-----	10,890	266	201	49,340	-----	180
Kentucky [5]	5,241	-----	5,679	-----	-----	-----	177	-----	7,324	13,100	-----	72
Louisiana:												
Gulf	79,555	887	-----	-----	26,443	-----	-----	8,450	10,983	[6] 45,082	1,947	756
Inland	24,406	-----	-----	-----	5,152	-----	-----	3,936	4,439	13,119	-----	226
Maryland	-----	3,782	-----	-----	2,698	398	-----	5,999	276	13,024	-----	-----
Massachusetts [7]	-----	1,368	-----	-----	864	928	-----	14,842	94	18,097	-----	-----
Michigan	19,764	-----	5,714	-----	-----	-----	391	-----	18,247	24,400	-----	306
Mississippi	4,380	-----	-----	-----	-----	-----	-----	-----	-----	412	-----	30
Missouri	34	-----	115	2,051	-----	-----	3,500	438	2,300	8,436	-----	-----
Montana	6,768	-----	-----	-----	-----	-----	-----	-----	8,436	8,227	461	81
New Jersey	-----	7,268	3,653	-----	8,564	5,711	3,998	39,834	4,741	71,872	-----	-----
New Mexico	39,001	-----	-----	-----	-----	1,452	-----	426	-----	1,865	-----	83
New York:												
East	-----	4,773	-----	-----	-----	-----	-----	6,429	-----	11,024	-----	-----
West	4,999	-----	6,547	-----	-----	-----	-----	-----	4,489	11,036	-----	-----
Ohio:												
East	2,764	-----	12,997	-----	-----	-----	59	-----	1,974	14,901	-----	-----
West	405	-----	26,236	-----	4	-----	11,704	-----	1,809	39,471	-----	253
Oklahoma	155,952	-----	-----	4,071	-----	-----	52,335	721	-----	57,071	1,623	592
Pennsylvania:												
East	-----	15,359	1,778	-----	6,561	4,115	10,176	49,696	237	87,976	-----	-----
West	17,353	-----	13	-----	-----	-----	2,151	-----	16,313	18,448	-----	-----
Texas:												
Gulf	122,257	7,501	-----	-----	41,958	17,951	10,712	258,007	2,220	337,923	14,362	1,083
Inland	370,869	-----	-----	-----	7	2,305	1,099	58,481	-----	61,802		1,100
Utah	3	-----	-----	-----	-----	5	-----	-----	3,294	3,215	-----	-----
West Virginia	3,444	-----	906	-----	-----	-----	461	-----	2,487	3,840	-----	-----
Wyoming [8]	25,937	-----	-----	13	-----	-----	-----	-----	[9] 13,559	[9] 13,729	10	172
Total United States	1,351,847	42,662	127,822	64,972	92,468	37,893	150,067	459,198	323,967	1,294,283	51,600	10,275

[1] Subject to revision.
[2] Includes Washington.
[3] Includes Delaware, South Carolina, and Virginia.
[4] Includes Minnesota and Wisconsin.
[5] Includes Tennessee.
[6] Includes Alabama.
[7] Includes Rhode Island.
[8] Includes Nebraska.
[9] Includes Idaho and South Dakota.

intrastate deliveries. The total demand for New Mexico crude in 1940 decreased by 2 million barrels to 37 million.

The demand for Wyoming crude rose to almost 28 million barrels in 1940—a gain of 3 million. Arkansas crude demand totaled 25 million barrels—an increase of over 3 million—and the demand for Michigan crude was 20 million barrels—a loss of 3 million, representing a large decline in interstate shipments and a smaller increase in intrastate shipments.

Receipts of crude petroleum at refineries in the United States, 1936–40, by methods of transportation

[Millions of barrels]

Method of transportation	1936	1937	1938	1939	1940 [1]
By boat:					
Intrastate	68.6	78.5	74.1	72.7	72.1
Interstate	184.9	201.8	182.8	188.6	205.6
Foreign	32.3	27.5	26.4	33.1	42.6
Total by boat	285.8	307.8	283.3	294.4	320.3
By pipe lines:					
Intrastate	517.3	569.6	600.1	651.3	671.0
Interstate	247.2	276.7	254.3	250.5	268.9
Total by pipe lines	764.5	846.3	854.4	901.8	939.9
By tank car and truck:					
Intrastate	14.6	28.2	21.9	29.5	26.1
Interstate	7.6	8.5	7.8	10.9	12.7
Total by tank car and truck	22.2	36.7	29.7	40.4	38.8
Grand total	1,072.5	1,190.8	1,167.4	1,236.6	1,299.0

[1] Subject to revision.

PRICES AND VALUE

As indicated in figure 5 the price of Pennsylvania crude was again active in 1940, with the essential difference that nearly all the changes in 1940 were decreases, whereas all in 1939 were increases. Most of the other quotations were unchanged throughout the year, hence the average is estimated at $1.00 compared with $1.02 in 1939.

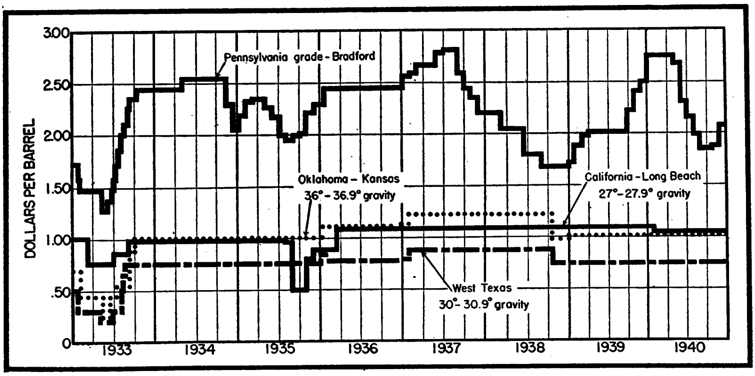

FIGURE 5.—Posted prices of selected grades of crude petroleum in the United States, 1933–40, by months.

Average monthly prices per barrel for selected grades of crude petroleum at wells in the United States in 1940

Month	Pennsylvania Grade		Illinois Basin	Oklahoma-Kansas 36°–36.9°	Panhandle, Tex. (Carson and Hutchinson Counties, 35°–35.9°)	West Texas, 30°–30.9°	East Texas	Gulf-Coast Grade, 30°–30.9°	California (Long Beach 27°–27.9°)
	Bradford	Southwest Pennsylvania							
January	$2.75	$2.40	$1.05	$1.02	$0.81	$0.75	$1.10	$1.08	$1.10
February	2.75	2.40	1.05	1.02	.81	.75	1.10	1.08	1.03
March	2.75	2.40	1.05	1.02	.81	.75	1.10	1.08	1.03
April	2.75	2.40	1.05	1.02	.81	.75	1.10	1.08	1.03
May	2.67	2.32	1.05	1.02	.81	.75	1.10	1.08	1.03
June	2.39	2.04	1.05	1.02	.81	.75	1.10	1.08	1.03
July	2.09	1.74	1.05	1.02	.81	.75	1.10	1.08	1.03
August	1.98	1.63	1.09	1.02	.81	.75	1.10	1.08	1.03
September	1.85	1.50	1.15	1.02	.81	.75	1.10	1.08	1.03
October	1.85	1.50	1.15	1.02	.81	.75	1.10	1.08	1.03
November	1.95	1.60	1.15	1.02	.81	.75	1.10	1.08	1.03
December	2.07	1.72	1.15	1.02	.81	.75	1.10	1.08	1.03
Average for year	2.32	1.97	1.09	1.02	.81	.75	1.10	1.08	1.04

Posted price per barrel of petroleum at wells in the United States in 1940, by grades, with dates of change

Date	Pennsylvania Grade		Corning Grade in Buckeye Pipe Line Co.[2]	Western Kentucky[3]	Illinois Basin[4]	Midland, Mich.[5]	Oklahoma-Kansas[6]	
	Bradford and Allegany districts[1]	In Southwest Pennsylvania pipe lines[2]					34°–34.9°	36°–36.9°
Jan. 1	$2.75	$2.40	$1.12	$0.90	$1.05	$1.02	$0.98	$1.02
May 22	2.50	2.15						
June 18	2.25	1.90						
July 12	2.00	1.65						
Aug. 21				1.10	1.15			
Aug. 28	1.85	1.50	.97			1.12		
Nov. 12	2.00	1.65	1.12					
Dec. 17	2.15	1.80						
	2.32	1.97	1.09	.97	1.09	1.05	.98	1.02

Date	Panhandle, Texas (Carson and Hutchinson Counties, 35°–35.9°)[7]	West Texas 30°–30.9[7]	Hobbs, N. Mex.[7]	Southwest Texas, Duval-Mirando, 22°–22.9°[8]	Van, Texas, 34°–34.9°[5]	East Texas[7]	Gulf Coast		
							Conroe, Tex.[8]	30°–30.9°[7]	20°–20.9°[7]
Jan. 1	$0.81	$0.75	$0.75	$0.92	$0.93	$1.10	$1.27	$1.08	$0.88
	.81	.75	.75	.92	.93	1.10	1.27	1.08	.88

Date	Rodessa, La., 36°–36.9°[9]	Smackover, Ark.[9]	Salt Creek, Wyo., 36°–36.9°[10]	Lance Creek, Wyo.[4]	California[11]			
					Kettleman, 38°–38.9°	Long Beach, 27°–27.9°	Midway-Sunset, 19°–19.9°	Santa Fe Springs, 33°–33.9°
Jan. 1	$0.97	$0.73	$1.02	$0.77	$1.39	$1.10	$0.74	$1.20
Feb. 1					1.33	1.03	.64	1.14
Oct. 17	[12] 1.05							
	.99	.73	1.02	.77	1.34	1.04	.64	1.15

[1] The Tide-Water Associated Oil Co.
[2] The South Penn Oil Co.
[3] Ashland Refining Co.
[4] The Ohio Oil Co.
[5] The Pure Oil Co.
[6] Standard Oil Co. (Indiana).
[7] Humble Oil & Refining Co.
[8] The Texas Co.
[9] Standard Oil Co. of Louisiana.
[10] Stanolind Oil & Gas Co.
[11] Standard Oil Co. of California.
[12] No gravity scale.

Value of crude petroleum at wells in the United States, 1938–39, by States [1]

State	1938		1939	
	Total (thousands of dollars)	Average per barrel	Total (thousands of dollars)	Average per barrel
Arkansas	16,900	$0.93	16,790	$0.79
California	257,250	1.03	229,000	1.02
Colorado	1,540	1.09	1,330	.95
Illinois	30,100	1.25	101,200	1.07
Indiana	1,260	1.27	1,675	.98
Kansas	72,100	1.20	63,100	1.04
Kentucky	7,570	1.30	5,900	1.05
Louisiana:				
Gulf Coast	77,100	1.16	72,300	1.06
Northern	33,000	1.15	25,700	1.01
Total Louisiana	110,100	1.16	98,000	1.05
Michigan	19,300	1.03	21,350	.91
Montana	5,190	1.05	5,860	.98
New Mexico	33,250	.93	30,850	.82
New York	9,550	1.89	10,650	2.09
Ohio	3,860	1.17	3,600	1.14
Oklahoma	209,500	1.20	166,300	1.04
Pennsylvania	32,760	1.88	36,200	2.08
Texas:				
Gulf Coast	137,250	1.19	132,800	1.08
East Texas proper	194,700	1.28	154,700	1.07
West Texas	65,500	.90	64,400	.81
Rest of State	141,700	1.05	126,430	.92
Total Texas	539,150	1.13	478,330	.99
West Virginia	5,600	1.52	6,000	1.68
Wyoming	18,000	.95	18,150	.85
Other States [2]	80	.98	185	.91
Total United States	1,373,060	1.13	1,294,470	1.02

[1] Figures for 1940 not yet available. [2] Mississippi (1939 only), Missouri, Tennessee, and Utah.

REFINED PRODUCTS

The intensified industrial activity in the United States that resulted from supplying the war needs of Europe and the country's initial defense requirements pushed up the domestic demand for almost all petroleum products to unprecedented levels. The relative rate of increase was somewhat exaggerated by the extra leap-year day in 1940. The 589,424,000-barrel domestic demand for motor fuel was 6 percent above the 1939 record of 555,509,000 barrels, and the 339,284,000-barrel domestic demand for residual fuel oil was 5 percent higher than the 1939 demand of 323,488,000 barrels. The domestic demand for kerosene and distillate fuel oil (both greater than normal as the result of a severe winter) was 14 and 19 percent higher, respectively, than in 1939. Coke was the only principal product of petroleum in less domestic demand in 1940 than in 1939.

The recession in volume of exports that began in 1939 was continued in 1940; total shipments of refined products were only 79 million barrels compared with 117 million in 1939. Curtailment of foreign demand, caused at first by rationing and the risks attending ocean transportation, increased as western European countries fell. Exports of motor fuel decreased from 44,638,000 barrels in 1939 to 25,107,000 in 1940, and exports of most of the other petroleum products except coke and asphalt also declined. The increased domestic demand for fuel oils coupled with lower import duties and plentiful foreign supplies encouraged domestic consumers to obtain part of their requirements for heavy oils from Latin American sources. As a result, exports of

Comparative analyses of statistics for the major refined products in the United States, 1936–40

[Thousands of barrels, except as otherwise indicated]

	1936	1937	1938	1939	1940 [1]
Motor fuel:					
Production	516,266	571,727	569,162	611,043	616,359
Imports	78	144	79	47	97
Exports	28,646	38,306	50,109	44,638	25,107
Stocks, end of period	60,437	74,650	70,779	81,722	83,647
Domestic demand	481,606	519,352	523,003	555,509	589,424
Kerosene:					
Production	56,082	65,308	64,580	68,521	73,882
Imports					204
Exports	6,936	8,886	7,504	8,241	3,374
Stocks, end of period	5,633	7,083	7,799	7,576	9,512
Domestic demand	51,428	54,972	56,360	60,503	68,776
Distillate fuel oil:					
Production	125,906	146,706	151,774	161,746	183,304
Transfers [2]	(3)	(3)	623	2,741	2,576
Imports	182	17			3,333
Exports	20,448	30,129	29,641	32,020	19,172
Stocks, end of period	22,813	22,566	27,873 [4] 36,224	33,718	42,940
Domestic demand	102,757	116,841	117,449	[5] 134,973	160,819
Residual fuel oil:					
Production	287,968	312,064	294,890	305,944	316,218
Transfers [2]	15,732	17,423	10,037	9,668	7,699
Imports	18,801	22,114	21,065	15,680	28,458
Exports	14,435	15,304	17,920	17,485	16,077
Stocks, end of period	[6] 84,236	[6] 95,019 [7] 81,507	97,746 [4] 101,971	92,290	89,304
Domestic demand	307,884	325,514	291,833	[5] 323,488	339,284
Lubricating oil:					
Production	30,927	35,321	30,826	35,036	36,765
Imports	4	7	7	5	11
Exports	8,691	10,975	9,417	11,881	10,494
Stocks, end of period	6,942 [8] 6,482	7,512	7,695	7,142	8,767
Domestic demand	22,323	23,323	21,233	23,713	24,657
Wax (thousands of pounds):					
Production	472,920	521,640	435,400	464,520	513,240
Imports	16,669	36,929	28,927	39,913	83,102
Exports	187,342	231,723	201,447	232,664	190,065
Stocks, end of period	115,434	144,992	129,340	75,648	125,272
Domestic demand	301,488	297,288	278,532	325,461	356,653
Coke (thousands of short tons):					
Production	1,378.2	1,306.6	1,602.2	1,666.4	1,526.6
Exports	124.6	164.3	155.6	286.2	302.1
Stocks, end of period	389.4	378.6	707.5	666.0	487.0
Domestic demand	1,253.1	1,153.1	1,117.7	1,421.7	1,403.5
Asphalt (thousands of short tons):					
Production	3,868.8	4,182.0	4,341.4	4,954.2	5,346.7
Imports	21.6	34.1	33.2	73.9	137.7
Exports	211.4	45.5	49.9	42.4	296.8
Stocks, end of period	364.2	557.4	490.4	550.0	614.0
Domestic demand	3,744.5	3,977.4	4,391.7	4,926.1	5,123.6
Road oil:					
Production	7,398	8,087	7,543	7,868	7,769
Stocks, end of period	851	984	680	702	624
Domestic demand	7,279	7,954	7,847	7,846	7,847
Other finished products:					
Production	2,148	2,382	1,921	2,359	3,202
Exports	71	101	112	123	944
Stocks, end of period	198	230	263	276	359
Domestic demand	2,099	2,249	1,776	2,223	2,175

[1] Subject to revision.
[2] Net transfers from crude oil to fuel oil; California only, 1936–38.
[3] Figures not available.
[4] Includes terminal stocks; compares with succeeding years.
[5] Upon new basis with transfers east of California included.
[6] California heavy crude included.
[7] For comparison with succeeding year; California heavy crude included in crude-oil stocks.
[8] For comparison with succeeding year.

residual fuel oil declined from 17,485,000 barrels in 1939 to 16,077,000 in 1940, whereas imports increased from 15,680,000 barrels in 1939 to 28,458,000 in 1940; exports of distillate fuel oil decreased from 32,020,000 barrels in 1939 to 19,172,000 in 1940; and imports, nonexistent in 1939, amounted to 3,333,000 barrels in 1940.

Crude oil runs to stills in 1940 totaled 1,294,283,000 barrels compared with 1,237,840,000 in 1939—an increase of 56,443,000 barrels. Foreign crude runs were 41,798,000 barrels (3.2 percent of the total) compared with 33,490,000 barrels (2.7 percent of the total) in 1939 and 26,187,000 barrels (2.2 percent of the total) in 1938.

Although the East Coast district—with 33,288,000 barrels of foreign crude runs in 1940 and 29,108,000 barrels in 1939—is the principal district using foreign crude, the Texas Gulf Coast district has shown the greatest relative increase, the 1940 runs being 7,458,000 barrels compared with 3,820,000 in 1939 and 1,567,000 in 1938. These increases of foreign crude runs to stills have had some influence on the lower yield of gasoline and higher yield of heavier oils.

Runs to stills and production at refineries in the United States of the various refined products, 1936–40 [1]

[Thousands of barrels, except as otherwise indicated]

Product	1936	1937	1938	1939	1940 [1]
Input:					
Crude petroleum:					
Domestic	1,034,637	1,157,444	1,138,828	1,204,350	1,252,485
Foreign	33,933	25,996	26,187	33,490	41,798
Total crude petroleum	1,068,570	1,183,440	1,165,015	1,237,840	1,294,283
Natural gasoline	33,817	39,381	39,961	39,606	39,330
Total input	1,102,387	1,222,821	1,204,976	1,277,446	1,333,613
Output:					
Gasoline	504,811	559,141	556,012	596,501	597,279
Kerosene	56,082	65,308	64,580	68,521	73,882
Distillate fuel oil	125,906	146,706	151,774	161,746	183,304
Residual fuel oil	287,968	312,064	294,890	305,944	316,218
Lubricating oil	30,927	35,321	30,826	35,036	36,765
Wax	1,689	1,863	1,555	1,659	1,833
Coke	6,891	6,533	8,011	8,332	7,633
Asphalt	21,278	23,001	23,878	27,248	29,406
Still gas	57,046	64,218	65,890	68,779	71,720
Wax .... thousands of pounds	472,920	521,640	435,400	464,520	513,240
Coke .... thousands of short tons	1,378.2	1,306.6	1,602.2	1,666.4	1,526.6
Asphalt .... do	3,868.8	4,182.0	4,341.4	4,954.2	5,346.7
Still gas .... millions of cubic feet	226,466	241,981	250,382	261,360	272,536
Road oil	7,398	8,087	7,543	7,868	7,769
Other finished products	2,148	2,382	1,921	2,359	3,202
Crude gasoline (net)	486	[2] 128	[2] 1,616	[2] 439	902
Other unfinished oils (net)	[2] 8,962	[2] 7,931	[2] 4,530	[2] 11,731	[2] 3,845
Shortage	8,719	6,256	4,242	5,623	7,545
Total output	1,102,387	1,222,821	1,204,976	1,277,446	1,333,613

[1] Subject to revision.
[2] Negative quantity; represents net excess of unfinished oils rerun over unfinished oils produced.

The total refinery output of motor fuel—597 million barrels—exceeded that in 1939 by less than a million barrels and included 264 million barrels of straight-run gasoline, 294 million barrels of cracked gasoline, and 39 million barrels of natural gasoline.

The yield of gasoline decreased to a greater degree in 1940 than in any previous year, amounting to only 43.1 percent of the crude oil run to stills, compared with 45.0 percent in 1939. Yield of distillate fuel oils—14.2 percent—represented a gain of 1.1 percent; the yields of other oils changed slightly (see fig. 6). These changes in yields resulted largely from a more rapidly increasing demand for heating oil than for gasoline and the attempt of refiners to adjust their operations to the altered requirements of consumers.

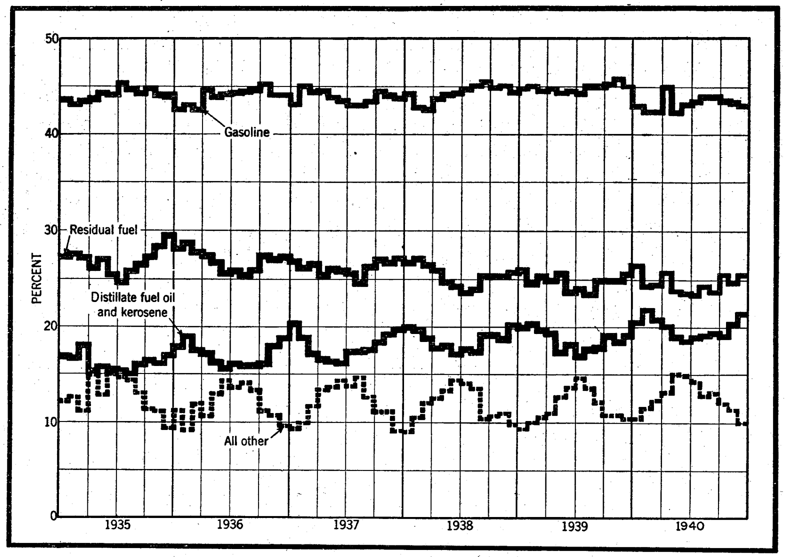

FIGURE 6.—Yields of principal petroleum products from crude oil run to stills in the United States, 1935–40, by months.

Summary of percentage yields of refined products in the United States, 1932–40.

[Computed on total crude runs to stills]

Product	1932	1933	1934	1935	1936	1937	1938	1939	1940 [1]
Finished products:									
Gasoline [2]	44.7	43.7	43.4	44.2	44.1	43.9	44.3	45.0	43.1
Kerosene	5.3	5.7	6.0	5.8	5.2	5.5	5.5	5.5	5.7
Distillate fuel oil	8.5	9.2	10.6	10.4	11.8	12.4	13.0	13.1	14.2
Residual fuel oil	27.5	27.6	26.8	26.9	27.0	26.4	25.3	24.7	24.4
Lubricating oil	2.7	2.8	2.9	2.9	2.9	3.0	2.6	2.8	2.8
Wax	.2	.2	.2	.2	.2	.2	.1	.1	.1
Coke	1.1	.9	.7	.7	.6	.6	.7	.7	.6
Asphalt	1.7	1.5	1.8	1.8	2.0	1.9	2.1	2.2	2.3
Road oil	.8	.6	.7	.6	.7	.7	.6	.6	.6
Still gas	5.0	5.2	5.0	5.3	5.3	5.4	5.7	5.5	5.5
Other	.2	.2	.2	.2	.2	.2	.2	.2	.3
Unfinished products:									
Gasoline }	[3].2	.5	[3].3	.1	(4)	(3 4)	[3].1	(3 4)	.1
Other }			.2	[3].3	[3].8	[3].7	[3].4	[3].9	[3].3
Shortage	2.5	1.9	1.8	1.2	.8	.5	.4	.5	.6
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Subject to revision.
[2] Based upon total gasoline production less natural gasoline used.
[3] Negative percentage; represents excess percentage rerun over percentage produced.
[4] Less than 0.1 percent.

Stocks of refined products in the United States, 1939–40, by months

[Thousands of barrels, except as otherwise indicated]

Product	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
1939												
Gasoline	73,847	79,691	81,189	81,623	78,342	74,395	71,824	66,448	65,498	68,116	71,619	77,301
Kerosene	6,711	5,452	5,605	5,663	6,551	7,949	8,855	9,361	9,952	9,967	9,019	7,576
Distillate fuel oil	32,300	28,727	25,899	26,471	27,813	31,877	35,340	37,626	38,138	40,093	37,888	33,718
Residual fuel oil	99,711	96,285	93,167	94,138	96,744	98,405	101,164	101,361	100,063	99,921	96,696	92,290
Lubricating oil	7,762	7,951	7,800	7,886	7,630	7,427	7,179	7,069	6,704	6,639	6,799	7,142
Wax	459	420	420	426	407	399	390	386	320	290	291	270
Coke	3,585	3,525	3,470	3,670	3,580	3,550	3,665	3,410	3,340	3,260	3,235	3,330
Asphalt	2,926	3,146	3,575	3,784	3,696	3,531	3,278	2,915	2,612	2,596	2,733	3,025
Wax ... thousands of pounds	128,627	117,711	117,537	119,301	113,925	111,604	109,322	108,173	89,584	81,147	81,369	75,648
Coke ... thousands of short tons	717.0	705.0	694.0	734.0	716.0	710.0	733.0	682.0	668.0	652.0	647.0	666.0
Asphalt ... do	532.0	572.0	650.0	688.0	672.0	642.0	596.0	530.0	475.0	472.0	497.0	550.0
Road oil	830	823	907	1,048	1,219	1,192	1,085	985	791	715	654	702
Other finished products	250	263	235	283	301	280	285	282	315	289	302	276
Unfinished gasoline	5,619	5,800	5,932	5,908	5,858	5,893	6,019	5,887	5,494	5,203	5,171	5,564
Other unfinished oils	38,707	38,361	38,216	37,732	38,036	38,692	40,296	40,819	40,801	38,765	37,947	36,915
Total	272,707	270,444	266,415	268,632	270,177	273,590	279,380	276,549	274,028	275,854	272,354	268,109
1940 [1]												
Gasoline	84,863	92,721	96,467	96,615	93,474	86,276	82,025	77,134	75,915	73,338	73,429	77,943
Kerosene	4,918	4,302	4,114	4,351	5,309	6,810	8,191	9,476	10,254	11,000	10,473	9,512
Distillate fuel oil	26,462	24,640	23,086	25,092	28,220	33,585	39,412	45,041	48,828	49,037	46,624	42,940
Residual fuel oil	89,281	89,784	89,351	88,932	89,835	91,148	93,029	94,421	94,947	94,658	92,392	89,304
Lubricating oil	7,328	7,825	8,084	8,065	8,170	8,161	8,573	8,457	8,596	8,464	8,365	8,767
Wax	266	295	323	346	369	394	407	401	393	407	429	447
Coke	3,140	3,140	3,120	3,315	3,405	3,485	3,390	3,235	3,085	2,905	2,635	2,435
Asphalt	3,262	3,559	3,845	4,224	4,174	3,745	3,427	3,234	2,695	2,579	2,893	3,377
Wax ... thousands of pounds	74,575	82,631	90,373	96,910	103,289	110,346	113,978	112,359	110,028	113,827	120,212	125,272
Coke ... thousands of short tons	628.0	628.0	624.0	663.0	681.0	697.0	678.0	647.0	617.0	581.0	527.0	487.0
Asphalt ... do	593.0	647.0	699.0	768.0	759.0	681.0	623.0	588.0	490.0	469.0	526.0	614.0
Road oil	763	809	924	1,145	1,360	1,257	1,077	892	844	719	570	624
Other finished products	288	320	368	407	405	411	417	379	358	341	352	359
Unfinished gasoline	6,112	6,574	7,243	6,948	7,385	7,293	7,040	6,567	5,992	5,847	6,088	6,466
Other unfinished oils	36,108	36,495	36,920	38,299	40,070	41,340	42,083	41,541	42,188	41,623	41,052	40,091
Total	262,791	270,464	273,845	277,739	282,176	283,905	289,071	290,778	294,095	290,918	285,302	282,265

[1] Subject to revision.

Runs to stills and production at refineries in the United States of the various refined products, 1939–40, by months

[Thousands of barrels, except as otherwise indicated]

Product	January	February	March	April	May	June	July	August	September	October	November	December	Total
1939													
Input:													
Crude petroleum	99,614	87,797	98,917	99,303	105,755	104,687	106,899	107,632	105,505	110,980	104,916	105,835	1,237,840
Natural gasoline	3,462	3,043	3,048	2,825	2,646	2,682	2,909	3,092	3,237	4,358	4,286	4,018	39,606
Total input	103,076	90,840	101,965	102,128	108,401	107,369	109,808	110,724	108,742	115,338	109,202	109,853	1,277,446
Output:													
Gasoline	48,308	42,721	47,373	47,426	49,780	49,418	50,439	51,643	50,770	54,612	52,387	51,624	596,501
Kerosene	5,702	5,174	5,900	5,813	5,909	5,439	5,390	5,783	5,806	6,141	5,642	5,822	68,521
Distillate fuel oil	14,122	12,709	13,539	13,301	12,393	13,566	12,688	13,246	12,975	15,017	13,757	14,433	161,746
Residual fuel oil	25,626	21,497	24,845	24,704	26,781	24,530	25,734	25,299	26,302	27,594	26,088	26,944	305,944
Lubricating oil	2,527	2,522	2,664	2,672	2,856	2,800	2,755	3,056	2,854	3,575	3,277	3,478	35,036
Wax	126	119	160	125	123	141	103	111	144	161	173	173	1,659
Coke	630	586	640	710	661	711	726	716	554	826	796	776	8,332
Asphalt	1,344	1,041	1,695	2,062	2,628	2,672	2,802	3,175	3,027	2,980	2,152	1,670	27,248
Still gas	5,281	4,829	5,576	5,586	5,998	5,968	6,120	6,125	5,809	5,970	5,756	5,761	68,779
Wax ... thousands of pounds	35,280	33,320	44,800	35,000	34,440	39,480	28,840	31,080	40,320	45,080	48,440	48,440	464,520
Coke ... thousands of short tons	126.0	117.2	128.0	142.0	132.2	142.2	145.2	143.2	110.8	165.2	159.2	155.2	1,666.4
Asphalt ... do	244.4	189.3	308.2	374.9	477.8	485.8	509.4	577.3	550.4	541.8	391.3	303.6	4,954.2
Still gas ... millions of cubic feet	20,068	18,350	21,189	21,227	22,792	22,678	23,256	23,275	22,074	22,686	21,873	21,892	261,360
Road oil	323	173	312	408	866	1,183	1,478	1,476	878	501	151	119	7,868
Other finished products	165	174	168	238	241	192	195	212	218	164	198	194	2,359
Unfinished gasoline (net)	[1] 112	181	[1] 55	[1] 24	[1] 50	35	126	[1] 132	[1] 393	[1] 311	[1] 97	393	[1] 439
Other unfinished oils (net)	[1] 1,143	[1] 1,115	[1] 1,011	[1] 1,108	[1] 220	99	409	[1] 518	[1] 1,071	[1] 2,654	[1] 1,520	[1] 1,879	[1] 11,731
Shortage	177	229	159	215	435	615	843	532	869	762	442	345	5,623
Total output	103,076	90,840	101,965	102,128	108,401	107,369	109,808	110,724	108,742	115,338	109,202	109,853	1,277,446
1940 [2]													
Input:													
Crude petroleum [3]	106,530	101,766	110,079	106,979	111,817	108,237	107,902	108,756	107,756	109,394	105,364	109,703	1,294,283
Natural gasoline	3,285	3,067	2,986	2,783	3,075	2,600	2,744	3,081	3,744	4,156	4,026	3,783	39,330
Total input	109,815	104,833	113,065	109,762	114,892	110,837	110,646	111,837	111,500	113,550	109,390	113,486	1,333,613
Output:													
Gasoline	48,985	46,253	49,490	48,766	50,424	49,261	49,660	50,788	51,088	51,726	49,795	51,043	597,279
Kerosene	5,375	5,945	6,570	6,257	6,641	5,785	5,797	5,629	6,062	6,496	6,431	6,894	73,882

Distillate fuel oil:													
Straight run	11,789	11,649	11,593	10,741	9,843	10,117	10,483	10,493	10,931	10,190	10,797	11,851	130,477
Cracked	4,759	4,613	4,753	4,519	4,698	4,037	3,956	4,464	3,804	4,191	4,276	4,757	52,827
Total	16,548	16,262	16,346	15,260	14,541	14,154	14,439	14,957	14,735	14,381	15,073	16,608	183,304
Residual fuel oil:													
Straight run	8,207	7,380	8,348	9,289	9,436	8,379	7,928	8,259	7,990	9,569	8,476	9,284	102,545
Cracked	19,875	17,300	18,522	16,083	17,112	17,090	17,320	18,192	17,514	18,375	17,649	18,641	213,673
Total	28,082	24,680	26,870	25,372	26,548	25,469	25,248	26,451	25,504	27,944	26,125	27,925	316,218
Lubricating oil	3,308	3,108	3,335	3,280	3,341	3,212	3,024	2,635	2,682	2,954	3,021	2,865	36,765
Wax	173	177	169	152	158	142	134	119	142	154	157	156	1,833
Coke	582	656	648	696	762	743	607	613	596	657	442	631	7,633
Asphalt	1,139	1,208	1,783	2,200	2,682	2,900	3,336	3,509	3,326	3,346	2,183	1,794	29,406
Still gas	5,522	5,392	6,083	5,943	6,479	6,418	6,286	6,430	6,024	5,884	5,587	5,672	71,720
Wax .... thousands of pounds	48,440	49,560	47,320	42,560	44,240	39,760	37,520	33,320	39,760	43,120	43,960	43,680	513,240
Coke .... thousands of short tons	116.4	131.2	129.6	139.2	152.4	148.6	121.4	122.6	119.2	131.4	88.4	126.2	1,526.6
Asphalt .... do	207.2	219.6	324.2	400.0	487.6	527.3	606.6	638.0	604.7	608.4	396.9	326.2	5,346.7
Still gas .... millions of cubic feet	20,984	20,490	23,115	22,583	24,620	24,388	23,887	24,435	22,891	22,359	21,231	21,553	272,536
Road oil	193	114	226	411	826	1,172	1,449	1,368	1,080	558	149	223	7,769
Other finished products	292	278	297	280	254	258	293	247	243	225	262	273	3,202
Unfinished gasoline (net)	548	462	669	[1] 295	437	[1] 92	[1] 253	[1] 473	[1] 575	[1] 145	241	378	902
Other unfinished oils (net)	[1] 1,620	[1] 284	[1] 139	645	1,010	583	[1] 32	[1] 1,231	64	[1] 961	[1] 685	[1] 1,195	[1] 3,845
Shortage	688	582	718	795	789	832	658	795	529	331	609	219	7,545
Total output	109,815	104,833	113,065	109,762	114,892	110,837	110,646	111,837	111,500	113,550	109,390	113,486	1,333,613

[1] Negative quantity; represents net excess rerun over production.
[2] Subject to revision.
[3] Detail by districts and months in section on "Consumption and distribution of crude petroleum."

Runs to stills and production at refineries in the United States of the various refined products, 1939–40, by districts

[Thousands of barrels, except as otherwise indicated]

Product	East Coast	Appalachian	Indiana, Illinois, Kentucky, etc.	Oklahoma, Kansas, and Missouri	Texas Inland	Texas Gulf Coast	Louisiana Gulf Coast	Arkansas-Louisiana Inland	Rocky Mountain	California	United States
1939											
Input:											
Crude petroleum	192,381	43,767	191,634	112,409	65,432	333,801	48,599	24,857	26,306	198,654	1,237,840
Natural gasoline	2,140	297	4,516	5,112	6,189	5,401	330	533	711	14,377	39,606
Total	194,521	44,064	196,150	117,521	71,621	339,202	48,929	25,390	27,017	213,031	1,277,446
Output:											
Gasoline	78,897	21,805	109,447	65,494	43,156	153,779	18,399	10,684	15,066	79,774	596,501
Kerosene	9,120	2,847	8,476	7,073	2,977	23,224	6,898	2,470	782	4,654	68,521
Distillate fuel oil	30,638	2,868	18,963	10,813	2,903	54,438	7,706	1,585	1,809	30,023	161,746
Residual fuel oil	54,440	5,415	28,962	19,011	14,769	78,391	12,076	6,170	5,728	80,982	305,944
Lubricating oil	9,055	6,128	3,111	3,100	221	8,454	1,504	538	180	2,745	35,036
Wax	678	347	136	114	10	254	80	----	40	----	1,659
Coke	34	116	4,600	924	510	901	2	----	308	937	8,332
Asphalt	10,130	782	5,330	1,949	905	1,599	1,429	988	362	3,774	27,248
Still gas	8,864	2,289	13,769	6,063	3,592	22,696	2,244	885	1,471	6,906	68,779
Wax ---- thousands of pounds	189,840	97,160	38,080	31,920	2,800	71,120	22,400	----	11,200	----	464,520
Coke ---- thousands of short tons	6.8	23.2	920.0	184.8	102.0	180.2	0.4	----	61.6	187.4	1,666.4
Asphalt ---- do	1,841.8	142.2	969.1	354.4	164.6	290.7	259.8	179.6	65.8	686.2	4,954.2
Still gas ---- millions of cubic feet	33,684	8,698	52,321	23,038	13,650	86,244	8,528	3,365	5,590	26,242	261,360
Road oil	370	123	2,206	1,006	286	125	1	471	819	2,461	7,868
Other finished products	823	233	556	129	82	147	103	1	74	211	2,359
Unfinished gasoline (net)	[1] 49	118	[1] 19	174	22	[1] 352	[1] 12	17	[1] 19	[1] 319	[1] 439
Other unfinished oils (net)	[1] 8,393	14	914	[1] 750	622	[1] 2,694	[1] 1,971	888	[1] 156	[1] 205	[1] 11,731
Shortage	[2] 86	979	[2] 301	2,421	1,566	[2] 1,760	470	693	553	1,088	5,623
Total output	194,521	44,064	196,150	117,521	71,621	339,202	48,929	25,390	27,017	213,031	1,277,446
1940 [3]											
Input:											
Crude petroleum	204,590	48,225	225,847	114,847	61,802	337,923	45,082	24,788	30,156	201,023	1,294,283
Natural gasoline	1,574	384	5,685	5,238	6,651	6,350	278	361	732	12,077	39,330
Total input	206,164	48,609	231,532	120,085	68,453	344,273	45,360	25,149	30,888	213,100	1,333,613
Output:											
Gasoline	77,248	23,508	125,405	65,585	40,072	144,813	16,514	10,861	16,388	76,885	597,279
Kerosene	11,447	3,213	10,344	7,196	2,753	26,164	5,897	2,722	824	3,322	73,882

Distillate fuel oil:											
Straight run	26,674	3,138	17,249	8,301	1,951	44,421	2,887	983	1,936	22,937	130,477
Cracked	13,302	897	6,694	3,247	306	17,608	4,520	526	246	5,481	52,827
Total	39,976	4,035	23,943	11,548	2,257	62,029	7,407	1,509	2,182	28,418	183,304
Residual fuel oil:											
Straight run	16,963	1,566	13,991	6,353	5,573	20,446	3,813	3,301	3,716	26,823	102,545
Cracked	36,286	4,784	23,826	13,434	8,130	58,404	6,074	2,978	2,887	56,870	213,673
Total	53,249	6,350	37,817	19,787	13,703	78,850	9,887	6,279	6,603	83,693	316,218
Lubricating oil	8,550	6,016	3,545	3,447	238	9,142	1,630	680	179	3,338	36,765
Wax	700	358	195	141	5	273	100		61		1,833
Coke	26	128	4,718	815	384	746			220	596	7,633
Asphalt	9,772	931	5,417	2,219	1,069	1,904	2,006	1,111	814	4,163	29,406
Still gas	10,779	2,800	15,586	6,305	4,217	20,610	2,071	852	1,543	6,957	71,720
Wax thousands of pounds	196,000	100,240	54,600	39,480	1,400	76,440	28,000		17,080		513,240
Coke thousands of short tons	5.2	25.6	943.6	163.0	76.8	149.2			44.0	119.2	1,526.6
Asphalt do	1,777.0	169.3	984.9	403.5	194.5	346.1	364.6	202.0	147.9	756.9	5,346.7
Still gas millions of cubic feet	40,960	10,640	59,226	23,958	16,024	78,318	7,871	3,239	5,863	26,437	272,536
Road oil	271	154	2,274	722		216	10	214	1,267	2,641	7,769
Other finished products	1,196	294	850	133	140	283	100		28	178	3,202
Unfinished gasoline (net)	93	90	[1] 380	514	151	[1] 222	[1] 24	[1] 21	21	680	902
Other unfinished oils (net)	[1] 5,392	[1] 261	1,711	[1] 714	1,087	[1] 231	[1] 961	392	[1] 51	575	[1] 3,845
Shortage	[2] 1,751	993	107	2,387	2,377	[2] 304	723	550	809	1,654	7,545
Total output	206,164	48,609	231,532	120,085	68,453	344,273	45,360	25,149	30,888	213,100	1,333,613

[1] Negative quantity; represents net excess rerun over production.
[2] Negative quantity (overage).
[3] Subject to revision.

The general trend of prices of refined products in 1940 was downward. Heavy exports and a severe winter were the principal factors in the brisk demand for heating oils that prevailed in late 1939 and the early part of 1940, but with mounting inventories and a more normal demand prices dropped. The price declines for lubricants and wax were as sharp as their rise in 1939. A record accumulation of gasoline stocks early in 1940 was indicated by the low prices that prevailed for this product during the year despite a substantial increase in domestic demand (see fig. 7).

Development in catalytic refining in 1940 centered in the search for new catalysts. The objectives of catalyst research is to find one that not only will produce a high yield of gasoline from any stock, but also function continuously. Under most present methods cracking must be interrupted every few minutes to permit purging and regenerating of the catalyst; in consequence, only about one-third of the operating time of a catalyst case is actually devoted to cracking, whereas, two-thirds of the operating time is consumed in regenerating the catalyst.

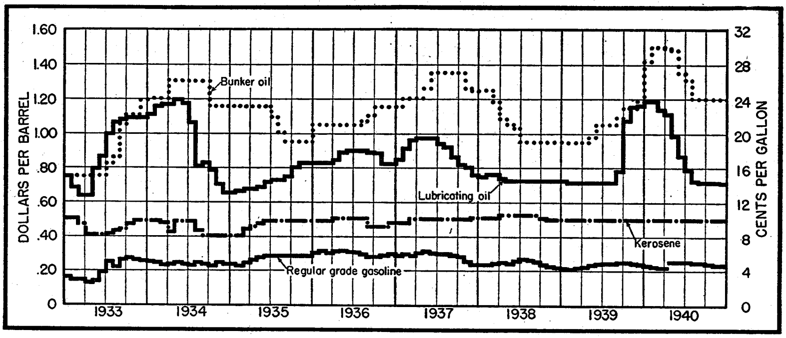

FIGURE 7.—Prices of refined petroleum products in the United States, 1933–40, by months.

Two sources have announced the discovery of catalysts that will speed up the catalytic cracking process. One catalyst is described as a synthetic product that will increase yield 15 to 20 percent, producing a better quality gasoline, and that can be purged more easily and quickly than commonly known types. The other is said to be a powder that becomes fluid in operation and flows like a liquid instead of being fixed in catalyst cases. Continuous cracking operations are maintained in one chamber, while the catalyst is regenerated in another.

During 1940 the attention of the petroleum industry was directed to the production of toluene. Although the lower-boiling-point portions of coal tar are the usual source of this essential base for the manufacture of trinitrotoluene, it can be made from petroleum gases also. One plant for manufacturing this commodity is in operation, and another with an annual capacity of 2 million gallons was scheduled to begin producing early in 1941.

The laboratory production of synthetic rubber from petroleum gases and the construction of plants for manufacturing it have been among the most interesting technological developments during the past 2 years. Germany and Russia, as well as the United States, have conducted experiments and research on synthetic rubbers for a number of years; more than 30 types—some closely related—have been developed.

Although Germany used a rubber made from coal, limestone, and gas products during the last war, it was not until 1927, when German chemists found that butadiene could be obtained commercially from coal and limestone, that the modern phase of synthetic rubber developed. Butadiene is the basic raw material for the production of Buna rubber. The discovery of the emulsion technique now used to produce copolymers of the Buna-S and Perbunan type led to abandonment of the metallic sodium method.

Butadiene may be produced from a number of raw materials, including acetylene, alcohol, and petroleum. In the process involving petroleum it is derived from butane, as well as from propylene and cyclohexane in still gases. Of the various types of Buna rubber the two most important are Buna-S, made from butadiene polymerized with styrene, and Perbunan (formerly Buna-N) and Perbunan Extra, made from butadiene polymerized with acrylonitrile.

Although none of the synthetic rubbers has all the qualities of natural rubber, most of them have qualities that are specifically desirable, such as better resistance to heat, water absorption, abrasion, and action of oil.

Although high cost makes competition of synthetic rubber with natural rubber difficult for ordinary uses under present economic circumstances, production facilities could be obtained quickly if the United States were deprived of its usual source of rubber for tire requirements, and mass production probably would lower the cost. At present Buna-S rubber is not produced commercially from petroleum in the United States. Two plants for the production of Perbunan rubber, however, are under construction, one at Baton Rouge, La., and the other at Borger, Tex.

REFINERY CAPACITY

The vital need in defense planning for current statistics on the production and capacity of refineries prompted the Bureau of Mines to compile its January 1, 1941, survey of refineries several months earlier than usual and to make available in this volume a discussion of both the 1940 and 1941 surveys.

Daily refinery capacity, including that of refineries under construction, was 4,860,194 barrels on January 1, 1941—138,981 barrels more than that on January 1, 1940, and 209,389 barrels more than that on January 1, 1939. Although the total number of plants increased from 557 on January 1, 1940, to 562 on January 1, 1941, the increase from 96 to 142 in the number of idle refineries and those under construction caused the number of operating refineries to decrease to 420 compared with 461 on January 1, 1940.

The number of idle refineries increased principally in Illinois and California. Coincident with the sharp decline in crude-oil production in Illinois the number of idle refineries increased from none on January 1, 1940, to 10 on January 1, 1941. The number of refineries operating in Illinois increased from 16 on January 1, 1939, to 24 on January 1, 1940, and refining capacity from 151,650 to 188,450 barrels. By January 1, 1941, the number of refineries operating decreased to 16, but capacity increased to 226,400 barrels, indicating that the increase in capacity in 1940 was at the large refineries, whereas the plants closed in 1940 were the small refineries that depended on a plentiful supply of cheap crude oil.

Summary of refinery capacity in the United States, January 1, 1937–41

Year	Number of refineries				Capacity (barrels per day)			
	Operating	Shut down	Building	Total	Operating	Shut down	Building	Total
1937	423	149	11	583	3,966,616	328,265	81,200	4,376,081
1938	431	120	10	561	[1] 3,970,196	[1] 380,955	[1] 283,020	4,634,171
1939	435	103	7	545	3,933,785	574,770	142,250	4,650,805
1940	461	86	10	557	4,196,694	431,952	92,567	4,721,213
1941	420	136	6	562	4,180,588	538,381	141,225	4,860,194

[1] New basis; for complete information see Bureau of Mines Information Circular 7034.

The combination of lower prices for gasoline and termination of a favorable distributing arrangement for independent refineries in the Los Angeles area caused the number of idle plants in California to rise from 11 on January 1, 1940, to 30 on January 1, 1941. Closing of 14 refineries operating in the State—73 were in operation on January 1, 1940, and 59 on January 1, 1941—reduced the net operating capacity from 799,110 barrels to 761,510.

Total refining capacity increased most in the East Coast and Texas Gulf Coast districts, the capacity of each rising about 55,000 barrels. The operating ratio in 1940, or the proportion of crude runs to capacity, was 82 percent, the same as in 1939.

The daily capacity of cracking plants on January 1, 1941, was 1,151,193 barrels of cracked gasoline output; this figure includes plants with a capacity of 48,145 barrels that were under construction and an idle capacity of 82,042 barrels, or 46,904 barrels more than the capacity of January 1, 1940.

Much of the construction at refineries in 1940 did not increase crude-oil capacity; some of it involved improved methods of refining

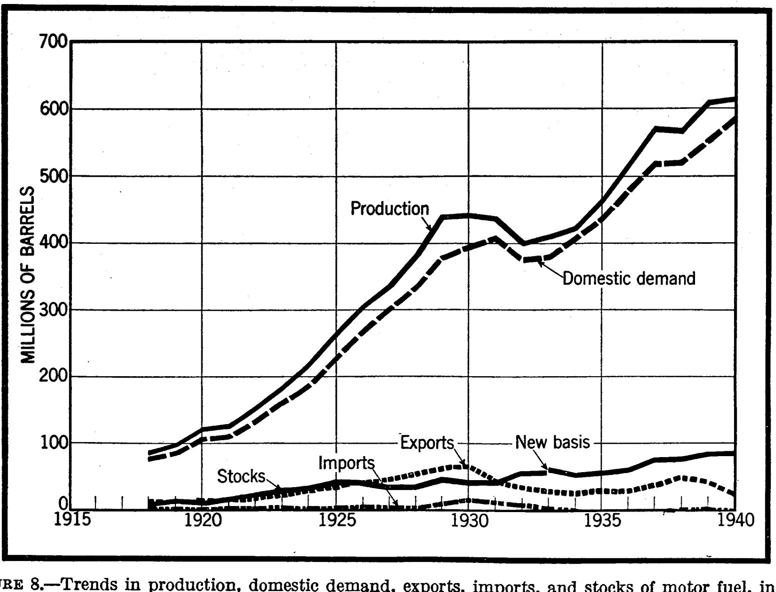

FIGURE 8.—Trends in production, domestic demand, exports, imports, and stocks of motor fuel, in the United States, 1918–40.

lubricating oils, such as solvent-extraction plants, and much of it consisted of plants for hydrogenating, catalytic cracking, polymerization, extraction of toluene, and of production of synthetic rubber.

MOTOR FUEL

Demand.—The usual new record for domestic motor-fuel demand was established in 1940 at 589,424,000 barrels, a 6-percent increase over the 1939 record—555,509,000 barrels. Total demand, however, increased only 2.4 percent owing to a 44-percent drop in exports from 44,638,000 barrels in 1939 to 25,107,000 in 1940 (see fig. 8).

Comparative analyses of statistics for motor fuel in the United States in 1940, by months [1]

[Thousands of barrels]

	1940						
	January	February	March	April	May	June	July
Production	50,243	47,596	51,230	50,625	52,183	51,325	51,879
Daily average	1,621	1,641	1,653	1,687	1,683	1,711	1,674
Imports	18	3	24		16	3	5
Exports	2,274	1,903	2,265	2,075	1,992	2,581	1,686
Daily average	73	66	73	69	64	86	54
Stocks, end of period	89,339	97,478	101,860	102,727	99,988	93,276	89,609
Domestic demand	40,370	37,557	44,607	47,683	52,946	55,459	53,865
Daily average	1,302	1,295	1,439	1,589	1,708	1,849	1,738

	1940						1939 (total)
	August	September	October	November	December	Total	
Production	52,658	52,313	52,907	50,892	52,508	616,359	611,043
Daily average	1,699	1,744	1,707	1,696	1,694	1,684	1,674
Imports	2	8	3	11	4	97	47
Exports	2,087	1,907	2,149	2,205	1,983	25,107	44,638
Daily average	67	64	69	73	64	69	122
Stocks, end of period	84,836	82,953	79,907	79,531	83,647	83,647	81,722
Domestic demand	55,346	52,297	53,807	49,074	46,413	589,424	555,509
Daily average	1,785	1,743	1,736	1,636	1,497	1,610	1,522

[1] Subject to revision.

Domestic motor-fuel demand per motor vehicle in use increased from 19.33 barrels (812 gallons) in 1939 to 19.89 barrels (835 gallons) in 1940. The estimated number of motor vehicles in use on July 1 increased by more than 900,000 in 1940 to about 29,600,000; this record was partly attributable to an increase in new registrations from 3,140,000 in 1939 to 3,991,000 in 1940. The increasing number of motor vehicles scrapped, however, prevented the number in use from increasing to the full extent of the increase in new registrations.

Studies of traffic surveys, toll-bridge statistics, and other traffic statistics indicate that truck traffic in metropolitan areas has stabilized at about 18 to 19 percent of total motor-vehicle traffic. The proportion of truck traffic on the highways, however, is still increasing and is about 16 to 17 percent of the total.

Domestic demand for motor fuel per motor vehicle in use in the United States, 1938–40

	1938	1939	1940 [1]
Domestic demand for motor fuel ... thousands of barrels	523,003	[2] 555,509	589,424
Motor vehicles in use July 1 ... number	28,168,500	28,732,100	29,638,600
Motor-fuel demand per motor vehicle in use:			
Actual ... barrels	18.57	[2] 19.33	19.89
Based upon 1924–31 trend [3] ... do	21.86	22.57	23.27
Deviation from trend ... do	−3.29	[2] −3.24	−3.38
Production and trade [4] ... index numbers	77	86	93

[1] Subject to revision.
[2] Revised figures.
[3] Least squares straight-line trend based on 1924–31 data. Depression years have been omitted because they are not normal.
[4] Federal Reserve Bank of New York; computed normal=100.

Distribution of domestic motor-fuel demand in the United States, 1936–40

[Thousands of barrels]

	1936	1937	1938	1939	1940 [1]
Passenger cars:					
Highway	150,896	161,302	161,821	170,401	179,690
City	170,128	182,614	186,459	196,820	207,422
Total passenger cars	321,024	343,916	348,280	367,221	387,112
Trucks:					
Highway	35,462	39,723	40,757	45,195	49,399
City	57,643	63,084	61,136	66,687	72,576
Total trucks	93,105	102,807	101,893	111,882	121,975
Busses	14,500	15,500	15,300	15,300	15,500
Total automotive demand [2]	428,629	462,223	465,473	494,403	524,587
Other demand	52,977	57,129	57,530	61,106	64,837
Grand total	481.606	519,352	523,003	555,509	589,424

[1] Subject to revision.
[2] 89 percent of total motor-fuel demand.

Gasoline-temperature index and estimated influence of weather on motor-fuel demand in the United States in 1940 by months

Month	Gasoline-temperature index [1]	Influence on motor-fuel demand (thousands of barrels)	Month	Gasoline-temperature index [1]	Influence on motor-fuel demand (thousands of barrels)
January	−7.1	−3,477	September	−0.4	−373
February	.9	−155	October	.7	−230
March	−1.1	−450	November	−.2	−388
April	−1.6	−494	December	3.7	843
May	−.4	−401			
June	.7	−221	Average index	−.4	
July	.6	−290	Total influence		−6,043
August	−.1	−407			

[1] In degrees departure from 46-year normal.

Consumption of domestic motor fuel was reduced possibly 6 million barrels in 1940 by inclement weather. The gasoline-temperature index table shows that the index was minus 7.1° for January—the coldest month in the 16 years that the gasoline-temperature index has been employed. Calculations indicate that consumption of motor fuel during that month is estimated at over 3 million barrels less than it would have been under normal weather conditions, although the reduction in consumption owing to the diminished use of automobiles was offset by other factors. December was the only month in the year when the temperature index was not below the 1925–38 average (1° above the Weather Bureau's 46-year normal).

The decline in exports of motor fuel, well under way in the latter part of 1939, continued throughout 1940. The British blockade imposed at the beginning of the war prevented shipments to Germany during the last few months of 1939. The invasion of Denmark and Norway in April and of the Low Countries in May 1940, the fall of France, and the entry of Italy into the war in June so extended the blockade that the United States lost virtually all of its European oil market except that in the British Isles. Even Britain, as far as possible, bought its oil from South America or other sources to conserve exchange.

The pleasure use of automobiles was severely curtailed or even eliminated except in the Americas, and such motor vehicles as were permitted to operate abroad were encouraged to use gasoline substitutes. Aside from the motor fuel produced from coal in Germany, and to a smaller degree in England, Japan, and France, the most popular substitutes are liquefied gas, gas carried in bags on top of the automobile, and charcoal or producer gas generated by the motor vehicles using it. Alcohol was developed in many of these countries during peace times to secure an independent source of motor fuel, but the need for edibles is so great in most European countries that agricultural efforts are being directed toward raising food rather than toward the production of crops for the manufacture of alcohol.

Production.—Motor-fuel production increased less than 1 percent in 1940 but rose to 616,359,000 barrels from 611,043,000 in 1939. The small increase in the production of motor fuel in 1940 resulted from a decline in gasoline exports and an adjusted balance in refinery operations whereby needed heavy oils were obtained by increasing the yield of those products and reducing the yield of gasoline. The production of motor fuel in 1940 comprised 263,584,000 barrels of straight-run gasoline, 294,365,000 of cracked gasoline, 3,161,000 of benzol, and 55,249,000 of natural gasoline, the latter consisting of about 39 million barrels blended at refineries and about 16 million barrels utilized elsewhere.

Straight-run gasoline continued to represent 42.8 percent of all motor fuel produced; but the ratio for cracked gasoline—the trend of which had been upward for a number of years—declined from 48.3 percent to 47.8—the first decrease since 1934 and the second in the history of Bureau of Mines statistics. The ratio for natural gasoline blended at refineries declined from 6.5 percent to 6.4 in 1940, but that for "other" natural gasoline increased from 1.8 percent to 2.6, making the total ratio for natural gasoline 9.0 percent in 1940.

Yields.—Although technologic improvement advanced and much catalytic cracking, polymerization, and alkylation equipment was installed in 1940, the yield of gasoline dropped from 45.0 percent of the crude runs to stills in 1939 to 43.1 percent in 1940. An adjustment in refinery operations was necessary when the extremely cold weather of early 1940 increased the first-quarter demand for distillate fuel oil 25 percent compared with the demand for the first quarter of 1939. Refinery operations were concentrated on making heating oil, and the yield of gasoline dropped from 44.7 percent in the first quarter of 1939

Production of gasoline in the United States in 1940, by methods of manufacture, districts, and months [1]

[Thousands of barrels]

Method and district	January	February	March	April	May	June	July	August	September	October	November	December	Total
Straight run:													
East Coast	3,092	2,476	2,994	2,713	2,308	2,670	2,608	2,604	2,927	2,350	2,631	2,658	32,031
Appalachian	884	771	869	718	951	775	745	851	865	858	825	856	9,968
Indiana, Illinois, Kentucky, etc	3,841	3,997	4,593	4,486	5,144	4,972	4,927	4,564	4,414	4,507	4,366	4,292	54,103
Oklahoma, Kansas, and Missouri	2,647	2,351	2,653	2,656	2,925	2,756	2,778	2,824	2,628	2,459	2,201	2,301	31,179
Texas Inland	1,158	1,146	1,197	1,350	1,421	1,454	1,515	1,625	1,233	1,226	1,285	1,518	16,128
Texas Gulf Coast	5,040	4,943	4,585	5,511	4,463	4,762	4,721	4,273	4,612	4,799	4,572	5,314	57,595
Louisiana Gulf Coast	643	768	573	858	693	674	620	633	680	716	744	880	8,482
Arkansas and Louisiana Inland	611	561	541	544	573	567	511	562	571	551	511	570	6,673
Rocky Mountain	729	668	740	716	822	651	684	779	714	655	652	636	8,446
California	3,064	2,728	3,029	3,530	3,226	3,141	3,311	3,405	3,610	3,481	3,266	3,188	38,979
Total straight run	21,709	20,409	21,774	23,082	22,526	22,422	22,420	22,120	22,254	21,602	21,053	22,213	263,584
Percent yield [2]	20.4	20.0	19.8	21.6	20.1	20.7	20.8	20.4	20.6	19.7	20.0	20.3	20.4
Cracked:													
East Coast	3,599	3,015	3,724	3,587	3,427	3,581	3,862	4,140	3,632	3,899	3,384	3,793	43,643
Appalachian	1,082	1,033	1,100	1,015	937	1,085	1,198	1,194	1,127	1,155	1,050	1,180	13,156
Indiana, Illinois, Kentucky, etc	5,340	4,896	5,065	4,837	5,490	5,357	5,849	5,994	5,686	6,062	5,382	5,659	65,617
Oklahoma, Kansas, and Missouri	2,085	2,038	2,303	2,232	2,461	2,638	2,432	2,564	2,728	2,604	2,618	2,465	29,168
Texas Inland	1,560	1,485	1,488	1,499	1,486	1,403	1,359	1,335	1,379	1,493	1,472	1,334	17,293
Texas Gulf Coast	6,276	6,479	7,027	6,407	7,354	6,748	6,684	6,531	6,682	7,019	6,859	6,802	80,868
Louisiana Gulf Coast	616	593	756	686	600	612	589	670	629	649	699	655	7,754
Arkansas and Louisiana Inland	306	328	279	286	293	284	309	356	342	343	352	349	3,827
Rocky Mountain	581	555	578	546	621	571	550	655	700	559	679	615	7,210
California	2,546	2,355	2,410	1,806	2,154	1,960	1,664	2,148	2,185	2,185	2,221	2,195	25,829
Total cracked	23,991	22,777	24,730	22,901	24,823	24,239	24,496	25,587	25,090	25,968	24,716	25,047	294,365
Percent yield [2]	22.5	22.4	22.4	21.4	22.2	22.4	22.7	223.5	23.3	23.8	23.4	22.8	22.7
Total production including natural gasoline:													
East Coast	6,852	5,564	6,794	6,382	5,856	6,366	6,560	6,827	6,715	6,451	6,216	6,665	77,248
Appalachian	2,000	1,840	2,007	1,761	1,908	1,884	1,975	2,070	2,027	2,049	1,914	2,073	23,508
Indiana, Illinois, Kentucky, etc	9,591	9,342	10,084	9,701	11,039	10,715	11,192	11,025	10,630	11,195	10,382	10,509	125,405
Oklahoma, Kansas, and Missouri	5,232	4,805	5,363	5,281	5,774	5,748	5,577	5,818	5,850	5,583	5,308	5,246	65,585
Texas Inland	3,316	3,221	3,242	3,372	3,416	3,265	3,308	3,463	3,256	3,421	3,320	3,472	40,072
Texas Gulf Coast	11,762	11,829	12,039	12,305	12,483	11,920	11,813	11,330	11,989	12,426	12,241	12,676	144,813
Louisiana Gulf Coast	1,276	1,372	1,347	1,566	1,308	1,300	1,225	1,318	1,341	1,424	1,467	1,570	16,514
Arkansas and Louisiana Inland	953	924	855	851	893	874	838	941	937	928	898	969	10,861
Rocky Mountain	1,392	1,298	1,397	1,309	1,465	1,258	1,271	1,473	1,467	1,290	1,428	1,340	16,388
California	6,611	6,058	6,362	6,238	6,282	5,931	5,901	6,523	6,876	6,959	6,621	6,523	76,885
Total United States: 1940	48,985	46,253	49,490	48,766	50,424	49,261	49,660	50,788	51,088	51,726	49,795	51,043	597,279
1939	48,308	42,721	47,373	47,426	49,780	49,418	50,439	51,643	50,770	[3] 54,612	[3] 52,387	[3] 51,624	[3] 596,501

[1] Subject to revision.

[2] Based on crude runs to stills.

[3] Includes aviation gasoline (thousands of barrels) as follows: October 981, November 845, December 1,048, total 2,784.

to 42.5 percent for the same period in 1940. During the remainder of the year an effort was made to increase heating-oil stocks and reduce gasoline stocks, with the result that yields of gasoline were kept low, and stocks, which were 16,589,000 barrels higher on March 31, 1940, than on the same date in 1939, were only 1,544,000 barrels higher on December 31, 1940, than at the end of 1939.

The decline in yield of gasoline was shared by both straight-run and cracked gasolines, the former decreasing 0.7 percent—from 21.1 to 20.4—and the latter 1.2 percent—from 23.9 to 22.7. Several factors account for the decrease. If the demand for heavy oils is strong the refiner may select crudes of low gasoline content. Foreign crude usually is of much lower gravity than domestic crude, and the increased runs of foreign oil in 1940 had some influence in lowering the yield. The diversion of cracking stock to supply heating-oil requirements, such as probably occurred in the early part of 1940, would lower the yield of cracked gasoline, whereas the decline in the quantity of unfinished oils rerun (from 11,731,000 barrels in 1939 to 3,845,000 in 1940) probably would account for more than 0.3 percent in the difference between the yield of cracked gasoline in 1939 and 1940.

The yield of gasoline in all of the districts except Arkansas and Louisiana Inland declined, the greatest difference being in the Texas Gulf Coast district, where the decrease from 44.1 percent in 1939 to 41.0 percent in 1940 amounted to 3.1 percent. The next largest was in the East Coast district, where a decrease of 3.2 percent in cracked gasoline was partly offset by a rise in straight-run, with the result that the 1940 yield was 37.0 percent—2.9 percent less than that for 1939. The decline for the Rocky Mountain district was 2.7 percent, shared by both straight-run and cracked gasoline, whereas the yield for the Inland Texas district decreased 3.7 percent in straight-run but gained 1.3 percent in cracked gasoline.

Texas Inland had the highest yield of any district, with 54.1 percent; and the Indiana, Illinois, Kentucky, etc., district was next, with 53.0 percent. California had the lowest, with 32.9 percent.

Prices.—Although the quality of gasoline has been improving steadily, there was no change in the grades on which prices are quoted between 1937 and 1940. The confusion and dissatisfaction resulting from the variety of knock-rating methods led the Western Refiners Association in April 1940 to adopt the A. S. T. M. (motor) method, which in 1939 had been made standard by the American Society for Testing Materials, instead of the L–3 method recognized by the association since 1937. At the same time the association established new grades.

The grade known in 1931 as 57 octane and below was changed in 1933 to 59 octane and below, in 1934 to 62 octane and below, and in 1940 to 61 octane and below. The regular grade was 57–65 octane from October 1931 to May 1933, when it was changed to 60–64 octane, and then in 1934 changed again to 63–70 octane. In 1936 this grade was split into two classifications—63–67 octane and 68–70 octane—the latter being designated as regular gasoline. In 1937, when the L–3 method of determining the octane number was adopted, these two grades were changed to 63–66 and 67–69 octane, and a new grade—70–72 octane—was added and designated as regular gasoline. In 1940 the 63–66 octane grade remained unchanged, whereas the 67–69 and 70–72 octane grades were eliminated and a 72–74 octane

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grade was designated as regular gasoline. Although prices were quoted on a premium grade of above 65 octane in 1931, which was changed in 1933 to 65 octane and above and in 1934 to 71 octane and above, sales of this grade on the open market were discontinued in 1934. The three grades now sold on the open market are 61 octane and below, 63–66 octane, and 72–74 octane.

Octane rating and refinery prices in cents per gallon for regular-grade gasoline in Mid-Continent (group 3) area, 1931–40

Year	Average price	Octane rating	Method of rating [1]	Date rating effective	Year	Average price	Octane rating	Method of rating [1]	Date rating effective
1931	[2] 4.08	57–65	C. F. R. research	Oct. 19	1936	5.95	68–70	A. S. T. M.	Apr. 15
1932	4.66	57–65	do	Do.	1937	5.91	70–72	L–3	Sept. 20
1933	3.92	60–64	A. S. T. M.	May 8	1938	5.53	70–72	do	Do.
1934	4.75	63–70	do	Aug. 6	1939	5.12	70–72	do	Do.
1935	5.27	63–70	do	Do.	1940	4.86	72–74	A. S. T. M.	Apr. 8

[1] For description of various methods of octane rating see Bureau of Mines Minerals Yearbook, 1940, p. 1000.
[2] Average price, October 19 to December 31.

The accompanying table shows the annual average price of regular-grade gasoline, the octane ratings, and dates of change from 1931, when octane numbers were first used, through 1940.

The average refinery price for the new regular-grade (72–74 octane) gasoline from April 8 to December 31 was less than that of the premium grade (above 65 octane) during most of the depression in 1932 and 1933. Although it is only about 9 octane numbers higher than the premium grade of 1932–33, the difference in the method of determining the rating would make the spread considerably more.

Average monthly prices of gasoline in the United States, 1939–40, in cents per gallon

	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
1939													
Monthly average at refineries in Oklahoma: 67–69 octane [1]	4.38	4.34	4.42	4.55	4.73	4.91	4.94	4.95	5.00	5.00	4.98	4.92	4.76
Average of 50 cities on 1st of month: [2]													
Dealer's net	9.56	9.40	9.35	9.37	9.45	9.49	9.67	9.61	9.69	9.79	9.87	9.75	9.58
Service station (including State tax) [3]	17.76	17.55	17.48	17.51	17.60	17.66	17.86	17.74	17.84	17.94	18.07	17.93	17.74
1940													
Monthly average at refineries in Oklahoma: [1]													
67–69 octane (L–3) [4]	4.67	4.46	4.43	4.43									4.50
72–74 octane (A. S. T. M.) [4]				5.00	5.00	5.00	5.00	4.94	4.89	4.79	4.75	4.75	4.90
Average of 50 cities on 1st of month: [2]													
Dealer's net	9.78	9.73	9.61	9.42	9.24	9.00	8.91	8.91	8.69	8.59	8.58	8.46	9.08
Service station (including State tax)	7.95	17.85	17.76	17.59	17.33	17.08	16.95	17.00	16.73	16.60	16.61	16.49	17.16

[1] National Petroleum News. [2] American Petroleum Institute; compiled by The Texas Co.
[3] Revised figures. [4] 67–69 octane (L–3 method) discontinued April 11; 72–74 octane (A. S. T. M. method) initiated April 8.

During the last 2 years the Bureau of Mines has used the 67–69 octane gasoline to represent price changes because of its comparability with the 68–70 octane grade that preceded it, although the 70–72 octane gasoline was the grade recognized as regular. As shown in the table of monthly gasoline prices, the price for new regular grade gasoline (72–74 octane) was 0.57 cent higher on the date of change than that for the 67–69 octane gasoline. This difference, deducted from the 8-month average price for the 72–74 octane gasoline, would make the price for the latter 4.33 cents or 0.43 cent less than the 1939 average for the 67–69 octane gasoline.

Although the trend of prices in 1939 was upward, the 1940 trend was down. The old grade declined from 4.67 cents at the beginning of the year to 4.43 cents before it was discontinued, whereas the new grade, which started at 5 cents in April and maintained that price during the summer, dropped to 4.75 cents by the end of the year. The weak prices in 1940 can be attributed principally to the large stocks of motor fuel accumulated during the winter months.

The average service-station price for regular-grade gasoline (ex tax) dropped to 12.75 cents—only 0.34 cent above the depression low of 12.41 cents in 1933 and 0.56 cent lower than the 1939 average. From the 13.53-cent price on January 1 the trend was downward to 12.09 cents on December 1. By December 31, however, the average price had recovered to 12.17 cents.

In general, price changes were largest in the Rocky Mountain and Southeastern areas. The price at Helena, Mont., changed from 18.5 cents (ex tax) to 13—a decrease of 5.5 cents from January 1 to December 31—while at Cheyenne, Wyo., there was a decrease of 5 cents—from 15 to 10 cents.

The drop in the average price (ex tax) in the Rocky Mountain areas from 16.66 cents on January 1, 1940, to 13.55 cents on January 1, 1941, brought the January 1, 1941, average for the area 0.34 cent under the average of 13.89 cents prevailing in the Pacific Coast territory. The latter price represented a decline of 1.33 cents in the Pacific Coast area from 15.22-cent average on January 1, 1940. The cost of gasoline was lowest in the Atlantic and New England States, the average price being 10.50 cents on January 1, 1941.

The highest price paid by motorists for gasoline on January 1, 1941, was 23.6 cents (including 6.6 cents tax) at Twin Falls, Idaho. Knoxville, Tenn., ranked second with a price of 23.0 cents, including taxes of 8.5 cents. Syracuse (N. Y.) motorists paid the least for gasoline—13.2 cents, including 5.5 cents tax. This city was followed, in turn, by Boston, Mass., with 13.7 cents and Hartford with 14.0 cents; both included 4.5 cents tax.

The increase in the Federal tax on gasoline from 1 cent a gallon to 1½ cents on July 1 was the most important legislation of the year as regards the cost of gasoline to motorists. The only change in State taxes occurred in Minnesota, where payment of the 1-cent-a-gallon emergency gasoline tax ceased September 1, reducing the tax rate from 4 cents to 3.

In 1940 Idaho, Nevada, North Dakota, and South Dakota approved diversion prohibition amendments to their constitutions; a total of 11 States now forbid the diversion of gasoline-tax receipts to uses other than for highway purposes.

Aviation gasoline.—The production of finished and unfinished aviation gasoline in 1940 was 14,736,000 barrels. Comparable data are available for only the last 3 months of 1939, but it is believed that the 1940 total represented a gain of 40 percent. Transfers of low-octane material to regular-grade gasoline in 1940 were 723,000 barrels, exports were 4,649,000 barrels (including 1,203,000 barrels of antiknock compounds), and 6,658,000 barrels were domestic demand. Preliminary figures indicate that 2,259,000 barrels were consumed during the year by civilian aircraft, 1,797,000 barrels by 448 commercial planes, and 462,000 by 16,903 private planes, leaving about 4 million barrels for military purchases and miscellaneous consumption. Stocks of aviation gasoline on December 31, 1940, totaled 6,354,000 barrels compared with 3,648,000 barrels on hand the first of the year.

Comparative analyses of statistics for aviation gasoline in 1940, by months [1]

[Thousands of barrels]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Production	952	1,022	1,347	1,441	1,185	1,041	1,148	1,255	1,161	1,279	1,593	1,312	14,736
Transfers to regular gasoline	------	------	------	------	------	------	------	------	20	89	344	270	723
Exports:													
Antiknock compounds	23	154	87	18	72	106	24	187	145	132	178	77	1,203
Other	155	125	249	302	415	540	186	382	156	159	357	420	3,446
Total exports	178	279	336	320	487	646	210	569	301	291	535	497	4,649
Stocks, end of month	3,918	4,264	4,818	5,178	5,514	5,268	5,465	5,780	6,018	6,216	6,318	6,354	6,354
Domestic demand	504	397	457	761	362	641	741	371	602	701	612	509	6,658

[1] First data compiled were for October 1939; the production figures in thousands of barrels for October, November, and December 1939 were respectively, 981, 845, and 1,048; transfers, none; exports of antiknock compounds, none, the figures not being available but believed negligible; other exports, 287, 274, and 372; stocks, 3,386, 3,490, and 3,648; domestic demand, 234, 467, and 518. Data for 1939–40 are included in other tables of this report.

Exports of aviation gasoline, including antiknock compounds, amounted to 4,649,000 barrels in 1940. This is higher than the 1939 total (4,234,000 barrels) but the figures are not comparable as data on exports of antiknock compounds were not available before January 1, 1940. Up to the time of its collapse France led in the receipts of this product. Shipments to France were 514,000 barrels in the first 6 months of the year compared with 504,000 barrels shipped to the United Kingdom in the same period. The most important shipments for the year were United Kingdom 1,525,000 barrels, Netherlands Indies 578,000, Japan 528,000, and France 514,000.

Prices for aviation gasoline at the beginning of the year ranged from 14.2 cents a gallon (ex tax) at Kansas City, Mo., to 22.5 cents at Helena, Mont. Prices in the Ohio territory at the beginning of the year were 16, 17, and 18 cents, respectively, for 74-, 80-, and 87-octane gasoline. These prices dropped one-half cent during the year, and on September 1 a new grade was added at 14.5 cents as well as a 100-octane grade at 24.5 cents.

Stocks.—Motor-fuel stocks exceeded all records in 1940; finished and unfinished gasoline inventories amounted to 103,710,000 barrels on March 31, or 16,589,000 barrels more than on the same date in 1939. Refineries had not adjusted their operations to meet the growing demand for heating oil when they encountered a 25-percent increase over the previous year brought on by the severe weather in the early part of 1940. Heavy runs to stills to meet this demand for heating oil resulted in a rapid accumulation of gasoline. Only after drastic readjustments in operations whereby the yields of gasoline were reduced severely did adjustment of motor-fuel stocks to a normal ratio begin.

At the end of 1939 inventories of finished and unfinished gasoline totaled 82,865,000 barrels, whereas at the end of 1940, despite the rapid rise during the first few months of the year, they were only 84,409,000 barrels. The latter figure represented 55.2 days' supply compared with 60.2 days' supply at the end of 1939. If these figures are adjusted for stocks of aviation fuel accumulated for defense purposes the days' supply decreased from 57.5 at the end of 1939 to 51.0 at the end of 1940, which is even less than the 53.3 at the end of 1938.

Days' supply of motor fuel on hand in the United States at end of month, 1938–40

Month	1938			1939 [2]			1940 [3]		
	Finished gasoline	Natural gasoline	Total motor fuel	Finished gasoline	Natural gasoline	Total motor fuel	Finished gasoline	Natural gasoline	Total motor fuel
January	61.7	3.8	65.5	54.6	3.5	58.1	62.4	3.3	65.7
February	58.6	3.5	62.1	52.1	3.1	55.2	61.3	3.2	64.5
March	53.2	3.5	56.7	50.8	3.0	53.8	58.2	3.2	61.4
April	51.8	3.8	55.6	46.6	3.2	49.8	54.5	3.5	58.0
May	46.1	3.8	49.9	43.1	3.4	46.5	48.3	3.4	51.7
June	44.1	4.1	48.2	42.5	3.8	46.3	48.1	4.0	52.1
July	39.3	4.3	43.6	38.3	3.7	42.0	44.3	4.1	48.4
August	39.0	4.9	43.9	37.1	3.7	40.8	42.7	4.3	47.0
September	38.5	4.9	43.4	38.1	3.4	41.5	42.1	3.9	46.0
October	39.1	4.1	43.2	40.9	3.1	44.0	42.9	3.8	46.7
November	42.1	3.8	45.9	47.3	3.0	50.3	47.0	3.9	50.9
December	[2] 49.0	[2] 3.2	[2] 52.6	56.2	3.2	59.4	51.0	3.7	54.7

[1] Stocks divided by the daily average total demand (domestic demand plus exports) for succeeding month.
[2] Revised figures.
[3] Subject to revision.

More than half of the 1,544,000-barrel gain in finished and unfinished inventories from December 31, 1939, to December 31, 1940, is attributable to an increase in unfinished stocks from 5,564,000 barrels to 6,466,000. Only 642,000 barrels more of finished gasoline was available at the end of the year than at the beginning, the respective quantities being 77,301,000 and 77,943,000 barrels. The greatest expansion occurred in the Indiana, Illinois, Kentucky, etc., district, where stocks (finished and unfinished) of 15,883,000 barrels at the end of the year were 2,262,000 barrels higher than the 13,621,000 available at the beginning of the year. The Louisiana Gulf Coast district increase of 501,000 barrels (more than 20 percent) to a total of 2,941,000 compared with the 2,440,000 barrels available on December 31, 1939. Although the 503,000-barrel decrease in Texas Gulf Coast stocks, which dropped from 14,936,000 barrels to 14,433,000, was the greatest, finished stocks in California were reduced from 16,121,000 barrels to 14,927,000. A 680,000-barrel increase (66 percent) in unfinished stocks, however, partly offset this decline, so that the net reduction from 17,153,000 barrels to 16,639,000 was only 514,000 barrels.

Stocks of gasoline in the United States in 1940, by districts and months [1]

[Thousands of barrels]

District	January 31	February 29	March 31	April 30	May 31	June 30	July 31	August 31	September 30	October 31	November 30	December 31
Finished gasoline: [2]												
East Coast	18,744	18,902	21,536	23,286	22,855	21,752	21,425	20,822	19,807	17,865	17,038	17,701
Appalachian	3,683	3,797	3,961	3,828	3,568	2,931	2,961	2,680	2,983	2,901	3,000	2,975
Indiana, Illinois, Kentucky, etc	14,727	17,218	19,033	18,411	17,649	15,949	15,567	14,497	14,051	13,902	14,175	15,206
Oklahoma, Kansas, and Missouri	7,776	8,219	8,249	7,652	7,286	6,197	6,147	5,865	6,003	5,757	5,939	6,838
Texas Inland	2,296	2,535	2,470	2,551	2,496	2,181	2,017	1,914	1,669	1,700	1,888	2,232
Texas Gulf Coast	15,326	18,522	17,702	17,357	16,919	16,206	14,454	12,845	12,679	12,860	12,344	13,180
Louisiana Gulf Coast	2,581	2,555	2,475	2,671	2,494	2,356	2,248	2,200	2,254	2,342	2,476	2,586
Arkansas and Louisiana Inland	854	998	918	878	786	726	759	688	729	668	670	771
Rocky Mountain	1,956	2,301	2,418	2,330	2,131	1,725	1,409	1,164	1,211	1,076	1,301	1,527
California	16,920	17,674	17,705	17,651	17,290	16,253	15.038	14,459	14,529	14,267	14,598	14,927
Total finished gasoline	84,863	92,721	96,467	96,615	93,474	86,276	82,025	77,134	75,915	73,338	73,429	77,943
Unfinished gasoline:												
East Coast	815	845	936	832	967	1,002	962	1,064	729	882	912	921
Appalachian	396	483	541	610	601	599	551	524	448	443	428	447
Indiana, Illinois, Kentucky, etc	625	824	946	935	772	756	709	637	692	673	674	677
Oklahoma, Kansas, and Missouri	506	745	734	775	764	621	552	406	345	355	449	579
Texas Inland	328	336	381	394	422	422	415	309	292	352	356	404
Texas Gulf Coast	1,744	1,605	1,681	1,484	1,881	1,780	1,661	1,418	1,330	1,168	1,211	1,253
Louisiana Gulf Coast	537	451	532	376	353	318	369	341	329	253	275	355
Arkansas and Louisiana Inland	34	35	29	23	25	22	23	26	24	28	29	26
Rocky Mountain	90	86	96	105	115	114	109	109	109	106	98	92
California	1,037	1,164	1,367	1,414	1,485	1,659	1,689	1,733	1,694	1,587	1,656	1,712
Total unfinished gasoline	6,112	6,574	7,243	6,948	7,385	7,293	7,040	6,567	5,992	5,847	6,088	6,466
Total finished and unfinished:												
East Coast	19,559	19,747	22,472	24,118	23,822	22,754	22,387	21,886	20,536	18,747	17,950	18,622
Appalachian	4,079	4,280	4,502	4,438	4,169	3,530	3,512	3,204	3,431	3,344	3,428	3,422
Indiana, Illinois, Kentucky, etc	15,352	18,042	19,979	19,346	18,421	16,705	16,276	15,134	14,743	14,575	14,849	15,883
Oklahoma, Kansas, and Missouri	8,282	8,964	8,983	8,427	8,050	6,818	6,699	6,271	6,348	6,112	6,388	7,417
Texas Inland	2,624	2,871	2,851	2,945	2,918	2,603	2,432	2,223	1,961	2,052	2,244	2,636
Texas Gulf Coast	17,070	20,127	19,383	18,841	18,800	17,986	16,115	14,263	14,009	14,028	13,555	14,433
Louisiana Gulf Coast	3,118	3.006	3.007	3,047	2,847	2,674	2,617	2,541	2,583	2,595	2,751	2,941
Arkansas and Louisiana Inland	888	1,033	947	901	811	748	782	714	753	696	699	797
Rocky Mountain	2,046	2,387	2,514	2,435	2,246	1,839	1,518	1,273	1,320	1,182	1,399	1,619
California	17,957	18,838	19,072	19,065	18,775	17,912	16,727	16,192	16,223	15,854	16,254	16,639
Total United States: 1940	90,975	99,295	103,710	103,563	100,859	93,569	89,065	83,701	81,907	79,185	79,517	84,409
1939	79,466	85,491	87,121	87,531	84,200	80,288	77,843	72,335	70,992	73,319	76,790	82,865

[1] Subject to revision.

[2] Includes all stocks of finished gasoline at refineries, bulk terminals, and pipe lines.

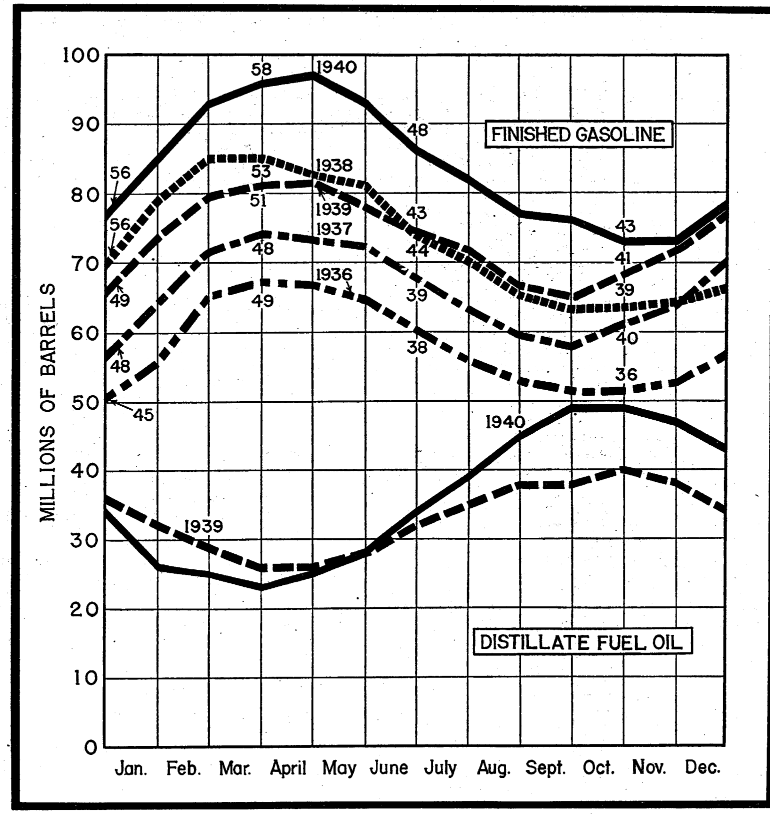

FIGURE 9.—Stocks of finished gasoline in the United States, 1936–40, by months, with figures representing days' supply at certain periods; also stocks of distillate fuel oil, 1939–40, by months.

Figure 9, showing the monthly figures for finished gasoline stocks in millions of barrels from January 1, 1936, to December 31, 1940, indicates how much more rapidly stocks in storage increased in the early part of 1940 than in normal years. This chart also shows the equivalent days' supply for certain periods. The figures for days' supply on the chart represent the quantity of finished gasoline on hand at the end of the month divided by the total demand for the succeeding month.

Figure 9 also shows the stocks of distillate fuel oil for 1939–40, to stress the contrast in seasonal variations in stocks of the two products. This chart shows further the unusual situation in heating oil, the stocks of which were 9,222,000 barrels higher at the end of 1940 than at the end of 1939, whereas the demand to be met in the succeeding month was 1,418,000 barrels less.

Production and consumption by States.—Texas, furnishing 31 percent, led in the production of gasoline. Percentages for the next important States were California, 13; Pennsylvania, 8; and Indiana and Illinois, 7 each.

New York's lead in consumption was reduced to only 0.2 percent in 1940 (see fig. 10). The percentage consumption of the principal States was as follows: New York, 8.2; California, 8.0; Pennsylvania, 6.5; Illinois, 6.3; Ohio, 6.1; and Texas, 5.9.

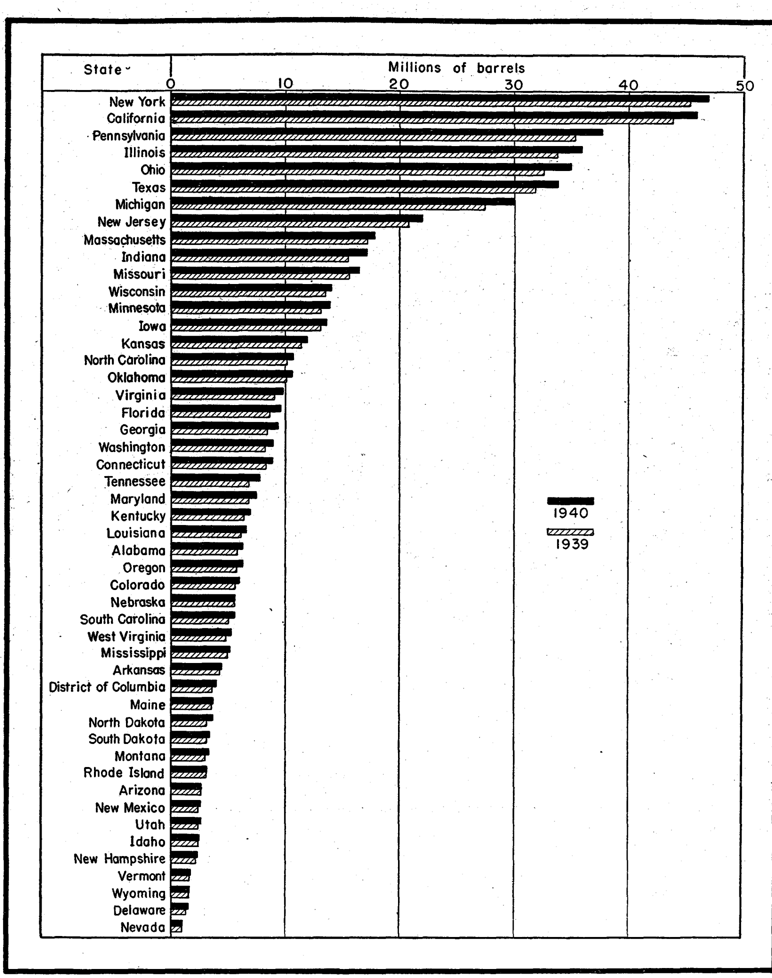

FIGURE 10.—Consumption of gasoline in the United States, 1939–40, by States.

Distribution.—Transportation of motor fuel by pipe line increased from 94,708,000 barrels in 1939 to 96,657,000 in 1940; this indicates a gain of only 2 percent, but actually the increase was much larger, as intercompany deliveries were eliminated beginning January 1, 1940. Water-borne shipments from California to the East coast increased from 3,665,000 barrels in 1939 to 3,966,000 in 1940 and those from the Gulf coast to the East coast from 114,633,000 barrels to 119,142,000. Domestic shipments on the Mississippi River and its tributaries increased from 51,808,000 barrels in 1938 to 59,183,000, in 1939.

Production and consumption of gasoline in the United States, 1938–40, by States

[Thousands of barrels]

State	1938		1939		1940 [1]	
	Production	Consumption [2]	Production	Consumption [2]	Production	Consumption [2]
Alabama	(3)	5,483	(3)	5,869	(3)	6,307
Arizona		2,441		2,550		2,699
Arkansas	3,028	4,040	3,452	4,339	3,702	4,546
California	77,528	41,722	[4] 79,774	43,760	[4] 76,885	45,904
Colorado	1,170	5,404	1,720	5,659	2,020	5,976
Connecticut		7,768		8,217		9,068
Delaware		1,328		1,391		1,495
District of Columbia		3,316		3,571		4,027
Florida		8,062		8,710		9,713
Georgia	[5] 4,990	8,066	[5] 4,646	8,531	[5] 4,329	9,346
Idaho	(6)	2,255	(6)	2,387	(6)	2,547
Illinois	28,309	31,703	[7] 33,538	33,803	[7] 41,386	35,944
Indiana	40,737	15,032	44,490	15,973	43,180	17,175
Iowa		12,574		13,103		13,637
Kansas	[8] 31,231	11,162	[8] 31,596	11,353	[8] 32,964	11,943
Kentucky	[9] 4,729	6,108	[9] 6,021	6,545	[9] 7,049	6,954
Louisiana	[3] 24,953	5,890	[3] 25,631	6,220	[3] 23,673	6,627
Maine		3,449		3,575		3,747
Maryland	(5)	6,475	(5)	6,945	(5)	7,491
Massachusetts	[10] 4,625	16,433	[10] 4,959	17,170	[10] 6,554	17,791
Michigan	6,822	25,094	7,932	27,455	10,216	29,979
Minnesota		12,613	(7)	13,111	(7)	13,861
Mississippi		4,616		4,988	(3)	5,219
Missouri	(8)	14,489	(8)	15,590	(8)	16,623
Montana	2,562	2,800	3,313	3,012	3,836	3,276
Nebraska	(6)	5,368	(6)	5,607	(6)	5,629
Nevada		920		1,045		1,043
New Hampshire		2,028		2,204		2,282
New Jersey	26,214	19,748	28,539	20,776	25,451	22,023
New Mexico	[11] 3,100	2,294	[11] 3,056	2,427	[11] 3,320	2,617
New York	5,515	42,910	6,355	45,255	7,826	46,918
North Carolina		9,546		10,229		10,938
North Dakota		3,031		3,137		3,638
Ohio	21,517	30,448	24,943	32,649	31,603	35,022
Oklahoma	34,488	9,732	33,898	10,159	32,603	10,584
Oregon		5,469		5,826		6,250
Pennsylvania	43,353	33,419	47,014	35,296	46,550	37,666
Rhode Island	(10)	2,881	(10)	3,092	(10)	3,190
South Carolina	(5)	4,656	(5)	5,055	(5)	5,577
South Dakota	(6)	3,080	(6)	3,174	(6)	3,422
Tennessee	(9)	6,687	(9)	6,875	(9)	7,785
Texas	182,427	30,247	196,935	31,926	184,885	33,806
Utah	(11)	2,213	(11)	2,375	(11)	2,552
Vermont		1,531		1,619		1,686
Virginia		8,457		9,098		9,943
Washington		8,057	(4)	8,320	(4)	9,024
West Virginia	1,627	4,533	1,712	4,879	2,017	5,262
Wisconsin		12,916		13,494		14,049
Wyoming	[6] 7,087	1,472	[6] 6,977	1,619	[6] 7,230	1,668
Total United States	556,012	509,966	596,501	539,963	597,279	574,469

[1] Subject to revision.
[2] American Petroleum Institute.
[3] Alabama and Mississippi included with Louisiana.
[4] Washington included with California.
[5] Maryland and South Carolina included with Georgia.
[6] Idaho, Nebraska, and South Dakota included with Wyoming.
[7] Minnesota included with Illinois.
[8] Missouri included with Kansas.
[9] Tennessee included with Kentucky.
[10] Rhode Island included with Massachusetts.
[11] Utah included with New Mexico.

Shipments of motor fuel by pipe lines in the United States, in 1940, by months

[Thousands of barrels]

	1940													1939 total
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
Motor fuel turned into lines	7, 167	6, 213	7, 181	7, 168	8, 218	8, 328	8, 634	8, 806	9, 250	9, 107	8, 568	8, 424	97, 064	95, 123
Motor fuel delivered from lines	6, 366	6, 072	6, 789	7, 698	8, 427	8, 447	8, 762	9, 429	9, 072	9, 010	8, 714	7, 871	96, 657	94, 708
Shortage	124	49	112	17	15	85	3	50	52	29	42	10	588	262
Stocks in lines and working tanks, end of month	5, 932	6, 024	6, 304	5, 757	5, 533	5, 329	5, 198	4, 525	4, 651	4, 719	4, 531	5, 074	5, 074	{3, 480 {[1]5,255

[1] For comparison with 1940.

KEROSENE AND RANGE OIL

The domestic demand for kerosene mounted sharply to a new record in 1940, but the export market, reflecting the general interruption of foreign trade in many countries, dropped to approximately a third of the 1939 volume. Domestic requirements for kerosene increased from 60,503,000 barrels in 1939 to 68,776,000 in 1940—a gain of 14 percent, or double the rate of expansion in 1939 over 1938; exports declined from 8,241,000 barrels in 1939 to 3,374,000 in 1940, an unprecedented "low." Total requirements of kerosene for both domestic and foreign markets increased from 68,744,000 barrels in 1939 to 72,150,000 in 1940—a 5-percent gain.

Comparative analyses of statistics for kerosene in the United States, 1939–40, by months and districts

Month and district	Production (thousands of barrels)		Yield (percent)		Domestic demand (thousands of barrels)		Stocks (thousands of barrels)	
	1939	1940 [1]	1939	1940 [1]	1939	1940 [1]	1939	1940 [1]
By months:								
January	5, 702	5, 375	5. 7	5. 0	5, 980	7, 642	6, 711	4, 918
February	5, 174	5, 945	5. 9	5. 8	5, 901	6, 263	5, 452	4, 302
March	5, 900	6, 570	6. 0	6. 0	5, 201	6, 273	5, 605	4, 114
April	5, 813	6, 257	5. 9	5. 8	5, 042	5, 621	5, 663	4, 351
May	5, 909	6, 641	5. 6	5. 9	4, 368	5, 297	6, 551	5, 309
June	5, 439	5, 785	5. 2	5. 4	3, 570	3, 942	7, 949	6, 810
July	5, 390	5, 797	5. 0	5. 4	3, 710	4, 257	8, 855	8, 191
August	5, 783	5, 629	5. 4	5. 2	4, 438	4, 114	9, 361	9, 476
September	5, 806	6, 062	5. 5	5. 6	4, 638	5, 173	9, 952	10, 254
October	6, 141	6, 496	5. 5	5. 9	5, 019	5, 608	9, 967	11, 000
November	5, 642	6, 431	5. 4	6. 1	6, 023	6, 768	9, 019	10, 473
December	5, 822	6, 894	5. 5	6. 3	6, 613	7, 808	7, 576	9, 512
Total United States	68, 521	73, 882	5. 5	5. 7	60, 503	68, 776	7, 576	9, 512
By districts:								
East Coast	9, 120	11, 447	4. 7	5. 6	(2)	(2)	1, 318	2, 428
Appalachian	2, 847	3, 213	6. 5	6. 7			297	183
Indiana, Illinois, Kentucky, etc.	8, 476	10, 344	4. 4	4. 6			1, 089	983
Oklahoma, Kansas, and Missouri	7, 073	7, 196	6. 3	6. 3			686	481
Texas Inland	2, 977	2, 753	4. 6	4. 5			149	159
Texas Gulf Coast	23, 224	26, 164	7. 0	7. 7			1, 917	3, 154
Louisiana Gulf Coast	6, 898	5, 897	14. 2	13. 1			773	646
Arkansas and Louisiana Inland	2, 470	2, 722	9. 9	11. 0			184	224
Rocky Mountain	782	824	3. 0	2. 7			105	128
California	4, 654	3, 322	2. 3	1. 7			1, 058	1, 126
Total United States	68, 521	73, 882	5. 5	5. 7	60, 503	68, 776	7, 576	9, 512

[1] Subject to revision.
[2] Figures not available.

On account of the 5-percent increase in crude runs to stills in 1940 and a higher yield of kerosene, refiners not only could meet the increased demand for kerosene but also added to the quantities held in storage during the year. The output of kerosene increased from 68,521,000 barrels in 1939 to 73,882,000 in 1940— an 8-percent gain. Most of the higher production can be attributed to the larger volume of crude runs; however, the improved yield of kerosene (5.7 percent in 1940 compared with 5.5 in 1939) was also a factor.

Sales of kerosene in the United States, 1938–39, by regions, States, and uses

[Thousands of barrels]

Region and State	Sold as range oil		Tractor fuel		All other uses		Total	
	1938	1939	1938	1939	1938	1939	1938	1939
Pacific Coast:								
California	86	104			1,206	1,170	1,292	1,274
Oregon	10	1	4	6	59	62	73	69
Washington	11	7			124	141	135	148
Arizona	6	6			82	99	88	105
Nevada	1	1			10	14	11	15
Rocky Mountain:								
Idaho	2	3	14	14	7	8	23	25
Montana	7	16	52	53	41	42	100	111
Wyoming	4	5	18	18	14	16	36	39
Utah	20	18	9	13	12	10	41	41
Colorado	22	24	69	75	50	51	141	150
New Mexico	23	25	29	28	44	43	96	96
North Central:								
North Dakota	36	56	167	171	47	59	250	286
South Dakota	74	77	124	130	69	73	267	280
Minnesota	150	207	255	244	457	476	862	927
Nebraska	97	114	196	176	159	181	452	471
Iowa	125	206	302	309	670	698	1,097	1,213
Wisconsin	143	208	187	201	522	558	852	967
Illinois	612	952	328	350	1,482	1,549	2,422	2,851
Indiana	107	152	127	124	1,068	1,102	1,302	1,378
Michigan	192	288	117	123	685	735	994	1,146
Ohio	270	279	181	206	823	800	1,274	1,285
Kentucky	34	56	31	48	486	456	551	560
Tennessee	101	113	89	79	426	434	616	626
South Central:								
Missouri	263	295	136	159	687	702	1,086	1,156
Kansas	154	168	206	200	271	282	631	650
Texas	242	279	314	425	1,365	1,414	1,921	2,118
Oklahoma	111	114	148	171	464	510	723	795
Arkansas	197	165	80	129	411	448	688	742
Louisiana	175	148	35	64	649	670	859	882
Mississippi	51	62	126	162	311	332	488	556
Alabama	82	89	26	24	344	366	452	479
New England:								
Maine	1,087	1,219	1	1	42	46	1,130	1,266
New Hampshire	701	781			37	38	738	819
Vermont	448	468	1		77	84	526	552
Massachusetts	9,629	10,455			452	448	10,081	10,903
Rhode Island	2,076	2,111			79	82	2,155	2,193
Connecticut	3,068	3,219	1	2	128	151	3,197	3,372
Middle Atlantic:								
New York	5,528	5,772	128	132	1,092	1,180	6,748	7,084
New Jersey	2,647	2,804	31	36	1,190	1,229	3,868	4,069
Pennsylvania	571	619	141	160	1,361	1,388	2,073	2,167
Delaware	86	96			52	56	138	152
Maryland	435	490	26	25	529	543	990	1,058
District of Columbia	51	71	1	2	76	85	128	158
South Atlantic:								
Virginia	170	186	7	9	560	576	737	771
West Virginia	37	33	4	3	147	181	188	217
North Carolina	329	513	88	94	641	652	1,058	1,259
South Carolina	96	166	33	34	437	434	566	634
Georgia	145	191	31	38	442	458	618	687
Florida	293	409	92	108	423	448	808	965
Total United States	30,805	33,841	3,955	4,346	20,810	21,580	55,570	59,767

Stocks of kerosene, which declined in 1939 compared with 1938, expanded noticeably in 1940. Kerosene held in storage at the end of 1940—9,512,000 barrels—was 26 percent above the inventory at the close of 1939. Even with the increased demand, oil companies built up their stocks to a 51 days' supply at the 1940 rate of domestic consumption compared with a 46 days' supply for 1939. Outstanding gains in stocks of kerosene in 1940 were reported for the East Coast and Texas Gulf Coast refinery districts, where the increments were 84 and 65 percent, respectively.

The additions to kerosene storage in the Texas Inland, Arkansas and Louisiana Inland, Rocky Mountain, and California refinery districts were relatively unimportant, and actual declines in 1940 compared with 1939 were indicated for the Appalachian; Indiana, Illinois, Kentucky, etc.; Oklahoma-Kansas and Missouri; and Louisiana Gulf Coast areas.

War conditions plus the closing of many trade routes by blockades, reduced exports of kerosene in 1940 to 3,374,000 barrels compared with 8,241,000 in 1939. Incidentally, the 1940 quantity is about half the previous "low" for kerosene exports, of 6,651,000 barrels established in 1935. Little kerosene is imported into the United States, and the 204,000 barrels received in 1940 is the first consignment to be reported since 1932, when 71,000 barrels entered; the 1940 imports originated in Mexico and were received at the port of New York.

Sales of range oil in the United States, 1937–39, by States[1]

[Thousands of barrels]

State	1937	1938	1939	
			Total	Percent of total
Massachusetts	9,645	9,959	10,814	29.2
New York	5,817	5,951	6,255	16.9
Connecticut	2,972	3,191	3,322	9.0
New Jersey	2,722	2,854	3,026	8.2
Rhode Island	2,079	2,127	2,172	5.8
Illinois	762	977	1,387	3.7
Maine	1,108	1,174	1,328	3.6
New Hampshire	708	701	781	2.1
Pennsylvania	639	641	698	1.9
North Carolina	312	331	532	1.4
Maryland	443	437	492	1.3
Michigan	261	294	479	1.3
Vermont	480	448	468	1.3
Wisconsin	257	280	446	1.2
Florida	271	325	439	1.2
Minnesota	302	296	403	1.1
Missouri	294	306	355	.9
Ohio	230	290	320	.9
Texas	242	257	304	.8
Other States	2,715	2,868	3,040	8.2
Total United States	32,259	33,707	37,061	100.0

[1] Figures for 1940 by States not yet available.

Beginning in 1937, the Bureau of Mines has conducted an annual survey covering the distribution of sales of kerosene by States and principal uses. Deliveries of kerosene reported by oil companies for 1939 totaled 59,767,000 barrels compared with sales of 55,570,000 barrels in 1938—an 8-percent gain. The quantity in 1939 was divided as follows: Sold as range oil, 33,841,000 barrels compared with 30,805,000 in 1938; tractor fuel, 4,346,000 barrels in 1939 (3,955,-000 in 1938), and all other uses, 21,580,000 barrels in 1939 (20,810,000 in 1938). The proportion of kerosene sales reported as range fuel increased from 55 percent of the total in 1938 to 57 percent in 1939. Some light fuel oil (Grade 1) is also sold for range fuel in addition to kerosene delivered for the same purpose. Light fuel oil sold for this particular use totaled 3,220,000 barrels in 1939 and 2,902,000 in 1938. The demand for range oil in 1939, including both kerosene and light fuel oil, was 37,061,000 barrels compared with 33,707,000 in 1938.

Prices of kerosene in 1940 remained practically unchanged compared with 1939 quotations. The average price of 41°–43° gravity water-white kerosene at refineries in Oklahoma moved fractionally upward from 3.97 cents a gallon for 1939 to an average of 4.04 cents for 1940. A seasonal rise brought the Oklahoma refinery price from a monthly average of 3.88 cents a gallon for November 1939 to a peak of 4.13 cents a gallon for May 1940; from that point quotations declined slowly throughout the summer and fell to the low price for the year—3.94 cents a gallon—in November. The increasing demand for kerosene forced the price up to 3.99 cents a gallon in the final month of 1940.

The tank-wagon price of kerosene at Chicago—10 cents a gallon, effective October 8, 1938—remained unchanged throughout 1939 and 1940.

FUEL OIL

The demand for fuel oil in 1939—a record up to that time—was far surpassed in 1940. A gain in exports and a decline in imports of fuel oil in 1939 were just reversed in 1940 when, owing to adverse international trade conditions, exports dropped sharply below the record volume of 1939 while imports, because of an unusual demand for heating oils in the opening months of the year and an expanding industrial program, were double the quantity received from foreign sources in 1939. The running of more crude to stills and a greater percentage yield brought about increased production of fuel oil in 1940 compared with 1939. A downward trend in stocks in 1939, which resulted in a shrinkage of 12 million barrels in the fuel-oil inventory for that year, was checked in 1940 when 6 million barrels were added to storage.

Until recently all transfers of crude petroleum to the fuel-oil account in refinery districts east of California were considered to be light grades and therefore were embodied in the statistics covering distillate fuel oil. As some authorities maintain that some of these transfers at least are made up of heavier crudes, changes in the 1939 and 1940 transfer items have become necessary. Crude oil used as fuel on pipe lines is considered, under present accounting methods, to be light fuel oil and therefore remains in the distillate fuel-oil account as a transfer, and crudes used as fuel on leases and for general industrial purposes is counted as a transfer to the residual fuel-oil supply. These changes for 1939 and 1940 do not alter the total domestic demand for fuel oil, as the quantity representing crude oil used as fuel on leases and for general industrial purposes is merely deducted from the demand for distillate fuel oil and added to the requirements for residual fuel oil. In the 1939 statistics 3,750,000 barrels of crude oil, formerly part of transfers east of California, were taken from distillate fuel oil and added to the residual fuel oil. The corresponding item for 1940 is 3,629,000 barrels, representing a decline in the demand for distillate and a similar increase in the deliveries of residual grades.

Salient statistics of fuel oil in the United States, 1939–40 [1]

[Thousands of barrels]

	1939			1940 [1]		
	Distillate fuel oil	Residual fuel oil	Total	Distillate fuel oil	Residual fuel oil	Total
Stocks at beginning of year:						
Refinery	27,873	97,746	125,619	26,374	87,774	114,148
Bulk terminal	8,351	4,225	12,576	7,344	4,516	11,860
Production	161,746	305,944	[2] 467,690	[3] 183,304	[4] 316,218	499,522
Transfers from crude oil to fuel oil:						
California	616	5,918	6,534	279	4,070	4,349
East of California	2,125	[5] 3,750	5,875	2,297	[5] 3,629	5,926
Imports:						
Bonded		14,751	14,751	257	10,518	10,775
Duty paid		929	929	3,076	17,940	21,016
Exports	32,020	17,485	49,505	19,172	16,077	35,249
Stocks at end of year:						
Refinery	26,374	87,774	114,148	32,082	83,548	115,630
Bulk terminal	7,344	4,516	11,860	10,858	5,756	16,614
Indicated domestic demand:						
Class I railroads, purchases [6]	(7)	(7)	62,235	(7)	(7)	67,131
Public-utility power plants [8]	(7)	(7)	17,423	(7)	(7)	16,724
Bunker oil, foreign trade	(7)	(7)	35,711	(7)	(7)	32,925
All other demands	(7)	(7)	343,092	(7)	(7)	383,323
	134,973	323,488	458,461	160,819	339,284	500,103

[1] Subject to revision.
[2] Includes 260,441,000 barrels produced by cracking.
[3] Includes 52,200,000 barrels produced by cracking.
[4] Includes 211,434,000 barrels produced by cracking.
[5] Distillate fuel oil transferred to residual fuel oil.
[6] Interstate Commerce Commission; total includes Diesel fuel.
[7] Figures not available.
[8] Federal Power Commission.

Expanding requirements for industrial fuel during the year and a heavy heating-oil load in the first quarter brought the domestic demand for fuel oil to a new record volume of 500,103,000 barrels in 1940—a 9-percent gain over the 1939 total of 458,461,000 barrels. The demand for distillate or light fuel oil, which constitutes about one-third of total fuel-oil deliveries and which is largely used for heating purposes, rose from 134,973,000 barrels in 1939 to 160,819,000 in 1940 or 19 percent. This outstanding gain in deliveries of distillate fuel oil in 1940 was the result of prolonged cold weather in the opening months of the year, which caused a brisk market for heating oils. Although residual grades make up the bulk of fuel-oil deliveries the demand for these heavier oils depends largely on prevailing economic conditions. Accelerated industrial activities in 1940 forced the demand for residual fuel oils to a new peak of 339,284,000 barrels, a 5-percent gain over 1939 requirements of 323,488,000 barrels.

An examination of the fuel-oil demand by quarters shows that the market for light distillate grades was 26 percent higher in the first 3 months of 1940 than in the same period of 1939 due to the unusual requirements for heating oils. During the early months of 1940 the oil companies were called upon to supply unprecedented quantities of the light grades, and for January 1940 the demand actually reached an outstanding increase of 36 percent above the same month in 1939. The turn-over of distillate fuel oil was relatively high throughout 1940, being 16 percent above the 1939 demand in the second quarter, 8 percent up in the third quarter, and 20 percent up in the final 3 months. Quarterly totals pertaining to the residual fuel-oil demand in 1940 do not reveal such marked increases as are found in the distillate fuel-oil statistics. There was a 10-percent gain in the first quarter of 1940 compared with 1939, when the unusual demand for heavy heating oils inflated the total. Gains in deliveries were nominal in the second and fourth quarters of 1940 over similar periods of 1939; however, the demand in the third quarter of 1940 was slightly below that in the corresponding months of the previous year.

Sales of fuel oil[1] *and of range oil in the United States, 1935–39, by uses*[2]

[Thousands of barrels]

Use	1935	1936	1937	1938	1939
Fuel oil:					
Railroads	55, 651	61, 727	69, 458	57, 829	63, 235
Ships' bunkers (including tankers)	74, 581	80, 324	84, 990	74, 266	79, 254
Gas and electric power plants	23, 647	26, 799	26, 510	27, 567	32, 039
Smelters and mines	2, 448	3, 768	74, 798	60, 038	67, 043
Manufacturing industries	61, 128	67, 558			
Heating oils	76, 853	99, 257	116, 617	118, 323	136, 232
Fuel oil (#1) sold as range oil	(3)	(3)	2, 747	2, 902	3, 220
U. S. Navy, Army transports, etc	10, 428	9, 241	9, 135	11, 756	12, 472
Oil-company fuel	48, 116	46, 021	42, 924	43, 517	49, 045
Miscellaneous uses	13, 133	13, 714	14, 624	11, 652	14, 403
Total United States	365, 985	408, 409	441, 803	407, 850	456, 943
Exports and shipments to noncontiguous Territories	28, 948	34, 883	45, 433	47, 561	49, 505
Total	394, 933	443, 292	487, 236	455, 411	506, 448
Range oil	21, 526	27, 292	32, 259	33, 707	37, 061

[1] Includes distillate fuel oil, residual fuel oil, and some crude oil burned as fuel.
[2] Figures for 1940 not yet available.
[3] Figures not available.

Data on the final distribution of fuel oil in 1940 by principal uses will not become available until the Bureau of Mines completes its annual survey of sales, made in cooperation with the oil companies. Preliminary figures released by the Interstate Commerce Commission covering fuel-oil and Diesel-fuel purchases by class I railroads indicate a total of 67,131,000 barrels in 1940 compared with 62,235,000 in 1939. Monthly statistics published by the Bureau of Foreign and Domestic Commerce, United States Department of Commerce, show that bunker loadings on vessels engaged in foreign trade were 32,925,000 barrels in 1940 compared with 35,711,000 in 1939. The fuel oil used by coastwise vessels in 1940 may raise the total to approximately 80,000,000 barrels for 1940 or slightly above the 1939 item of 79,254,000 barrels. Fuel oil used by public-utility electric-power plants declined from 17,423,000 barrels in 1939 to 16,724,000 in 1940, according to reports of the Federal Power Commission. It is believed that when the quantity of fuel oil required by the gas-manufacturing industry in 1940 becomes known through the American Gas Association the combined total for the electric-power and gas-manufacturing utilities will show little change from the 1939 demand of 32,039,000 barrels. Preliminary estimates for other principal fuel-oil demands in 1940 are as follows: Smelters, mines, and manufacturing industries, 73,000,000 barrels; heating oils, 162,000,000; United States Navy, Army, and Coast Guard, 14,500,000; and oil-company fuel, 52,900,000.

Figure 11 gives a graphic representation of fuel-oil deliveries in 1931–40 by principal uses. The columns for 1940 are based upon estimated items. Both light and heavy fuel oils are included, with kerosene sold as range oil.

Exports and shipments of fuel oil to noncontiguous Territories of the United States, which have mounted steadily in recent years to

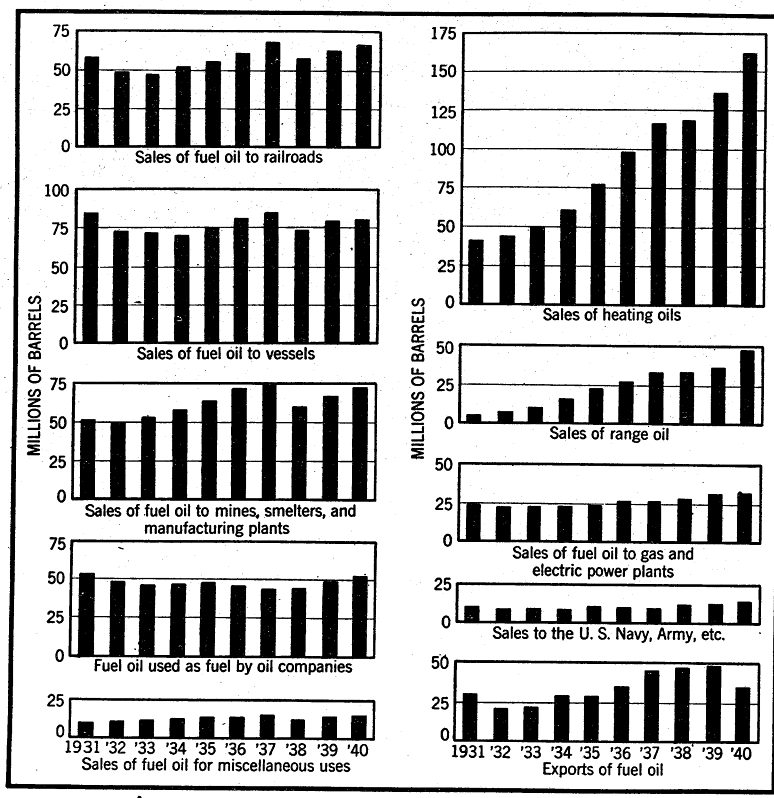

FIGURE 11.—Sales of fuel oil and range oil in the United States, 1931–40, by uses.

record volumes for both 1938 and 1939, declined sharply (29 percent) in 1940 to 35,249,000 barrels compared with 49,505,000 in 1939. This shrinkage in foreign requirements for American fuel oil is directly attributable to chaotic trade conditions in various war areas and the blockading of European ports. The loss in the fuel-oil export trade in 1940 was more pronounced for the distillate grades than for residual fuel oil. Overseas takings of light fuel oil declined from 32,020,000 barrels in 1939 to 19,172,000 in 1940, a 40-percent drop, but the foreign demand for heavy fuel oil was off only 8 percent or from 17,485,000 barrels in 1939 to 16,077,000 in 1940. Greatly expanded shipment of residual fuel oil to the noncontiguous Territories of the United States was a counterbalancing factor that held the 1940 foreign trade in heavy fuel oil near the level reported for 1939.

Comparative analyses of statistics for distillate fuel oil in the United States, 1939–40, by months and districts

[Thousands of barrels]

Month and district	Production		Yield (percent)		Transfers				Imports		Exports		Domestic demand		Stocks	
					East of Calif.[1]		California									
	1939	1940 [2]	1939	1940 [2]	1939	1940 [2]	1939	1940 [2]	1939	1940 [2]	1939	1940 [2]	1939 [3]	1940 [2] [3]	1939	1940 [2]
By months:																
January	14,122	16,548	14.2	15.5	154	207	13	-----	-----	-----	1,695	1,549	16,518	22,462	32,300	26,462
February	12,709	16,262	14.5	16.0	144	193	88	38	-----	542	2,138	1,234	14,376	17,623	28,727	24,640
March	13,539	16,346	13.7	14.8	150	216	73	31	-----	358	2,896	2,318	13,694	16,187	25,899	23,086
April	13,301	15,260	13.4	14.3	163	199	34	36	-----	326	2,345	1,966	10,581	11,849	26,471	25,092
May	12,393	14,541	11.7	13.0	176	217	38	37	-----	201	4,004	2,130	7,261	9,738	27,813	28,220
June	13,566	14,154	13.0	13.1	175	202	78	7	-----	159	2,839	2,129	6,916	7,028	31,877	33,585
July	12,688	14,439	11.9	13.4	178	197	103	36	-----	215	2,857	1,837	6,649	7,223	35,340	39,412
August	13,246	14,957	12.3	13.7	185	183	45	19	-----	301	3,361	1,469	7,829	8,362	37,626	45,041
September	12,975	14,735	12.3	13.7	189	174	47	2	-----	262	3,015	947	9,684	10,439	38,138	48,828
October	15,017	14,381	13.5	13.1	205	182	37	59	-----	301	2,756	1,356	10,548	13,358	40,093	49,037
November	13,757	15,073	13.1	14.3	208	158	20	10	-----	478	2,116	1,284	14,074	16,848	37,888	46,624
December	14,433	16,608	13.6	15.1	198	169	40	4	-----	190	1,998	953	16,843	19,702	33,718	42,940
Total United States	161,746	183,304	13.1	14.2	2,125	2,297	616	279	-----	3,333	32,020	19,172	134,973	160,819	33,718	42,940
By districts:																
East Coast	30,638	39,976	15.9	19.5	-----	-----	-----	-----	-----	3,038	151	91			10,381	15,922
Appalachian	2,868	4,035	6.6	8.4	-----	-----	-----	-----	-----	-----	49	4			387	537
Indiana, Illinois, Kentucky, etc.	18,963	23,943	9.9	10.6	412	561	-----	-----	-----	-----	5	6			4,372	4,318
Oklahoma, Kansas and Missouri	10,813	11,548	9.6	10.1	341	549	-----	-----	-----	-----	-----	-----			1,544	1,231
Texas Inland	2,903	2,257	4.4	3.7	614	644	-----	-----	-----	-----	3,628	23	[4]	[4]	348	288
Texas Gulf Coast	54,438	62,029	16.3	18.4	470	302	-----	-----	-----	295	13,084	7,996			5,608	8,406
Louisiana Gulf Coast	7,706	7,407	15.9	16.4	161	123	-----	-----	-----	-----	2,239	472			935	1,593
Arkansas and Louisiana Inland	1,585	1,509	6.4	6.1	12	16	-----	-----	-----	-----	-----	-----			203	252
Rocky Mountain	1,809	2,182	6.9	7.2	115	102	-----	-----	-----	-----	47	32			278	328
California	30,023	28,418	15.1	14.1	-----	-----	616	279	-----	-----	12,817	10,548			9,662	10,065
Total United States	161,746	183,304	13.1	14.2	2,125	2,297	616	279	-----	3,333	32,020	19,172	134,973	160,819	33,718	42,940

[1] Figures represent crude oil used as fuel on pipe lines.
[2] Subject to revision.
[3] Crude oil used on leases and for general industrial purposes credited to residual fuel oil.
[4] Figures not available.

A 7-percent increase in production of fuel oil from 467,690,000 barrels in 1939 to 499,522,000 in 1940 is mainly the result of 5 percent greater crude runs to stills and in a lesser degree to a small net gain in the percentage yields of fuel oil in 1940 over 1939. Most of the expansion in fuel-oil production during 1940 is found in the lighter grades, of which the percentage yield increased from 13.1 in 1939 to 14.2 in 1940. The output of distillate fuel oil advanced from 161,746,000 barrels in 1939 to 183,304,000 in 1940, a 13-percent increment owing to the pressure for light heating oils in the early months of 1940 and the effort to build up depleted stocks for the 1940–41 heating season. The percentage yields of both gasoline and residual fuel oil were lowered in 1940 to increase the production of the desired light-burning oils. As the percentage yield of residual fuel oil declined slightly in 1940, the small gain (3 percent) in the output—from 305,944,000 barrels in 1939 to 316,218,000—must be credited entirely to increased volume of crude runs by refineries.

The unprecedented demand for light fuel oil in areas east of California forced refiners to increase their production of distillate oil from 131,723,000 barrels in 1939 to 154,886,000 in 1940, an 18-percent gain, whereas in California, where stocks were increasing and the domestic demand remained at the same level in 1940 as in 1939, production dropped from 30,023,000 barrels in 1939 to 28,418,000 in 1940, or 5 percent. The bulk of the distillate fuel oil used for heating in eastern and north-central areas originates at refineries in the East Coast, Indiana, Illinois, Kentucky, etc., and Texas Gulf Coast refinery districts, and here, owing to the heavy demand, the production of distillate fuel oil increased 30, 26, and 14 percent, respectively, in 1940 compared with 1939. Large percentage gains were also made in production of light fuel oil in the Appalachian and Rocky Mountain refinery districts; however, the quantities involved were relatively unimportant. The Texas Inland, Louisiana Gulf Coast, and Arkansas and Louisiana Inland districts produced less distillate fuel oil in 1940 than in 1939. The production of residual fuel oil in areas east of California showed little gain (3 percent) in 1940 over 1939, as refiners there, curtailing the yields of both gasoline and heavy fuel oil, endeavored to satisfy the unusual demand for the light grades of fuel oil. An outstanding exception appears in the Indiana-Illinois, Kentucky, etc., refinery district, where with greatly increased production of crude oil and with runs to stills 18 percent above the 1939 level, the production of residual fuel oil increased 31 percent in 1940 compared with 1939. Substantial gains over 1939 in output of residual fuel oil were also made in the Appalachian and Rocky Mountain districts in 1940, but the quantities for both years were small. In other refinery areas east of California the production of heavy fuel oils gained but little in 1940, and actual declines were reported for the East Coast, Texas Inland, and Louisiana Gulf Coast districts. A downward trend in the production of residual fuel oil in California was reversed, and the output increased 3 percent (from 80,982,000 barrels in 1939 to 83,693,000 in 1940).

Non-gasoline-bearing crudes burned as oil fuel are entered as "transfers" and constitute an additional (though minor) as well as a diminishing source of supply at present. Transfers of crude petroleum to the fuel-oil account decreased from 12,409,000 barrels in 1939 to 10,275,000 in 1940—a shrinkage of 17 percent. Owing to lack of active demand, light crude transferred to distillate fuel oil in the California marketing area has dropped from 623,000 barrels in 1938 to 616,000 in 1939 and to 279,000 in 1940. Transfers of heavy crude oil to residual fuel in California declined from 10,037,000 barrels in 1938 to 5,918,000 in 1939 and to 4,070,000 in 1940 in spite of a rising domestic demand and diminishing stocks in 1939 compared to 1940, probably largely because of the lack of a price incentive and the scarcity of heavy crudes suitable for fuel purposes. Other light crudes, classed as transfers to distillate fuel oil, which under present accounting methods represent quantities used as fuel by pipe lines in areas east of California, totaled 2,125,000 barrels in 1939 and 2,297,000 in 1940, while shifts of crude petroleum to residual fuel oil, covering fuel used on leases and for general industrial purposes in these same areas, dropped from 3,750,000 barrels in 1939 to 3,629,000 in 1940.

Importations of fuel oils more than doubled in 1940 compared with 1939 owing to brisk domestic demand, a favorable duty rate of 10½ cents a barrel, and abnormally high tanker charges on coastwise shipments of domestic fuel oils from the Gulf to East Coast areas. Venezuela and Netherlands West Indies were the chief sources of imported fuel oils, which totaled 31,791,000 barrels in 1940 compared with 15,680,000 in 1939. Imports of fuel oil for some time have been limited largely to heavy or residual grades brought in under bond for the supply of vessels; however, with the ships' bunkering business on a decline and an active domestic market, this custom was reversed in 1940, so that the larger share of fuel-oil imports was entered as duty-paid and was intended for domestic consumption. Fuel oil imported in bond declined from 14,751,000 barrels in 1939 to 10,775,000 in 1940, while the duty-paid quantity increased from 929,000 barrels in 1939 to 21,016,000 in 1940. No distillate fuel oil of foreign origin was entered in 1938 or 1939; however, 3,333,000 barrels were received in 1940, consisting of 257,000 barrels imported in bond and 3,076,000 barrels duty-paid. Imported residual fuel oil entering bonded storage declined from 14,751,000 barrels in 1939 to 10,518,000 in 1940, a 29-percent shrinkage. Heavy fuel oils paying duty and intended for domestic use jumped from 929,000 barrels in 1939 to 17,940,000 in 1940, or almost to the record volume of 19,398,000 received in 1932.

A loss of 14 million barrels in exports of fuel oil in 1940 was partly absorbed in a rising domestic market, but a portion of the decline in foreign trade appears as a 6-million-barrel gain in stocks of fuel oil during the year. The relation between the loss in exports of fuel oil and the gain in stocks is obvious when it is noted that virtually all of the decline (about 13 million barrels) in exports was confined to distillate grades and that these light fuel oils, failing to find a market, went to storage; as exports of residuals showed only a small decline (about 1 million barrels) there was no excess beyond what could be sold in an active domestic market. Total fuel-oil stocks of 126,008,000 barrels held at the end of 1939 increased to 132,244,000 on December 31, 1940. The increment in stocks in 1940 is net, however, as distillate grades increased by about 9 million barrels from 33,718,000 in 1939 to 42,940,000 in 1940, while residual fuel oil in storage declined from 92,290,000 to 89,304,000.

Comparative analyses of statistics for residual fuel oil in the United States, 1939–40, by months and districts

[Thousands of barrels]

Month and district	Production		Yield (percent)		Transfers [1]				Imports		Exports		Domestic demand		Stocks	
					East of California		California									
	1939	1940 [2]	1939	1940 [2]	1939	1940 [2]	1939	1940 [2]	1939	1940 [2]	1939	1940 [2]	1939 [3]	1940 [2] [3]	1939	1940 [2]
By months:																
January	25,626	28,082	25.7	26.4	381	325	792	314	927	1,882	1,354	1,139	28,632	32,473	99,711	89,281
February	21,497	24,680	24.5	24.3	257	307	540	364	984	3,044	927	769	25,777	27,123	96,285	89,784
March	24,845	26,870	25.1	24.4	257	307	915	382	1,337	4,128	2,065	932	28,407	31,188	93,167	89,351
April	24,704	25,372	24.9	23.7	275	361	871	337	1,317	1,930	1,488	1,532	24,708	26,887	94,138	88,932
May	26,781	26,548	25.3	23.8	302	321	448	424	2,103	1,327	1,854	1,379	25,174	26,338	96,744	89,835
June	24,530	25,469	23.4	23.5	307	299	497	413	1,935	2,139	1,684	1,959	23,924	25,048	98,405	91,148
July	25,734	25,248	24.1	23.4	289	270	188	343	1,465	1,397	1,144	1,387	23,773	23,990	101,164	93,029
August	25,299	26,451	23.5	24.3	328	370	195	269	1,723	2,384	1,613	1,815	25,735	26,267	101,361	94,421
September	26,302	25,504	24.9	23.7	326	276	315	432	675	1,709	1,624	1,552	27,292	25,843	100,063	94,658
October	27,594	27,944	24.9	25.5	360	216	351	218	1,532	2,891	1,296	1,366	28,683	30,192	99,921	94,647
November	26,088	26,125	24.9	24.8	343	287	244	241	1,012	2,395	1,116	1,334	29,796	29,980	96,696	92,392
December	26,944	27,925	25.5	25.5	325	290	562	333	670	3,232	1,320	913	31,587	33,955	92,290	89,304
Total United States	305,944	316,218	24.7	24.4	3,750	3,629	5,918	4,070	15,680	28,458	17,485	16,077	323,488	339,284	92,290	89,304
By districts:																
East Coast	54,440	53,249	28.3	26.0	----	----	----	----	15,665	28,015	----	----			7,976	10,446
Appalachian	5,415	6,350	12.4	13.2	----	----	----	----	----	----	----	54			494	376
Indiana, Illinois, Kentucky, etc	28,962	37,817	15.1	16.7	243	758	----	----	----	----	74	981			3,020	2,972
Oklahoma, Kansas, and Missouri	19,011	19,787	16.9	17.2	186	223	----	----	----	----	----	----			2,733	2,122
Texas Inland	14,769	13,703	22.6	22.2	1,042	456	----	----	----	----	1,928	91			2,301	1,725
Texas Gulf Coast	78,391	78,850	23.5	23.3	1,044	781	----	----	----	443	3,894	3,412	(4)	(4)	6,579	8,486
Louisiana Gulf Coast	12,076	9,887	24.8	21.9	698	633	----	----	13	----	193	163			1,213	2,306
Arkansas and Louisiana Inland	6,170	6,279	24.8	25.3	216	497	----	----	----	----	----	----			566	389
Rocky Mountain	5,728	6,603	21.8	21.9	321	281	----	----	2	----	----	----			515	590
California	80,982	83,693	40.8	41.6	----	----	5,918	4,070	----	----	11,396	11,376			66,893	59,892
Total United States	305,944	316,218	24.7	24.4	3,750	3,629	5,918	4,070	15,680	28,458	17,485	16,077	323,488	339,284	92,290	89,304

[1] Represents quantities used on leases and for general industrial purposes, formerly included in transfers of distillate fuel oil cost of California.
[2] Subject to revision.
[3] Includes transfers.
[4] Figures not available.

Sales of fuel oil[1] *in the United States, 1935–39, by regions and States*[2]

[Thousands of barrels]

Region and State	1935	1936	1937	1938	1939
Pacific Coast:					
Washington	8,976	9,331	11,352	9,241	9,193
Oregon	7,773	9,918	10,879	9,308	8,752
California	66,627	65,895	70,952	59,316	69,790
Arizona	2,545	2,585	3,994	2,838	2,220
Nevada	2,182	2,791	3,790	2,690	3,109
Rocky Mountain:					
Idaho	140	223	520	420	483
Montana	1,676	1,652	1,802	1,451	1,947
Wyoming	1,418	1,549	1,799	1,654	1,853
Utah	260	404	508	471	485
Colorado	464	581	644	636	880
New Mexico	835	715	561	502	557
North Central:					
North Dakota	269	294	416	442	594
South Dakota	474	536	613	777	891
Minnesota	2,986	4,093	5,184	4,974	5,909
Nebraska	1,315	1,743	1,955	1,982	2,483
Iowa	1,378	1,873	2,261	2,325	2,969
Wisconsin	2,992	4,022	4,823	4,748	5,793
Illinois	15,037	18,351	20,964	19,930	22,561
Indiana	6,935	7,450	7,905	7,824	8,977
Michigan	8,634	9,000	9,847	8,228	10,119
Ohio	5,826	7,173	8,030	7,105	8,161
Kentucky	815	799	973	840	1,110
Tennessee	328	387	593	557	695
South Central:					
Missouri	6,583	7,605	8,980	8,502	9,339
Kansas	7,394	7,764	7,364	6,687	7,605
Texas	39,382	41,841	43,231	37,672	42,012
Oklahoma	9,581	9,461	9,083	8,269	8,112
Arkansas	2,544	2,876	2,658	2,056	2,156
Louisiana	10,481	11,614	12,350	10,871	11,318
Mississippi	476	593	796	529	631
Alabama	1,294	1,545	1,889	2,113	2,127
New England:					
Maine	1,756	2,328	2,490	2,150	2,645
New Hampshire	1,176	1,363	1,513	1,431	1,812
Vermont	393	458	566	539	675
Massachusetts	17,187	18,829	21,798	21,362	24,392
Rhode Island	6,591	6,894	7,283	6,839	7,893
Connecticut	5,742	7,047	7,822	7,482	9,064
Middle Atlantic:					
New York	36,087	42,215	43,428	43,389	48,154
New Jersey	32,554	41,458	44,232	42,862	48,087
Pennsylvania	23,452	26,098	26,320	26,213	27,285
Delaware	914	1,335	1,666	1,400	1,596
Maryland	7,715	8,423	9,549	9,003	10,218
District of Columbia	1,509	1,911	2,108	2,137	2,541
South Atlantic:					
Virginia	2,575	3,420	3,638	4,824	4,539
West Virginia	919	840	807	912	1,046
North Carolina	402	504	591	699	930
South Carolina	509	591	679	757	1,109
Georgia	1,497	1,744	1,787	2,022	2,288
Florida	7,387	8,287	8,810	8,871	9,838
Total, United States	365,985	408,409	441,803	407,850	456,943

[1] Includes distillate fuel oil, residual fuel oil, and some crude oil burned as fuel.
[2] Figures for 1940 not yet available.

A regional analysis of fuel-oil stocks reveals that practically all the increase in distillate grades was confined to refinery districts east of California, where inventories expanded from 24,056,000 barrels in 1939 to 32,875,000. Furthermore, most of the gains in stocks of distillate in eastern areas occurred in the East Coast district, where quantities in storage increased 53 percent from 10,381,000 barrels in 1939 to 15,922,000. Holdings of light fuel oil also increased noticeably in the Gulf Coast refinery districts supply areas for the East Coast and export markets—from 5,608,000 barrels in 1939 to 8,406,000 (50-percent increase) for the Texas Gulf district and from 935,000 barrels to 1,593,000 (70-percent increase) for the Louisiana Gulf district. Gains in stocks of distillate in other eastern areas were unimportant, and actual losses were reported for the Indiana-Illinois, Kentucky, etc.; Oklahoma, Kansas, and Missouri; and Texas Inland refinery districts. Although there was a net loss in the combined domestic and export markets for distillate fuel oil in California, the addition to stocks was only nominal, as both production and transfers of light crude to the fuel-oil account also declined during the year.

An increase of 4 million barrels in stocks of residual fuel oil in refinery districts east of California was offset by a decline of 7 million barrels in the California area, resulting in a net shrinkage in national totals. Heavy fuel oils held in storage east of California rose from 25,397,000 barrels in 1939 to 29,412,000. Most of this net gain in eastern markets was in the East Coast refinery district, where inventories of heavy fuel oils increased from 7,976,000 barrels in 1939 to 10,446,000. The Gulf areas also reported high percentage gains in stocks of residual oil; quantities in storage in the Texas Gulf Coast increased from 6,579,000 barrels to 8,486,000, and those held in the Louisiana Gulf Coast expanded from 1,213,000 barrels to 2,306,000. All other refinery districts east of California showed losses in heavy-fuel-oil stocks, except the Rocky Mountain area, where quantities held are relatively small. Although the production of residual fuel oil increased in the California district the added supply was not adequate to meet an increased domestic demand plus exports maintained at the 1939 level, so a 7-million-barrel draft on stocks became necessary, and the inventory declined from 66,893,000 barrels in 1939 to 59,892,000 in 1940. In recent years dwindling transfers of non-gasoline-bearing crude to the residual-fuel-oil supply, caused by the drop in production in California of crude of that type, were a secondary reason for the greater use of heavy fuels from storage.

The movement of residual fuel oil from California to Gulf and East Coast ports, which made a marked rise from 338,000 barrels in 1938 to 2,289,000 in 1939, dwindled to 566,000 in 1940, probably owing partly to the improved demand for heavy fuel oils on the West Coast. Shipments of distillate fuel oil from California to eastern markets, although small in volume, increased from 633,000 barrels in 1939 to 721,000.

The heavy demand for distillate fuel oil in the East Coast area in 1940 was responsible for the sharp rise in tanker shipments from the Gulf; the movement increased from 34,701,000 barrels to 44,429,000 a 28-percent gain. The eastern market for residual grades, depending more on industrial activities than on the demand for heating oils, did not expand proportionately; consequently boat shipments from the Gulf advanced only moderately from 65,446,000 barrels to 67,422,000, a 3-percent gain.

Gulf to North Atlantic Coast tanker rates, which are reflected in fuel-oil prices for eastern areas, advanced sharply from an average of 27.8 cents a barrel for clean boats in 1939 to 52.6 cents in 1940, and charges for carrying residual grades moved upward from an average of 25.8 cents a barrel in 1939 to 46.9 cents in 1940, owing to a general scarcity of tankers and removal of boats from the Gulf to East Coast run. Barrel rates for distillate grades on this route, which reached an average of 62.6 cents in December 1939, continued upward to a 72-cent average in February 1940, influenced by the heavy movement of light burning oils to meet the unusual demand in eastern markets. The desire of the oil companies to prevent a shortage of distillate oils in the North Atlantic area for the 1940–41 heating season maintained the traffic from the Gulf to North Atlantic points well into the middle of 1940, and because of this demand for boats the June 1940 rate averaged 55.5 cents a barrel compared with 19.3 cents for June 1939. The slack season "low" of 20.3 cents average a barrel was not reached until September 1940 and was somewhat above the 1939 "low" of 16.9 cents reported for August of the latter year. The removal of more tankers from oil-company control in the final months of the year, coming with the opening of the heating season, forced up tanker prices for clean boats on the Gulf to North Atlantic run to a top quotation of 80 cents a barrel in December 1940—a monthly average of 79 cents compared with 62.2 cents for December 1939. The Gulf to North Atlantic rate on "dirty" boats used for transporting residual fuel oil continued to increase from the 1939 peak of 52.9 cents average a barrel reached in December to 63.8 cents for March 1940. There was a small decline in April; however, the May average of 69.5 cents a barrel was the high price for 1940. Quotations declined from that point to 20 cents in September, the lowest average monthly price of the year, then moved upward again as the winter demand developed, until an average price of 61.2 cents a barrel was asked in December 1940.

A rising demand, depleted stocks, and increased tanker rates were responsible for higher fuel-oil prices in some areas in 1940 compared with 1939. The Oklahoma refinery price of No. 2 straw fuel oil—a representative domestic heating grade—averaged 3.47 cents a gallon in 1940 and 3.37 cents in 1939. Bunker C at New York harbor averaged $1.34 a barrel in 1940 compared with $1.04 in 1939, while the Gulf price of the same product advanced 7 cents a barrel over the 1939 average to 90 cents in 1940. There was very little change in the average price for Bunker C on the Pacific coast, and the Los Angeles quotation was 82 cents a barrel in 1940, only 1 cent over the 1939 average. Diesel-fuel prices for ships' bunkers were also correspondingly higher in 1940.

The Oklahoma refinery price for No. 2 straw fuel oil went to an average of 3.56 cents a gallon in February 1940, the high quotation of the year, compared with the 1939 maximum of 3.49, which came in January of that year. As the spring heating season of 1940 drew to a close the Oklahoma refinery quotation declined to 3.46 cents in March and to 3.44 in April and remained at that slack-season level compared with 3.31 cents a gallon in the summer of 1939, until the fall demand brought the price to an average of 3.48 cents in October and to 3.54 in December 1940.

Bunker C (including No. 6) fuel-oil prices at New York harbor, which are influenced by Gulf-to-North Atlantic tanker rates (the latter were higher in 1940 than in 1939) averaged $1.34 a barrel in 1940 compared with $1.04 in 1939. Advancing demand and the shortage of supplies forced the price quoted by some dealers at New York for heavy fuel oils from $1.15 a barrel to $1.50 late in December 1939. The new price was not adopted immediately by all suppliers, so that the average for January 1940 remained at $1.42 a barrel; however, it became fixed at $1.50 in February and March. There was a tendency toward a price cut to $1.35 a barrel in the middle of April as the question of supplies became easier; however, it was June before the lower quotation became generally established. A slackened demand and lower tanker rates brought about further price cuts in July, until an average of $1.20 a barrel for Bunker C was quoted for August, and that value held until the end of 1940. Bunker C fuel oil at Gulf ports advanced from an average of 83 cents a barrel in 1939 to 90 cents in 1940. The price of 95 cents in effect late in 1939 held until February 1940, when the quotations of some dealers reached $1.05 a barrel in response to the pressure for heavy fuel oils on the Atlantic coast. March initiated slightly lower prices, and by August quotations had settled to an average of 85 cents a barrel, which lasted for the remainder of the year. The average price of Bunker C at Los Angeles—82 cents a barrel in 1940—was only slightly above the 1939 average—81 cents. The price of 82 cents in January 1940 increased to 88 for the spring months, followed by some slackening to an average price of 83 cents a barrel in June, then a return to 88 cents in August and a gradual decline to 68 cents average in November, the low price of the year. A slight rise in December 1940 made the monthly average 70 cents a barrel.

Monthly average prices of kerosene and fuel oils in the United States, 1939–40 [1]

	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
1939													
41°-43° gravity w. w. kerosene at refineries, Oklahoma cents per gallon	4.06	4.06	4.06	4.06	4.05	4.00	3.96	3.89	3.88	3.88	3.88	3.91	3.97
Kerosene, tank-wagon at Chicago ..... cents per gallon	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
No. 2 straw fuel oil at refineries, Oklahoma ... cents per gallon	3.49	3.44	3.44	3.44	3.44	3.31	3.31	3.31	3.31	3.31	3.31	3.31	3.37
Bunker C for ships:													
New York dollars per barrel	.95	.95	.95	.95	.98	1.05	1.05	1.05	1.09	1.15	1.15	1.19	1.04
Gulf coast ..... do	.75	.75	.75	.75	.79	.83	.83	.81	.86	.95	.95	.95	.83
California ..... do	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.84	.88	.81
Diesel oil for ships:													
New York dollars per barrel	1.75	1.68	1.65	1.65	1.66	1.68	1.68	1.68	1.70	1.86	1.90	1.96	1.74
Gulf coast ..... do	1.55	1.48	1.45	1.45	1.45	1.45	1.45	1.45	1.51	1.70	1.70	1.70	1.53
California ..... do	1.45	1.45	1.45	1.40	1.40	1.40	1.39	1.38	1.40	1.40	1.40	1.40	1.41
1940													
41°-43° gravity w. w. kerosene at refineries, Oklahoma cents per gallon	3.95	4.00	4.02	4.09	4.13	4.08	4.06	4.06	4.06	4.06	3.94	3.99	4.04
Kerosene, tank-wagon at Chicago ..... cents per gallon	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
No. 2 straw fuel oil at refineries, Oklahoma ... cents per gallon	3.43	3.56	3.46	3.44	3.44	3.44	3.44	3.44	3.44	3.48	3.50	3.54	3.47
Bunker C for ships:													
New York dollars per barrel	1.42	1.50	1.50	1.49	1.48	1.35	1.31	1.20	1.20	1.20	1.20	1.20	1.34
Gulf coast ..... do	.95	.97	.97	.95	.91	.88	.86	.85	.85	.85	.85	.85	.90
California ..... do	.82	.88	.88	.88	.86	.83	.85	.88	.85	.72	.68	.70	.82
Diesel oil for ships:													
New York dollars per barrel	2.15	2.15	2.21	2.28	2.18	2.00	1.85	1.78	1.70	1.70	1.82	1.98	1.98
Gulf coast ..... do	1.70	1.70	1.70	1.70	1.68	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.64
California ..... do	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40

[1] National Petroleum News.

Representative retail prices for heating oils are compiled by the Bureau of Labor Statistics, United States Department of Labor. The consumers' price of No. 2 grade at Chicago averaged 7.73 cents a gallon as of March 15, 1940, compared with 7.44 cents on the same date in 1939. Second- and third-quarter quotations for this grade averaged 7.30 cents a gallon, or lower than the corresponding prices of 7.44 cents in the second quarter and 7.62 cents in the third quarter of 1939. The December 15, 1940, price of 7.73 cents a gallon was about one-fourth cent above the average in December 1939. The average price of No. 2 heating oil at New York was reported at 7.14 cents a gallon for March 15, 1940, compared with 6.22 cents a year previous. Quotations for this grade declined to 6.73 cents on June 15, 1940, and to 6.12 cents on September 15, corresponding to average prices of 5.87 and 6.38 cents a gallon, respectively, in June and September 1939. The December 15, 1940, average price of 6.94 cents a gallon compares with 6.69 cents in December 1939.

LUBRICATING OIL

Not only was the substantial gain in domestic consumption of lubricating oil in 1939 maintained in 1940, but also the 24,657,000 barrels in the latter year constituted a new record that was 4 percent higher than the 1939 record of 23,713,000 barrels. Production also increased, rising to 36,765,000 barrels from 35,036,000 in 1939, and exports declined from 11,881,000 barrels to 10,494,000, resulting in a rise in stocks from 7,142,000 to 8,767,000 barrels.

Automotive consumption of lubricants in the United States, 1939–40

[Thousands of barrels]

Use	Passenger cars		Trucks		Busses	
	1939	1940 [1]	1939	1940 [1]	1939	1940 [1]
Crankcase oil	7,655	7,699	2,086	2,175	217	215
Transmission oils	551	581	201	220	38	39
Total lubricating oils	8,206	8,280	2,287	2,395	255	254
Chassis greases	496	523	101	110	11	11
Total lubricants	8,702	8,803	2,388	2,505	266	265

[1] Subject to revision.

Domestic demand for lubricating oil, 1936–40

[Thousands of barrels]

Year	Automotive				Industrial	Total demand
	Passenger cars	Trucks	Busses	Total		
1936	8,297	2,165	254	10,716	11,607	22,323
1937	8,453	2,285	267	11,005	12,318	23,323
1938	8,152	2,168	259	10,579	10,654	21,233
1939	8,206	2,287	255	10,748	12,965	23,713
1940 [1]	8,280	2,395	254	10,929	13,728	24,657

[1] Subject to revision.

The usual correlation between the consumption of industrial lubricating oil and business activity is reflected in the table of distribution of domestic demand for lubricating oil by uses. This table shows that with the increase in business activity during 1940 the largest part of the gain in demand was in industrial consumption. The increasing mileage of automobile travel per unit of oil used is shown in only a small gain in consumption of oil by motor vehicles.

Preliminary statistics indicate that about 30,500 barrels of lubricating oil was used in commercial air transport in 1940 and about 13,600 barrels in private flying compared with 21,933 and 10,957 barrels, respectively, in 1939. The newer planes, particularly the fighting ships, which require oil that can withstand extreme conditions, have given the manufacturer of lubricants new problems. The severe demands of the last few years by both automobiles and aircraft resulted in solvent refining generally displacing the older methods. Efforts for improvement are now centering on additives that will supply qualities to the oil needed to meet the new demands.

Comparative analyses of statistics for lubricating oil in the United States, 1939–40, by months and districts

Month and district	Production (thousands of barrels)		Yield (percent)		Domestic demand (thousands of barrels)		Stocks (thousands of barrels)	
	1939	1940[1]	1939	1940[1]	1939	1940[1]	1939	1940[1]
By months:								
January	2,527	3,308	2.5	3.1	1,609	2,054	7,762	7,328
February	2,522	3,108	2.9	3.1	1,653	1,522	7,951	7,825
March	2,664	3,335	2.7	3.0	1,988	1,883	7,800	8,084
April	2,672	3,280	2.7	3.1	1,770	2,138	7,886	8,065
May	2,856	3,341	2.7	3.0	2,132	2,063	7,630	8,170
June	2,800	3,212	2.7	3.0	1,902	2,146	7,427	8,161
July	2,755	3,024	2.6	2.8	1,982	1,871	7,179	8,573
August	3,056	2,635	2.8	2.4	2,034	2,024	7,069	8,457
September	2,854	2,682	2.7	2.5	2,235	2,150	6,704	8,596
October	3,575	2,954	3.2	2.7	2,656	2,482	6,639	8,464
November	3,277	3,021	3.1	2.9	1,927	2,449	6,799	8,365
December	3,478	2,865	3.3	2.6	1,825	1,875	7,142	8,767
Total for year	35,036	36,765	2.8	2.8	23,713	24,657	7,142	8,767
By districts:								
East Coast	9,055	8,550	4.7	4.2			2,237	2,711
Appalachian	6,128	6,016	14.0	12.5			579	949
Indiana, Illinois, Kentucky, etc.	3,111	3,545	1.6	1.6			529	697
Oklahoma, Kansas, and Missouri	3,100	3,447	2.8	3.0			602	672
Texas Inland	221	238	.3	.4			21	58
Texas Gulf Coast	8,454	9,142	2.5	2.7	(2)	(2)	1,545	1,977
Louisiana Gulf Coast	1,504	1,630	3.1	3.6			233	236
Arkansas and Louisiana Inland	538	680	2.2	2.7			62	101
Rocky Mountains	180	179	.7	.6			88	102
California	2,745	3,338	1.4	1.7			1,246	1,264
Total United States	35,036	36,765	2.8	2.8	23,713	24,657	7,142	8,767

[1] Subject to revision.
[2] Figures not available.

The Texas Gulf Coast district became the leading producer of lubricants with an output of 9,142,000 barrels, displacing the East Coast district, where the production was 8,550,000 barrels. The Texas Gulf Coast district's 24.9-percent share of the United States production is the highest proportion that this region has had and compares with 19.6 percent in 1935, the beginning of the upward trend. The 23.3-percent share of the East Coast is the lowest proportion in a long downward trend for this district. Although the 680,000 barrels produced in the Arkansas and Louisiana Inland district represents only 1.8 percent of the total for the country; it is the highest for this district and compares with only 0.1 percent in 1929. The Louisiana Gulf

Coast district, which has increased its share of production from 1.3 percent in 1932 to 4.4 percent in 1940, and the California district, which has increased its share from 6.5 percent in 1935 to 9.1 percent in 1940, established new records, both in quantity produced and in their respective shares of the national total. The Rocky Mountain district, where the proportion has declined from 1.8 percent in 1929 to 0.5 percent in 1940, now has the smallest production of any area.

Stocks of lubricating oil began to accumulate with the decline in exports during the latter half of the year and by December 31 totaled 8,767,000 barrels—the largest year-end inventory since 1931. Gains in stocks were distributed throughout all of the districts.

Average monthly refinery prices of five selected grades of lubricating oil in the United States, 1939–40, in cents per gallon [1]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1939													
Oklahoma:													
200 viscosity, No. 3, color, neutral	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.13	10.59	13.25	14.00	14.00	11.14
150–160 viscosity at 210°, bright stock, 10–25 pour test	14.50	14.25	14.25	14.25	14.25	14.25	14.25	14.25	15.69	21.55	23.06	23.25	16.48
Pennsylvania:													
200 viscosity, No. 3 color, neutral 420–425 flash, 25 pour test	15.20	15.44	15.81	16.41	16.75	16.75	16.70	17.50	22.13	28.10	28.88	30.75	20.03
600 steam-refined, cylinder stock, filterable	8.05	8.38	8.88	9.00	9.00	9.00	8.50	8.50	12.13	15.60	16.38	17.25	10.89
Gulf Coast: 500 viscosity, No. 2½–3½ color, neutral	7.63	7.63	7.63	7.63	7.63	7.63	7.63	7.50	7.94	8.83	9.13	9.13	7.99
1940													
Oklahoma:													
200 viscosity, No. 3 color, neutral	14.00	13.90	13.38	13.25	12.80	11.56	10.78	10.10	9.75	9.75	9.75	9.75	11.56
150–160 viscosity at 210°, bright stock, 10–25 pour test	23.75	23.75	22.77	22.25	19.70	17.36	15.76	14.44	14.25	14.25	14.25	14.20	18.06
Pennsylvania:													
200 viscosity, No. 3 color, neutral, 420–425 flash, 25 pour test	31.64	27.95	26.55	25.00	22.20	21.70	21.00	21.25	21.50	21.13	21.25	21.50	23.56
600 steam-refined, cylinder stock, filterable	18.11	15.58	14.08	13.20	12.32	11.20	8.73	8.00	7.65	7.42	7.35	7.61	10.94
Gulf Coast: 500 viscosity, No. 2½–3½ color, neutral	9.13	9.13	9.13	9.08	9.00	9.00	8.95	8.63	8.75	8.56	8.50	8.50	8.86

[1] National Petroleum News.

The monthly trends in exports in 1940 were directly opposite from those in 1939. Whereas total exports for the year decreased from 11,881,000 barrels in 1939 to 10,494,000 in 1940, 6,624,000 barrels of the 1939 shipments were made in the latter half of the year compared with only 3,735,000 barrels in the same period in 1940. Export statistics appear in the section on Foreign Trade near the end of this chapter.

The slump in exports was reflected not only in accumulating stocks, as indicated above, but also in declines in the price of lubricating oil. After the sensational rise in 1931, prices for most grades shown in the accompanying table, were approximately the same at the end of 1940 as at the end of 1938. The one exception was the price for Pennsylvania neutral, which increased from an average of 15.20 cents a gallon in January 1939 to 31.64 cents in January 1940 and then decreased to 21.50 cents in December 1940—6.30 cents higher than the January 1939 average. At the same time the price for 600-steam-refined cylinder oil in western Pennsylvania, which averaged 8 cents a gallon during December 1938, averaged 7.61 cents in December 1940—a further reflection of the trend toward lighter oil for automobiles and the difficulty of disposing of the heavy lubricants. One company is converting its bright stocks to neutrals by cracking them.

A new process redistills the cylinder stock with kerosene. The kerosene, acting as a carrier, permits distillation to be conducted at a temperature low enough so that the lubricant is not cracked. Removal of the very viscous asphaltic material from the cylinder stock permits separation of the charge into a light and a heavy component, the specifications of which are better than the products of usual refining methods.

OTHER PRODUCTS

WAX

Domestic demand for paraffin wax established a new record in 1940 and increased to 356,653,000 pounds from 325,461,000 in 1939. In addition to the growing demand for this product in the manufacture of waxed paper and waxed cartons, paraffin waxes are being substituted for some imported waxes that are now difficut to obtain.

Exports declined from 232,664,000 pounds in 1939 to 190,065,000 in 1940. Production increased from 464,520,000 to 513,240,000 pounds, causing stocks to rise again to a normal level of 125,272,000 pounds from the unusually low level of 75,648,000 pounds at the end of 1939.

Comparative analyses of statistics for wax in the United States, 1939–40, by months and districts

[Thousands of pounds]

Month and district	Production		Domestic demand		Stocks			
					Crude scale		Refined	
	1939	1940 [1]	1939	1940 [1]	1939	1940 [1]	1939	1940 [1]
By months:								
January	35,280	48,440	20,642	35,187	87,729	54,575	40,898	20,000
February	33,320	49,560	27,166	17,028	79,747	57,017	37,964	25,614
March	44,800	47,320	20,495	19,343	79,803	62,801	37,734	27,572
April	35,000	42,560	14,597	29,537	80,396	66,425	38,905	30,485
May	34,440	44,240	28,533	24,103	77,218	71,415	36,707	31,874
June	39,480	39,760	19,589	21,687	81,592	73,742	30,012	36,604
July	28,840	37,520	16,898	30,333	78,155	74,750	31,167	39,228
August	31,080	33,320	20,503	41,897	77,229	71,193	30,944	41,166
September	40,320	39,760	32,651	37,988	67,552	68,544	22,032	41,484
October	45,080	43,120	40,567	37,350	61,860	68,940	19,287	44,887
November	48,440	43,960	39,849	30,662	60,343	72,089	21,026	48,123
December	48,440	43,680	43,971	31,538	56,527	77,428	19,121	47,844
Total for year	464,520	513,240	325,461	356,653	56,527	77,428	19,121	47,844
By districts:								
East Coast	189,840	196,000	(2)	(2)	22,636	26,418	6,363	23,664
Appalachian	97,160	100,240			14,096	14,974	872	2,800
Indiana, Illinois, Kentucky, etc.	38,080	54,600			8,275	24,135	1,703	2,523
Oklahoma, Kansas, and Missouri	31,920	39,480			2,555	3,898	1,207	1,216
Texas Inland	2,800	1,400			207	126		
Texas Gulf Coast	71,120	76,440			774	1,103	5,743	14,813
Louisiana Gulf Coast	22,400	28,000			871	302	1,986	1,192
Rocky Mountain	11,200	17,080			7,113	6,472	1,247	1,636
Total United States	464,520	513,240	325,461	356,653	56,527	77,428	19,121	47,844

[1] Subject to revision.
[2] Figures not available.

The drop in prices of wax in 1940 was almost as sharp as the increase in 1939. The price of the Pennsylvania grade of crude scale wax quoted by the Bureau of Mines declined from 6.75 cents a pound early in January to 2.85 cents at the end of the year, only one-half cent higher than the 2.33-cent price at the end of December 1938. Prices for fully refined wax decreased to a lesser extent, that of 5.6 cents for 122° to 124° on the Chicago market being only one-half cent below the high for the year but 1.6 cents above the price at the end of 1938.

According to predictions, a new emulsion process for deoiling wax, introduced during 1940, will eliminate the old sweating method. Although the process is still in the pilot-plant stage its sponsors claim that it will reduce the cost of producing wax materially.

Average monthly refinery price of 122° to 124° white crude scale wax at Pennsylvania refineries, 1936–40, in cents per pound [1]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
1936	2.33	2.40	2.57	2.58	2.41	2.34	2.38	2.39	2.43	2.43	2.43	2.45	2.43
1937	2.53	2.65	2.68	2.69	2.73	2.88	2.95	2.96	2.95	2.98	2.98	2.91	2.82
1938	2.52	2.13	2.02	1.93	1.93	2.17	2.29	2.37	2.40	2.39	2.33	2.32	2.23
1939	2.39	2.49	2.60	2.73	2.96	3.00	2.95	2.88	3.47	4.95	6.56	6.75	3.64
1940	6.21	5.57	5.32	4.79	4.69	4.19	2.93	2.21	2.51	2.81	2.93	2.87	3.92

[1] National Petroleum News.

COKE

Coke was the only major product of petroleum for which the domestic demand was lower in 1940 than in 1939; the 1,403,500 short

Comparative analyses of statistics for petroleum coke in the United States, 1939–40, by months and districts

Month and district	Production (thousands of short tons)		Yield (percent)		Domestic demand (thousands of short tons)		Stocks (thousands of short tons)	
	1939	1940 [1]	1939	1940 [1]	1939	1940 [1]	1939	1940 [1]
By months:								
January	126.0	116.4	0.6	0.5	106.0	137.8	717.0	628.0
February	117.2	131.2	.6	.6	121.1	125.7	705.0	628.0
March	128.0	129.6	.6	.6	129.2	119.9	694.0	624.0
April	142.0	139.2	.7	.7	78.9	72.7	734.0	663.0
May	132.2	152.4	.6	.7	117.0	111.4	716.0	681.0
June	142.2	148.6	.7	.7	115.6	101.9	710.0	697.0
July	145.2	121.4	.7	.5	90.7	120.3	733.0	678.0
August	143.2	122.6	.7	.6	168.8	117.4	682.0	647.0
September	110.8	119.2	.5	.6	86.6	122.3	668.0	617.0
October	165.2	131.4	.7	.6	158.5	134.0	652.0	581.0
November	159.2	88.4	.8	.4	125.7	99.6	647.0	527.0
December	155.2	126.2	.7	.6	123.6	140.5	666.0	487.0
Total for year	1,666.4	1,526.6	.7	.6	1,421.7	1,403.5	666.0	487.0
By districts:								
East Coast	6.8	5.2	(2)	(2)	(3)	(3)	2.0	2.0
Appalachian	23.2	25.6	.3	.3			15.0	17.0
Indiana, Illinois, Kentucky, etc.	920.0	943.6	2.4	2.1			191.0	107.0
Oklahoma, Kansas, and Missouri	184.8	163.0	.8	.7			29.0	7.0
Texas Inland	102.0	76.8	.8	.6			80.0	31.0
Texas Gulf Coast	180.2	149.2	.2	.2			87.0	104.0
Louisiana Gulf Coast	.4	-------	(2)	-------			7.0	1.0
Rocky Mountain	61.6	44.0	1.2	.7			60.0	35.0
California	187.4	119.2	.5	.3			195.0	183.0
Total United States	1,666.4	1,526.6	.7	.6	1,421.7	1,403.5	666.0	487.0

[1] Subject to revision. [2] Less than 0.1 percent. [3] Figures not available.

tons sold in 1940 were 18,200 tons less than the 1939 demand of 1,421,700 tons. This deficiency, however, was nearly offset by an increase of 15,900 tons in exports, making the total demand for the 2 years approximately the same. The exports—302,100 tons—established a new record; Canada, the principal customer, took 181,000 tons, and Japan 58,000 tons, 35,000 in the last 2 months of the year alone.

Production of coke amounted to 1,526,600 tons compared with 1,666,400 produced in 1939. The Indiana, Illinois, Kentucky, etc., district continued to lead, supplying 62 percent of the total output.

ASPHALT AND ROAD OIL

The domestic demand for asphalt in 1940 amounted to 5,123,600 short tons—197,500 tons more than the 1939 demand. Imports nearly doubled, while exports leaped from 42,400 tons to 296,800.

The domestic demand for road oil (7,847,000 barrels) was only 1,000 barrels higher than in 1939. Production declined 99,000 barrels and stocks 78,000.

Detailed statistics on asphalt and road oil appear in the chapter on Asphalt and Related Bitumens.

STILL GAS

The production of still gas in 1940 was 272,536 million cubic feet (71,720,000 barrels)—11,176 million cubic feet higher than in 1939. Despite the tendency to use still gas for the manufacture of high-octane gasoline, the amount burned as refinery fuel reached a new peak of 246,188 million cubic feet in 1939, which, in terms of British thermal units, supplied about one-half of all the heat utilized at refineries.

The principal districts maintained their usual rank in the production of still gas; Texas Gulf Coast led, and Indiana, Illinois, Kentucky, etc., and East Coast followed in order.

Production of still gas in the United States, 1938–40, by districts

District	1938		1939		1940 [1]	
	Millions of cubic feet	Equivalent, in thousands of barrels	Millions of cubic feet	Equivalent, in thousands of barrels	Millions of cubic feet	Equivalent, in thousands of barrels
East Coast	30,354	7,988	33,684	8,864	40,960	10,779
Appalachian	8,311	2,187	8,698	2,289	10,640	2,800
Indiana, Illinois, Kentucky, etc	46,527	12,244	52,321	13,769	59,226	15,586
Oklahoma, Kansas, and Missouri	24,681	6,495	23,038	6,063	23,958	6,305
Texas Inland	15,044	3,959	13,650	3,592	16,024	4,217
Texas Gulf Coast	79,644	20,959	86,244	22,696	78,318	20,610
Louisiana Gulf Coast	8,702	2,290	8,528	2,244	7,871	2,071
Arkansas and Louisana Inland	5,746	1,512	3,365	885	3,239	852
Rocky Mountain	5,119	1,347	5,590	1,471	5,863	1,543
California	26,254	6,909	26,242	6,906	26,437	6,957
Total United States	250,382	65,890	261,360	68,779	272,536	71,720

[1] Subject to revision.

MISCELLANEOUS PRODUCTS

The output of miscellaneous products in 1940 amounted to 3,202,000 barrels compared with 2,359,000 in 1939. Although the export total of 944,000 barrels for 1940 indicates a large gain over the 123,000 barrels exported in 1939 this is because exports of anti-knock compounds for the first 5 months and exports of liquefied petroleum gases, petrolatum, and greases for the entire year were included beginning January 1, 1940. Considering these reclassifications, the indicated domestic demand for 1940 also made a sizable gain over 1939.

Detailed data for 1940 by products are not available, but the 1939 figures show that liquefied petroleum gas, the first ranking product, increased in relative importance and that petrolatum, medicinal oil, and absorption oil retained second, third, and fourth places, respectively.

Production of miscellaneous oils in the United States, 1938–39, by districts and classes [1]

[Thousands of barrels]

District	Petrolatum	Absorption oil	Medicinal oil	Specialties	Liquefied petroleum gas	Other	Total
1938							
East Coast	115	10	139	10	376	140	790
Appalachian	137	7		2		24	170
Indiana, Illinois, Kentucky, etc	26			12	149	108	295
Oklahoma, Kansas, and Missouri	25	64				31	120
Texas Inland		50			3	5	58
Texas Gulf Coast	7			32	48	17	104
Louisiana Gulf Coast					15	32	47
Arkansas and Louisiana Inland						1	1
Rocky Mountain	1	2		4		90	97
California		36	33	93		77	239
Total United States	311	169	172	153	591	525	1,921
1939							
East Coast	115		159	2	416	131	823
Appalachian	190					43	233
Indiana, Illinois, Kentucky, etc	39			18	446	53	556
Oklahoma, Kansas, and Missouri	41	64				24	129
Texas Inland		64			5	13	82
Texas Gulf Coast	9			48	57	33	147
Louisiana Gulf Coast					27	76	103
Arkansas and Louisiana Inland						1	1
Rocky Mountain		2		4	7	61	74
California		42	33	81		55	211
Total United States	394	172	192	153	958	490	2,359

[1] Figures for 1940 not yet available.

WORLD PRODUCTION[2]

In spite of the disruption caused by the war in Europe the world production of petroleum was even larger in 1940 than in 1939, if numerous unofficial statistics and estimates can be considered reliable. Again a record-breaking figure was attained, and the total of 2,149,-378,000 barrels in 1940 marked a 3.4-percent increase over 1939; but the increase was due principally to the 7-percent augmented output in the United States, which accounted for 61 percent of the world total in 1939 and 63 percent in 1940. Outside the United States, with few exceptions, production declined.

The Western Hemisphere supplied 77 percent of the world output in 1939 and 78 percent in 1940. Production of crude in Venezuela, third in rank in the world, declined 10 percent from 1939 to 1940, as the interruption of normal shipping by the war blockade and the loss of European markets reduced the demand for residual fuel oil, the chief product manufactured from heavy Maracaibo crude. The production in Mexico increased 3 percent; European markets lost by the blockade were replaced by shipments to the United States. The entry into production of the Barco concession was chiefly responsible for the 18-percent increase in Colombian output of oil. In Argentina, in spite of a decline in the output of private companies, governmental enterprise (Y. P. F.), by increasing production especially in Mendoza and Salta, raised the national yield 10 percent in 1940 over 1939; but the country still depended on imports for 40 percent of its petroleum supply. In Canada, a 14-percent increase in petroleum production, chiefly in Alberta, did not reduce the dependence of the Dominion on the United States for the major part of its supply of mineral oils.

In Europe the U. S. S. R. and Rumania continued to furnish over 95 percent of the petroleum production of the Continent. In the U. S. S. R., second largest petroleum producer in the world, the output remained virtually stationary. In Rumania there was a decline of 6 percent from 1939 to 1940.

The most marked decline in the major producing countries of the world was in Iraq, where output decreased 16.5 percent from 1939 to 1940. The closing of the branch pipe line to Tripoli, Syria, after the defeat of France in June and the entry of Italy into the war in the same month suspended the westward movement of Iraq oil through the Mediterranean; and the branch pipe line to Haifa, Palestine, and the new refinery at Haifa furnished the only outlet for this crude. On the other hand, Iran increased its output slightly from 1939 to 1940. In the Netherlands Indies petroleum production was 2 percent less in 1940 than in 1939.

Of the minor producing countries Egypt showed the most marked increase—30 percent—owing to the output of the Ras Gharib field.

[2] By A. H. Redfield, Petroleum Economics Division, Bureau of Mines.

Crude petroleum produced in principal countries of the world, 1936–40, in thousands of barrels

[Compiled by L. P. Lounsbery]

Country	1936	1937	1938	1939	1940 [1]
North America:					
Canada	1,500	2,944	6,966	7,838	8,955
Mexico	41,028	46,690	38,279	42,779	44,064
Trinidad	13,237	15,503	17,737	19,270	20,219
United States	1,099,687	1,279,160	1,214,355	1,264,962	1,351,847
Other North America	62	33	78	112	114
Total North America	1,155,514	1,344,330	1,277,415	1,334,961	1,425,199
South America:					
Argentina	15,458	16,355	17,076	18,613	20,486
Bolivia	105	122	226	215	110
Colombia	18,756	20,599	21,582	22,037	26,067
Ecuador	1,942	2,161	2,246	2,313	2,349
Peru	17,593	17,457	15,839	13,508	13,427
Venezuela	154,794	186,230	188,174	205,784	184,761
Total South America	208,648	242,924	245,143	262,470	247,200
Europe:					
Albania	273	619	752	934	1,659
Czechoslovakia	127	123	130	120	119
France	503	502	513	500	496
Germany	3,115	3,176	3,861	4,487	4,544
Austria	50	221	383	693	719
Hungary		16	318	1,054	1,755
Italy	123	110	101	91	57
Poland	3,789	3,716	3,763	3,898	3,891
Rumania	63,659	52,452	48,487	45,932	43,231
U. S. S. R. [2]	186,206	193,241	204,956	212,500	212,909
Other Europe	1	4	9	10	10
Total Europe [2]	257,846	254,180	263,273	270,219	269,390
Asia:					
Bahrein Island	4,645	7,762	8,298	7,589	7,074
Burma	7,588	7,848	7,538	7,873	7,979
India, British	1,978	2,162	2,488	2,327	2,250
Iran (Persia)	62,718	77,804	78,372	78,151	78,592
Iraq	30,406	31,836	32,643	30,791	25,725
Japan (including Taiwan)	2,440	2,488	2,511	2,654	2,639
Netherlands Indies	50,025	56,724	57,318	62,087	60,830
Sakhalin	3,212	3,656	[3] 3,821	[3] 4,000	[3] 4,000
Sarawak and Brunei	5,209	6,009	6,913	7,097	7,047
Saudi Arabia	20	65	495	3,934	5,365
Total Asia [4]	168,241	196,354	200,397	206,503	201,501
Africa:					
Egypt	1,278	1,196	1,581	4,666	6,053
Other Africa	4	22	27	27	27
Total Africa	1,282	1,218	1,608	4,693	6,080
Australia and New Zealand	5	4	4	3	4
Undistributed	4	4	4	4	4
Grand total	1,791,540	2,039,014	1,987,844	2,078,853	2,149,378

[1] Approximate production. Derived in part from World Petroleum, vol. 12, No. 2, February 1941, pp. 20-21.
[2] Includes U. S. S. R. fields in Asia, other than Sakhalin.
[3] Approximate production.
[4] Exclusive of U. S. S. R. fields in Asia, other than Sakhalin, which are included with U. S. S. R. in Europe.

FOREIGN TRADE[3]

Imports.—Imports of mineral oils, crude and refined, into continental United States increased 23,856,000 barrels in 1940 over 1939. At the same time the domestic demand for all oils rose 92,324,000 barrels, whereas exports declined 58,370,000 barrels, giving an increase of 33,954,000 barrels in total demand from 1939 to 1940. As the production of crude petroleum, natural gasoline, and benzol was 91,147,000 barrels higher in 1940 than in 1939, altogether 38,116,000 barrels of all oils were added to stocks during 1940 compared with withdrawals of 42,933,000 barrels from storage during 1939. Imports of mineral oils, crude and refined, constituted 5.6 percent of the total new supply in continental United States during 1940 compared with 4 percent during 1939.

Imports of crude petroleum, especially for direct consumption, were considerably larger in 1940 than in 1939, probably because of the reduction in the excise tax on imported crude as a result of the Venezuelan Trade Agreement effective December 16, 1939, and the general increase in domestic demand, as well as the loss of European markets for Venezuelan and especially Mexican oils. Imports of crude from Venezuela were greater in 1940 than in 1939, but the principal increase was in receipts of crude from Mexico for direct consumption. Because of the low prices at which they were sold, these could enter the United States market in spite of the full excise tax of 21 cents a barrel which was applied to most of the Mexican imports of crude. The quota for Mexico and "all other countries" for 1940, to be admitted at the reduced rate of 10½ cents a barrel, was only 2,352,000 barrels; and only 1,336,000 barrels of the 12,262,000 barrels imported from Mexico in 1940 were admitted at the reduced rate. The settlement of the controversy between the Mexican Government and one of the expropriated companies facilitated imports of Mexican crude into the United States; but this did not account for more than a minor part of the increase in such imports.

Imports of refined oils consisted chiefly of residual fuel oil and unfinished oils for further processing, with some distillate fuel oil imported for the first time in quantity during 1940. Most of the residual fuel oil imported for direct consumption came from Venezuela, where refining activity has increased, and from the Netherlands West Indies, with minor amounts from Mexico and other countries; virtually all of the residual fuel oil imported in bond for supplies of vessels came from the Netherlands West Indies and Venezuela. The distillate fuel oil for direct consumption came chiefly from Mexico, with minor amounts from the Netherlands West Indies and Venezuela; that imported in bond, chiefly for manufacture and export, came from Venezuela and the Netherlands West Indies. Topped petroleum and unfinished oils (other than gasoline) were imported almost entirely from the Netherlands West Indies.

[3] By A. H. Redfield, Petroleum Economics Division, Bureau of Mines.

Mineral oils, crude and refined, imported into continental United States, 1939–40, by classes and months [1]

[Thousands of barrels]

Class	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	For direct consumption	In bond
1939															
Crude petroleum	1,868	1,598	1,630	2,932	3,928	3,664	2,934	2,898	3,084	3,099	3,132	2,328	33,095	28,447	4,648
Refined products:															
Gasoline, finished	12	7							6	3	16	3	47	47	
Gasoline, unfinished			187							20	65		272		272
Residual fuel oil	927	984	1,337	1,317	2,103	1,935	1,465	1,723	675	1,532	1,012	670	15,680	929	14,751
Lubricating oil			1		1		1	1		1			5		5
Paraffin wax	11	7	7	5	17	10	9	11	14	22	14	15	142	137	5
Asphalt	70	108	72	8	14	17	9	9	23	9	19	48	406	406	
Unfinished oils: Other	617	769	866	624	524	557	1,195	1,041	1,053	618	702	847	9,413	5,779	3,634
	3,505	3,473	4,100	4,886	6,587	6,183	5,613	5,683	4,855	5,304	4,960	3,911	59,060	35,745	23,315
1940															
Crude petroleum	1,950	2,343	2,895	3,169	4,097	3,688	3,981	4,223	3,912	3,815	3,932	4,733	42,738	41,525	1,213
Refined products:															
Gasoline, finished	18	3	24		16	3	5	2	8	3	11	4	97	97	
Kerosene							68		67			69	204	204	
Distillate fuel oil		542	358	326	201	159	215	301	262	301	478	190	3,333	3,076	257
Residual fuel oil	1,882	3,044	4,128	1,930	1,327	2,139	1,397	2,384	1,709	2,891	2,395	3,232	28,458	17,940	10,518
Lubricating oil										11			11	11	
Paraffin wax	24	14	19	45	31	8	19	57	26	31	16	6	296	266	30
Asphalt	25	10	5	2	1	2	102	173	55	220	2	161	758	758	
Unfinished oils: Other	813	671	564	734	761	687	775	689	583	396	114	234	7,021	5,146	1,875
	4,712	6,627	7,993	6,206	6,434	6,686	6,562	7,829	6,622	7,668	6,948	8,629	82,916	69,023	13,893

[1] Imports of crude as reported to Bureau of Mines; imports of refined products compiled from data of Bureau of Foreign and Domestic Commerce; figures may differ slightly from those used throughout other sections of this report.

Crude petroleum imported into and exported from continental United States in 1940, by countries and months [1]

[Thousands of barrels]

Country	1940 Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	1939 (total)
Imports:														
For direct consumption:														
Colombia			182				111			72		86	451	1,166
Mexico	405	284	577	832	1,085	924	1,463	1,396	1,558	1,329	1,396	1,013	12,262	1,688
Trinidad and Tobago														61
Venezuela	1,543	1,959	1,829	2,406	3,002	2,221	2,197	2,682	2,431	2,435	2,627	3,512	28,844	25,645
Other countries														2
	1,948	2,243	2,588	3,238	4,087	3,145	3,771	4,078	3,989	3,836	4,023	4,611	41,557	28,562
Bonded for manufacture and export:														
Mexico														3,359
Venezuela			278	130	179	513	78	72	70	75		133	1,528	2,185
Total imports	1,948	2,243	2,866	3,368	4,266	3,658	3,849	4,150	4,059	3,911	4,023	4,744	43,085	34,106
Exports:														
North America:														
Canada	1,015	1,349	1,200	1,733	2,799	3,465	3,730	3,118	2,942	3,739	2,586	1,102	28,778	28,121
Cuba	149	73	101	53	78	78	78	73		64		75	822	1,141
Mexico	8	7	11	12	7	168	91	8	6	12	11	8	349	290
South America:														
Argentina	159		113	100		103	106			103		95	779	2,125
Brazil	76					77						97	250	173
Europe:														
Belgium														279
Denmark														211
France	1,236	844	1,109	1,097	677	457							5,420	14,955
Germany														416
Italy	347	215	396	372		90							1,420	4,985
Netherlands														276
Portugal		81	152		58		142	28		36	34		531	140
Sweden			46										46	639
United Kingdom			95		116	93	105	56		68			533	560
Asia:														
China														89
Japan	1,170	757	819	804	952	960	1,194	887	1,129	1,159	1,083	615	11,529	16,086
Kwantung	91			90	91	75	157		91	79	91	79	844	818
Thailand (Siam)									91				91	232
Africa:														
Union of South Africa														84
Other countries	14		4	1	6	61	4		1	9		3	103	443
Noncontiguous Territories		1											1	13
Total exports	4,265	3,327	4,046	4,262	4,784	5,627	5,607	4,170	4,260	5,269	3,805	2,074	51,496	72,076
Revisions [2]	[3] 63				102	65							104	
Net exports	2,317	1,084	1,180	894	518	1,969	1,758	20	201	1,358	[4] 218	[4] 2,670	8,411	37,970

[1] Bureau of Foreign and Domestic Commerce. [2] By Bureau of Foreign and Domestic Commerce through April 9, 1941. [3] Negative quantity. [4] Net imports.

The chief increase in imports of this group of oils was in residual fuel oil for direct consumption and in distillate fuel oil, which was not imported into continental United States in 1939. These increases may be due largely to the reduction in the excise tax on imported fuel oils from 21 cents a barrel to 10½ cents as a result of the Venezuelan Trade Agreement effective December 16, 1939, as well as to the general increase in demand for both residual and distillate fuel oils. The loss of European markets on account of the war and the consequent accumulation of stocks in the Netherlands West Indies and Venezuela exercised a pressure that tended to force shipments to the United States, the nearest available large-scale market.

Exports.—The United States continued to be a net exporter of mineral oils, but the excess of exports and Territorial shipments over imports was reduced from 129,899,000 barrels in 1939 to 47,673,000 in 1940. The greater decrease in net exports and shipments was in refined products (52,107,000 barrels), due to the falling-off of exports, especially to Europe, as well as to an increase in imports of fuel oil.

Exports and Territorial shipments of mineral oils, crude and refined, comprised 9 percent of the total demand in 1940 compared with 13 percent in 1939.

Exports of crude petroleum from the United States were 28 percent less in 1940 than in 1939. Canada, the major purchaser of United States crude both in 1939 and 1940, increased its takings slightly in 1940. Fully 71 percent of the loss in crude exports was in shipments to Europe. No crude petroleum was exported from the United States to France after its surrender in June 1940; Germany, Belgium, the Netherlands, Finland, and Norway were eliminated by the war blockade, and Sweden virtually so. Italy ceased to receive United States crude after its entry into the war in June. Of all Europe only the United Kingdom and Portugal remained open to shipments of crude from the United States; and the United Kingdom curtailed its purchases from the United States to conserve dollar exchange, apparently obtaining its refinery requirements from Iran and Venezuela. Portugal, where petroleum refining has begun, increased its takings of United States crude in 1940 over 1939. On the other hand the Netherlands West Indies, where refining had to be curtailed because of the decline in European demand, decreased its receipts of crude petroleum from the United States in 1940 from 1939. Exports of crude petroleum to Japan, chiefly from California, were reduced, largely for lack of dollar exchange.

Any hopes remaining from 1939 that the war in Europe would increase the demand for petroleum products were disappointed. The requirements of armies, navies, and air forces were met by curtailing civilian consumption to an extent that had not been forseen. Europe, the major theater of war, actually took 60 percent less of major refined products from the United States in 1940 than in 1939. The United Kingdom reduced its purchases of major liquid petroleum products from the United States 34 percent from 1939 to 1940. Because of the losses of European markets the Netherlands West Indies, which ordinarily receives from the United States high-volatile gasoline, kerosene, and distillate fuel oil to blend with the products of its own refineries, decreased its receipts in 1940 from the level of 1939.

Mineral oils, crude and refined, shipped from continental United States and including shipments to noncontiguous Territories, 1939–40, by classes and months [1]

[Thousands of barrels]

Class	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1939													
Crude petroleum	4,480	4,810	4,966	6,222	8,643	5,831	7,304	5,969	6,925	6,947	5,323	4,656	72,076
Refined products:													
Motor fuel: [2]													
Aviation	536	194	397	323	692	466	266	221	206	287	274	372	4,234
Other	3,090	2,715	3,939	3,340	3,813	3,993	3,319	3,964	4,025	3,156	2,286	2,764	40,404
Total motor fuel	3,626	2,909	4,336	3,663	4,505	4,459	3,585	4,185	4,231	3,443	2,560	3,136	44,638
Kerosene	810	532	546	713	653	471	774	839	577	1,107	567	652	8,241
Distillate fuel oil	1,695	2,188	2,896	2,345	4,004	2,839	2,857	3,361	3,015	2,756	2,116	1,998	32,020
Residual fuel oil	1,354	927	2,065	1,488	1,854	1,684	1,144	1,613	1,624	1,296	1,116	1,320	17,485
Lubricating oil	851	680	828	816	981	1,101	1,022	1,133	984	985	1,190	1,310	11,881
Paraffin wax	66	68	94	72	57	89	60	53	108	68	44	52	831
Coke	52	41	49	115	166	163	158	127	191	113	193	63	1,431
Asphalt	18	41	15	21	15	20	17	18	24	19	13	12	233
Miscellaneous oils	5	8	9	9	9	8	8	4	14	17	18	14	123
Total refined	8,477	7,344	10,838	9,242	12,244	10,834	9,625	11,333	10,768	9,804	7,817	8,557	116,883
Total crude and refined	12,957	12,154	15,804	15,464	20,887	16,665	16,929	17,302	17,693	16,751	13,140	13,213	188,959
1940													
Crude petroleum	4,202	3,327	4,046	4,262	4,886	5,692	5,607	4,170	4,260	5,269	3,805	2,074	51,600
Refined products:													
Motor fuel: [2]													
Aviation [3]	155	125	249	302	415	646	210	569	301	291	535	497	4,295
Other	2,119	1,778	2,016	1,773	1,577	1,935	1,476	1,518	1,606	1,858	1,670	1,486	20,812
Total motor fuel	2,274	1,903	2,265	2,075	1,992	2,581	1,686	2,087	1,907	2,149	2,205	1,983	25,107
Kerosene	391	298	485	399	386	332	227	230	178	142	190	116	3,374
Distillate fuel oil	1,549	1,234	2,318	1,966	2,130	2,129	1,837	1,469	947	1,356	1,284	953	19,172
Residual fuel oil	1,139	769	932	1,532	1,379	1,959	1,387	1,815	1,552	1,366	1,334	913	16,077
Lubricating oil	1,068	1,089	1,193	1,161	1,173	1,075	741	727	393	615	671	588	10,494
Paraffin wax	76	101	91	68	80	47	32	32	41	38	41	31	678
Coke	83	27	69	137	115	154	100	181	135	167	214	128	1,510
Asphalt	106	133	104	162	169	194	137	176	93	119	82	158	1,633
Miscellaneous oils	40	211	126	85	117	45	72	43	42	53	63	47	944
Total refined	6,726	5,765	7,583	7,585	7,541	8,516	6,219	6,760	5,288	6,005	6,084	4,917	78,989
Total crude and refined	10,928	9,092	11,629	11,847	12,427	14,208	11,826	10,930	9,548	11,274	9,889	6,991	130,589

[1] Compiled from the records of Bureau of Foreign and Domestic Commerce; figures may differ slightly from those used throughout other sections of this report.
[2] Includes benzol, natural gasoline, and (since June 1, 1940) antiknock compounds.
[3] Includes antiknock compounds beginning with June. Data for January to May, inclusive, may be found in motor-fuel section.

Motor-fuel exports and Territorial shipments made a 44-percent drop. Exports of ordinary gasoline were cut in half—from 32,512,000 barrels in 1939 to 16,478,000 in 1940. The chief loss was in shipments to the United Kingdom. Canada, the United Kingdom, Brazil, and New Zealand reduced their takings from 1939 to 1940; none was shipped to France after June 1940. Although Japan, Australia, China, and the U. S. S. R. purchased more ordinary gasoline from the United States in 1940 than in 1939, their increased purchases did not compensate for the decline in shipments to the other major customers.

Exports of high-grade gasoline decreased one-fourth—from 4,001,000 barrels in 1939 to 2,992,000 in 1940. Less was shipped to Canada, Japan, the Netherlands West Indies, and Brazil in 1940 than in 1939. None was shipped to France or to Italy after June 1940. The United Kingdom, however, received more aviation gasoline in 1940 than in 1939.

The largest recession in the motor-fuel group was in exports of natural gasoline. These decreased 59 percent—from 4,111,000 barrels in 1939 to 1,707,000 in 1940. The principal declines were in exports to Japan, the United Kingdom, France, the Netherlands West Indies, and Italy.

Territorial shipments of motor fuel, undifferentiated, increased 9 percent from 1939 to 1940. Hawaii was the principal destination of these shipments.

A considerable drop was registered in exports and Territorial shipments of kerosene. Although China increased its purchases of illuminating oil from the United States, this did not compensate for the declines in shipments to the United Kingdom, the Netherlands West Indies, Japan and Kwantung, and Canada.

The loss of the German market was especially severe on exports of fuel oil. Less distillate fuel oil was exported to the Netherlands West Indies, to Japan, to France, and to the United Kingdom in 1940 than in 1939. Although more distillate fuel oil was shipped to Italy, the U. S. S. R., and Australia and to the noncontiguous Territories, this did not equalize the decreases in shipments to major foreign purchasers.

The decline in exports and Territorial shipments of residual fuel oil was less than it had been for distillate fuel oil from 1939 to 1940. The principal decreases in exports of residual fuel oil were in shipments to Japan and to Italy. These were offset in part by larger shipments to Canada, Spain, the United Kingdom, Cuba, and New Zealand and to the noncontiguous Territories.

Exports of lubricating oil are widely distributed and in consequence suffered less from the effects of the war in Europe. The greatest loss in 1940 was in shipments to Germany; but Europe in general took less lubricating oil from the United States in 1940 than in 1939. Although more lubricating oil was shipped to the United Kingdom, Japan, Australia, Brazil, China, and New Zealand in 1940 than in 1939, declines in shipments to Europe resulted in a net loss in exports of lubricating oils.

Exports and shipments of wax were 18 percent lower in 1940 than in 1939. The greatest decrease was in exports to Europe, especially to Italy, Belgium, the Netherlands, Spain, and Sweden. Although the United Kingdom and France took more paraffin wax from the United States in 1940 than in 1939 this did not serve to arrest the general decline in exports of wax to Europe.

Major petroleum products shipped from continental United States by countries of destination and shipments to and exports from noncontiguous Territories, 1939–40 [1]

[Thousands of barrels, except wax, which is in thousands of pounds]

Country	Motor fuel [2]		Kerosene		Fuel oil		Lubricating oil		Wax	
	1939	1940 [3]	1939	1940 [3]	1939	1940 [3]	1939	1940 [3]	1939	1940 [3]
Exports to foreign countries:										
North America:										
Canada	2,963	2,488	189	186	1,180	2,183	524	547	13,380	12,012
Cuba	534	533	1	-------	390	566	55	39	2,939	1,951
Mexico	387	445	25	29	456	1,082	99	102	21,833	24,069
Netherlands West Indies	5,126	976	561	26	4,843	2,015	19	20	1	33
Panama (including Canal Zone)	249	433	44	66	1,880	2,551	17	21	205	245
Other North America	465	468	224	124	684	744	68	63	7,596	4,469
	9,724	5,343	1,044	431	9,433	9,141	782	792	45,954	42,779
South America:										
Argentina	5	3	-------	1	-------	-------	23	47	3,325	2,458
Brazil	1,280	821	415	227	180	161	302	313	2,840	2,729
Chile	246	61	9	-------	2,184	2,290	90	78	4,885	3,781
Colombia	13	15	1	-------	1	2	28	27	7,193	3,108
Other South America	110	118	11	10	185	173	123	145	12,245	13,739
	1,654	1,018	436	238	2,550	2,626	566	610	30,488	25,815
Europe:										
Belgium	1,273	110	10	12	1,098	114	975	174	12,105	3,897
Denmark	813	-------	495	1	782	145	477	10	4,471	2,064
Eire	195	118	63	35	32	33	7	10	1,544	-------
Finland	211	214	50	55	104	36	27	17	1,094	145
France	2,646	854	-------	-------	133	-------	480	330	190	4,598
Germany	761	-------	17	-------	3,656	-------	1,032	-------	5,089	-------
Italy	320	89	14	-------	1,553	302	483	317	28,838	11,095
Netherlands	1,670	327	991	182	3,089	287	365	90	7,904	4,125
Norway	360	108	188	-------	663	306	80	53	2,729	837
Portugal	488	99	225	54	243	152	79	53	2,122	1,798
Spain	2,127	1,520	22	140	1,691	2,507	377	287	17,239	10,759
Sweden	3,207	359	464	17	1,498	296	268	94	16,705	6,156
United Kingdom	9,060	4,104	1,467	448	4,616	3,824	2,803	3,457	39,306	56,783
Other Europe	459	81	47	1	429	2	132	164	2,852	6,672
	23,590	7,983	4,053	945	19,587	8,004	7,585	5,056	142,188	108,929
Asia:										
India, British, and Burma	33	89	81	3	40	19	443	608	413	405
China, Hong Kong, and Kwantung	1,150	1,231	534	477	1,006	539	180	295	6,292	3,375
French Indochina	39	146	26	14	34	29	50	41	134	45
Japan	1,381	3,238	105	43	9,909	7,248	514	819	3	369
Philippine Islands	1,228	920	578	415	1,374	1,199	129	125	498	701
Thailand (Siam)	49	139	96	220	172	83	31	30	28	-------
U. S. S. R.	884	1,065	-------	-------	-------	65	-------	-------	66	-------
Other Asia	523	20	261	11	201	80	244	305	1,128	536
	5,287	6,848	1,681	1,183	12,736	9,262	1,591	2,223	8,562	5,431
Africa:										
Union of South Africa	270	142	29	41	10	5	173	327	2,447	3,305
Other Africa	634	185	588	127	1,029	162	360	535	2,449	3,338
	904	327	617	168	1,039	167	533	862	4,896	6,643

[1] Bureau of Foreign and Domestic Commerce.
[2] Includes natural gasoline, naphtha, and benzol, and, beginning with June 1, 1940, antiknock compounds.
[3] Subject to revision.

Major petroleum products shipped from continental United States by countries of destination and shipments to and exports from noncontiguous Territories, 1939–40 [1]—Continued

[Thousands of barrels, except wax, which is in thousands of pounds]

Country	Motor fuel [2]		Kerosene		Fuel oil		Lubricating oil		Wax	
	1939	1940 [3]	1939	1940 [3]	1939	1940 [3]	1939	1940 [3]	1939	1940 [3]
Exports to foreign countries—Continued.										
Oceania:										
Australia	756	962	108	154	35	70	600	627	334	60
New Zealand	388	14	29	7	139	149	106	161	97	154
Other Oceania	50	25	26	13	71	25	3	5	-------	-------
	1,194	1,001	163	174	245	244	709	793	431	214
	42,353	22,520	7,994	3,139	45,590	29,444	11,766	10,336	232,519	189,811
Shipments to noncontiguous Territories:										
Alaska	239	291	9	15	1,259	1,239	19	19	8	9
Hawaii	1,239	1,311	141	117	2,449	4,333	66	110	54	20
Puerto Rico	845	934	128	124	235	265	31	159	81	62
Virgin Islands	18	19	3	3	5	6	2	3	1	3
Other	26	20	2	3	7	2	1	-------	1	-------
	2,367	2,575	283	262	3,955	5,845	119	291	145	94
Exports from noncontiguous Territories:										
Alaska	11	11	-------	-------	12	15	1	-------	-------	-------
Puerto Rico	71	66	36	24	22	25	3	2	-------	-------
	82	77	36	24	34	40	4	2	-------	-------
Revisions [4]	-------	89	-------	[5] 3	-------	-------	-------	[5] 131	-------	160
Total shipments from United States	44,638	25,107	8,241	3,374	49,511	35,249	11,881	10,494	232,664	190,065

[1] Bureau of Foreign and Domestic Commerce.
[2] Includes natural gasoline, naphtha, and benzol, and, beginning with June 1, 1940, antiknock compounds.
[3] Subject to revision.
[4] By Bureau of Foreign and Domestic Commerce, through April 9, 1941.
[5] Negative quantity.

Less wax was exported from the United States to other North American countries (except Mexico), to South America, and to Asia (except Japan) and less to Australia, but more to New Zealand. Of the continents, only Africa took more wax from the United States in 1940 than in 1939; the increase was principally in exports to the Union of South Africa, to Morocco, and to Egypt.

Motor fuel exported and shipped to noncontiguous Territories from continental United States in 1940, by refinery districts and months[1]

[Thousands of barrels]

Refinery district	January	February	March	April	May	June
East Coast	44	89	101	44	80	70
Appalachian	10	23	5	8	31	22
Indiana, Illinois, Kentucky, etc	11	10	15	10	172	134
Texas Inland	6	5	6	6	6	5
Texas Gulf Coast	1,159	968	1,285	1,003	872	1,421
Louisiana Gulf Coast	254	154	190	173	217	354
Rocky Mountain	28	12	8	8	22	14
California	762	642	655	823	592	561
Total United States	2,274	1,903	2,265	2,075	1,992	2,581

Refinery district	July	August	September	October	November	December	Total
East Coast	22	61	20	118	51	73	773
Appalachian	31	19	8	12	9	2	180
Indiana, Illinois, Kentucky, etc	71	168	124	127	137	36	1,015
Texas Inland	7	3	6	6	5	6	67
Texas Gulf Coast	749	841	772	660	1,008	905	11,643
Louisiana Gulf Coast	235	283	145	328	234	334	2,901
Rocky Mountain	10	20	13	7	8	6	156
California	561	692	819	891	753	621	8,372
Total United States	1,686	2,087	1,907	2,149	2,205	1,983	25,107

[1] Compiled from data of Bureau of Foreign and Domestic Commerce; figures may differ slightly from those used throughout other sections of this report.

INTERCOASTAL SHIPMENTS[4]

Receipts of mineral oils, crude and refined, on the East coast from Gulf coast ports were 6.5 percent larger in 1940 than in 1939. Crude petroleum was the largest single item in these shipments and constituted 38 percent of the total shipments in 1940. Receipts of refined oils from Gulf coast ports were 9 percent larger in 1940 than in 1939.

Receipts of California mineral oils at East coast ports were smaller in 1940 than in 1939. Larger intercoastal shipments of gasoline did not suffice to offset a sharp drop in shipments of residual fuel oil.

[4] By A. H. Redfield, Petroleum Economics Division, Bureau of Mines.

Mineral oils, crude and refined, shipped from Gulf coast to East coast ports of the United States, 1939–40 [1]

[Thousands of barrels]

	Jan.	Feb.	Mar.	Apr.	May	June	July
Crude petroleum	14,625	12,466	14,293	14,075	15,020	14,691	12,903
Gasoline	7,448	6,916	10,331	10,791	10,770	10,275	11,336
Kerosene	2,948	2,770	2,302	2,123	1,948	1,474	1,667
Distillate fuel oil	5,168	5,538	4,365	2,888	2,805	2,601	2,858
Residual fuel oil	7,501	5,599	6,808	5,427	5,376	4,621	5,467
Lubricating oil	610	631	635	487	725	639	618
Miscellaneous oils	23	22	76	42	30	55	120
	38,323	33,942	38,810	35,833	36,674	34,356	34,969

	Aug.	Sept.	Oct.	Nov.	Dec.	Total	1939 (total)
Crude petroleum	13,402	11,656	13,398	12,425	13,033	161,987	157,819
Gasoline	10,850	10,024	10,763	10,016	9,622	119,142	114,633
Kerosene	1,690	2,072	2,011	2,696	3,561	27,262	22,404
Distillate fuel oil	2,437	2,684	2,695	4,411	5,979	44,429	34,701
Residual fuel oil	4,134	5,708	5,072	6,292	5,417	67,422	65,446
Lubricating oil	616	591	565	633	713	7,463	6,555
Miscellaneous oils	113	3	20	44	68	616	485
	33,242	32,738	34,524	36,517	38,393	428,321	402,043

[1] Petroleum Conservation Division, U. S. Department of the Interior.

Mineral oils, crude and refined, shipped from California to East coast ports of the United States, 1939–40

[Thousands of barrels]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	1939 (total)
Crude petroleum	-----	-----	72	64	-----	171	-----	115	72	32	123	29	678	947
Gasoline	179	197	376	149	384	452	370	531	268	382	252	426	3,966	3,665
Kerosene	-----	-----	-----	-----	-----	-----	-----	40	54	-----	-----	-----	94	391
Distillate fuel oil	211	71	-----	-----	-----	-----	-----	-----	182	103	154	-----	721	633
Residual fuel oil	164	62	-----	-----	33	-----	75	77	155	-----	-----	-----	566	2,289
Miscellaneous oils	27	79	106	3	68	76	70	74	142	73	4	2	724	545
	581	409	554	216	485	699	515	837	873	590	533	457	6,749	8,470

NATURAL GAS[1]

By F. S. Lott and G. R. Hopkins[2]

SUMMARY OUTLINE

Vigorous growth in the demand for natural gas accompanied the intense industrial activity and rising national income incident to the

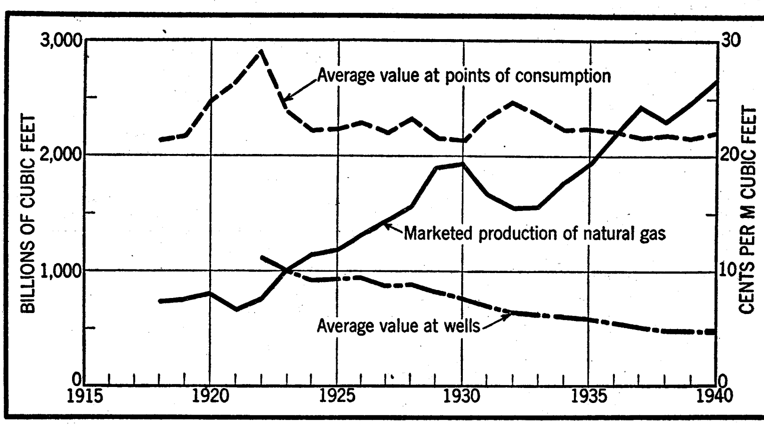

FIGURE 1.—Production and value of natural gas in the United States, 1918–40.

defense program of 1940. Marketed production gained 8 percent over 1939 to attain a total of about 2,672 billion cubic feet, a new high for the industry (see fig. 1). In several States, including the leaders—Texas, California, and Louisiana—production exceeded that of any previous year.

Estimated consumption (marketed production less exports) in 1940 was 2,667,010 million cubic feet, a gain over the 2,473,765 million consumed in 1939. All major classes of consumers except petroleum refineries and electric power plants apparently used more gas in 1940 than ever before. Unusually cold weather early in 1940 stimulated the domestic and commercial demand, and larger requirements for gas were general in industrial areas. The urgency of demand taxed the facilities of several major pipe-line systems and caused them to undertake construction programs to increase capacity.

[1] Data for 1940 are preliminary; detailed statistics with final revisions will be released later.
[2] Tables compiled by H. Backus, Petroleum Economics Division, Bureau of Mines.

Salient statistics of natural gas in the United States, 1936–40

	1936	1937	1938	1939	1940 [1]
Marketed production:					
California ..... millions of cubic feet	320,406	329,769	315,168	348,361	360,000
Louisiana ..... do	290,151	315,301	283,899	294,370	324,000
Oklahoma ..... do	280,481	296,260	263,164	250,875	265,000
Texas ..... do	734,561	854,561	882,473	979,427	1,090,000
West Virginia ..... do	138,076	149,084	134,342	159,226	180,000
Other States ..... do	404,127	462,645	416,516	444,497	453,000
Total production ..... do	2,167,802	2,407,620	2,295,562	2,476,756	2,672,000
Exports:					
To Canada ..... do	84	78	94	76	90
To Mexico ..... do	7,352	4,790	1,743	3,046	4,900
Imports from Canada ..... do	152	289	372	131	.....
Consumption:					
Domestic ..... do	343,346	371,844	367,772	391,153	442,000
Commercial ..... do	111,623	117,390	114,296	118,334	132,000
Industrial:					
Field ..... do	618,468	651,320	659,203	680,884	700,000
Carbon-black plants ..... do	283,421	341,085	324,950	347,270	369,000
Petroleum refineries ..... do	93,183	113,005	109,741	97,685	100,000
Electric public-utility power plants [2] millions of cubic feet	156,080	170,567	169,988	191,131	182,948
Portland-cement plants [3] ..... do	36,923	40,450	37,336	40,233	41,949
Other industrial ..... do	517,474	597,380	510,811	607,075	699,113
Total consumption ..... do	2,160,518	2,403,041	2,294,097	2,473,765	2,667,010
Domestic ..... percent of total	16	15	16	16	17
Commercial ..... do	5	5	5	5	5
Industrial ..... do	79	80	79	79	78
Number of consumers:					
Domestic ..... thousands	8,017	8,348	[4] 8,570	8,888	(5)
Commercial ..... do	657	680	[4] 695	715	(5)
Industrial [6] ..... do	39	39	39	40	(5)
Number of producing gas wells	54,500	55,050	53,770	53,530	(5)
Value (at wells) of gas produced:					
Total ..... thousands of dollars	119,193	123,457	113,571	120,243	128,256
Average per M cubic feet ..... cents	5.5	5.1	4.9	4.9	4.8
Value (at points of consumption) of gas consumed:					
Domestic ..... thousands of dollars	251,617	273,577	273,070	287,600	322,660
Commercial ..... do	53,693	57,161	56,247	58,494	64,944
Industrial ..... do	170,129	196,791	171,233	187,627	203,022
Total value ..... do	475,439	527,529	500,550	533,721	590,626
Average per M cubic feet:					
Domestic ..... cents	73.3	73.6	74.2	73.5	73.0
Commercial ..... do	48.1	48.7	49.2	49.4	49.2
Industrial ..... do	10.0	10.3	9.4	9.6	9.7
Domestic and commercial ..... do	67.1	67.6	68.3	67.9	67.5
Domestic, commercial, and industrial ..... cents	22.0	22.0	21.8	21.6	22.1
Treated for natural gasoline:					
Quantity ..... millions of cubic feet	1,815,000	2,108,800	2,035,562	2,150,000	2,380,000
Percent of total consumption	84	88	89	87	89

[1] Subject to revision.
[2] Federal Power Commission.
[3] Chapters on Cement in Minerals Yearbook.
[4] Revised figures.
[5] Figures not yet available.
[6] Exclusive of oil- and gas-field operators.

The number of domestic meters in service reached a new record of 8,887,460 in December 1939, a gain of 317,000 during the year. Since 1930, when separate data on domestic meters were first compiled, the number of homes connected to natural-gas distribution systems has consistently increased each year despite depression influences. There was a total growth of 76 percent in the 9-year period—an average of over 8 percent annually. The commercial market followed a similar trend, with a total gain of 73 percent in meters to a new peak of 715,390 at the end of 1939. The average consumption of gas for each domestic and commercial meter dropped sharply (21 percent) in 1931 and has remained relatively stable since then within the range of 50 to 55 thousand cubic feet a year.

The average value of domestic gas at points of consumption is estimated to have declined from 73.5 cents per thousand cubic feet in 1939 to 73.0 in 1940. Similarly, the value of commercial gas dropped from 49.4 to 49.2 cents. These estimates indicate that the total value of domestic consumption was about $322,660,000 and that of commercial consumption $64,944,000 in 1940. The average value of industrial consumption is thought to have increased one-tenth cent in 1940 to 9.7 cents per thousand cubic feet, making the indicated total value at points of consumption $203,022,000. The total value of all marketed production in the United States in 1940 therefore reached a new record of about $590,626,000—11 percent above 1939.

Exports to Mexico in 1940 increased 61 percent to 4,900 million cubic feet, and natural gas piped to Ontario, Canada (mixed with manufactured gas), amounted to 90 million compared to 76 million in 1939. No natural gas was imported in 1940, the former movement from Canada into Montana having been discontinued in June 1939.

EMPLOYMENT AND PRODUCTIVITY

The discussion of employment and productivity that has been given in this chapter for several years cannot be repeated for 1939, as the Bureau of Mines did not compile employment data for that year; however, complete information for 1939 was collected by the Bureau of the Census as part of its Decennial Census of Mines and Quarries, and the results should be published before the end of 1941.

GROSS PRODUCTION

The estimated gross production of natural gas in the United States in 1939 was 3,333,500 million cubic feet—9 percent more than in 1938. The output of gas wells increased 17 percent in 1939, stimulated chiefly by growth in the market demand for gas. Another important factor, however, was the sharp rise in the volume of gas processed at recycling plants in Texas "condensate" fields.

The indicated production of gas from oil wells was virtually the same in 1939 as in 1938, as rather sharp declines in Kansas, New Mexico, and Oklahoma were offset by gains in Illinois, Louisiana, and Wyoming. New information on the volume of gas produced at oil wells in several States was available for 1939. Its inclusion in the table that follows distorts to some extent the year-to-year changes in volume because similar information for 1938 is lacking. The 1938 totals for "gas from oil wells" and "losses and wastage" would be larger than shown if comparable data had been used for both years.

The increased volume of gas reported as used for repressuring (and pressure maintenance) is due entirely to reinjection of gas at high pressures into "condensate" reservoirs in Texas. Most States reported moderate declines in 1939.

The decrease of almost 50 percent in the storage of gas in natural underground reservoirs during 1939 resulted from reduced operations of this type in Kansas, Ohio, and Pennsylvania. In Kansas 19 billion cubic feet of gas were reported as stored from 1935 to 1938, inclusive. The recession in volume for 1939 suggests that stored reserves are regarded as adequate for current needs and facilities. In the eastern fields a rather widespread movement to store natural gas in depleted pools followed discovery of the prolific Oriskany sand production which—temporarily at least—provided productive capacity beyond local requirements. Because of competitive conditions much Oriskany gas was produced rapidly from its original site in 1937 and 1938 and piped to other areas to be stored for future use. The movement subsided in 1939 as some Oriskany pools approached depletion.

Gross production and disposition of natural gas in the United States, 1938–39, by States, in millions of cubic feet

State	Estimated production [1]			Estimated disposition			
	From gas wells	From oil wells	Total	Marketed production	Repressuring	Stored in ground	Losses and wastage [2]
1938							
Arkansas	5,300	18,900	24,200	11,301	108		12,791
California	13,000	419,000	432,000	315,168	40,000	2,144	74,688
Colorado	1,775	225	2,000	1,904			96
Illinois	150	17,850	18,000	1,169	500		16,331
Indiana	1,350	150	1,500	1,299	6		195
Kansas	54,000	62,000	116,000	75,203	1,655	[3] 5,443	38,249
Kentucky	46,000	5,300	51,300	46,163	800	61	3,530
Louisiana	260,000	100,800	360,800	283,899	6,000		70,901
Michigan	7,900	2,700	10,600	10,165			435
Mississippi	14,300		14,300	13,656			644
Missouri	1,490	10	1,500	1,369			131
Montana	20,900	800	21,700	21,216	188		296
New Mexico	30,000	138,000	168,000	50,706	452		116,842
New York	40,910	90	41,000	39,402			1,539
Ohio	35,800	3,200	39,000	35,257	90	[4] 3,532	2,632
Oklahoma	76,000	254,000	330,000	263,164	18,656	822	45,578
Pennsylvania	80,000	6,200	86,200	76,547	563	[5] 2,360	7,741
Texas	715,000	435,000	1,150,000	882,473	20,000		244,757
West Virginia	136,000	14,000	150,000	134,342	3,360	619	8,962
Wyoming	22,400	16,000	38,400	26,678	9,173		2,549
Other States [6]	4,700		4,700	4,481			219
	1,566,975	1,494,225	3,061,200	2,295,562	101,551	14,981	649,106
1939 [7]							
Arkansas	6,200	17,800	24,000	10,107	952		12,941
California	27,000	403,000	430,000	348,361	22,487	5,918	53,234
Colorado	1,850	450	2,300	2,015			285
Illinois	1,200	61,800	63,000	2,746	397		59,857
Indiana	950	450	1,400	791			609
Kansas	66,000	44,000	110,000	80,556	1,436	[8] 425	27,925
Kentucky	48,500	4,500	53,000	47,771	208		4,845
Louisiana	288,000	125,000	413,000	294,370	9,340		109,290
Michigan	9,150	2,250	11,400	10,726			674
Mississippi	15,290	10	15,300	14,527			773
Missouri	640	10	650	538			112
Montana	22,800	1,200	24,000	23,178	23		799
New Mexico	35,000	110,000	145,000	60,284	31		84,685
New York	30,900	100	31,000	29,222	85		1,466
Ohio	40,600	3,400	44,000	36,469	3,995	[9] 687	3,345
Oklahoma	76,000	234,000	310,000	250,875	13,896	65	45,042
Pennsylvania	97,000	6,500	103,500	93,882	733	[10] 831	8,437
Texas	880,000	450,000	1,330,000	979,427	105,000		245,353
West Virginia	158,000	14,000	172,000	159,226	2,946	[11] 106	9,446
Wyoming	22,500	22,200	44,700	26,614	9,872		8,014
Other States [6]	5,240	10	5,250	5,071			179
	1,832,820	1,500,680	3,333,500	2,476,756	171,401	8,032	677,311

[1] Marketed production plus quantities used in repressuring, stored in the ground, lost, and wasted (see footnote [2]).
[2] Includes gas (mostly residue gas) blown to the air, shrinkage at natural-gasoline plants, and transportation losses but does not include direct waste on producing properties, except where data are available.
[3] Produced approximately as follows—2,770 million cubic feet in Texas, 1,780 million in Oklahoma, and 893 million in Kansas.
[4] Produced approximately as follows—1,981 million cubic feet in West Virginia, 530 million in Kentucky, and 1,021 million in Ohio.
[5] Produced approximately as follows—736 million cubic feet in West Virginia, 216 million in Kentucky, 59 million in New York, and 1,349 million in Pennsylvania.
[6] North Dakota, South Dakota, Tennessee, Utah, Virginia (1939 only), and Washington.
[7] Subject to revision.
[8] Produced approximately as follows—220 million cubic feet in Texas, 122 million in Oklahoma, and 83 million in Kansas.
[9] Produced approximately as follows—86 million cubic feet in Kentucky, 4 million in Pennsylvania, 406 million in West Virginia, and 191 million in Ohio.
[10] Produced approximately as follows—227 million cubic feet in New York, 444 million in Pennsylvania, 128 million in West Virginia, and 32 million in Kentucky.
[11] Produced approximately as follows—58 million cubic feet in Kentucky and 48 million in West Virginia.

Indicated losses and wastage equaled 20 percent of the gross production in 1939 and 21 percent in 1938. There were material declines in California, Kansas, and New Mexico due principally to declining pressures in certain important fields with high gas-oil ratios. The apparent increases in Illinois, Louisiana, and Wyoming may in part be ascribed to less complete information on operations during 1938.

MARKETED PRODUCTION

An 8-percent expansion is estimated for marketed production in 1940 in the United States, which rose to 2,672 billion cubic feet—a new high for the industry. All leading producing States contributed to the increase.

Final data for 1939 show that production of gas was larger in most States than in 1938, the only notable exceptions being Oklahoma, where the output of casinghead gas continued to drop, and New York. California, Michigan, Mississippi, New Mexico, and Texas attained new peaks in marketed production in 1939.

In 1939 the same nine States as in 1938 reported greater production than consumption. The most important of these was Texas, with a net excess output of 182.9 billion cubic feet that was consumed in other States and Mexico. Louisiana had net exports of 129.7 billion cubic feet, West Virginia 89.8 billion, Kentucky 31.2 billion, and New Mexico 21.3 billion.

The average value of gas at the wells in 1939 was 4.9 cents per thousand cubic feet, unchanged from 1938. Small increases were noted in a number of States, those in Missouri and Pennsylvania being the most significant. Eleven States showed decreases; those in California, Texas, and West Virginia were the more important.

Natural gas produced in the United States and delivered to consumers, 1935–39, by States, in millions of cubic feet

Year	Arkansas	California	Colorado	Illinois	Indiana	Kansas	Kentucky	Louisiana	Michigan	Mississippi	Montana	New Mexico
1935	6,167	284,109	2,843	1,448	1,777	57,125	39,738	249,450	4,203	9,643	19,870	27,931
1936	8,500	320,406	3,687	865	2,241	69,178	43,903	290,151	7,167	11,821	23,003	33,928
1937	9,690	329,769	3,186	1,040	1,551	83,890	55,719	315,301	9,080	13,348	24,765	46,337
1938	11,301	315,168	1,904	1,169	1,299	75,203	46,163	283,899	10,165	13,656	21,216	50,706
1939	10,107	348,361	2,015	2,746	791	80,556	47,771	294,370	10,726	14,527	23,178	60,284

Year	New York	Ohio	Oklahoma	Pennsylvania	Texas	West Virginia	Wyoming	Other States	Total	Value at points of consumption: Total (thousands of dollars)	Value at points of consumption: Average per M cubic feet (cents)
1935	8,288	49,592	274,313	94,464	642,366	115,772	26,643	853	1,916,595	429,374	22.4
1936	12,431	46,994	280.481	110,362	734,561	138,076	29,322	725	2,167,802	476,813	22.0
1937	21,325	42,783	296,260	115,928	854,561	149,084	31,023	2,980	2,407,620	528,354	21.9
1938	39,402	35,257	263,164	76,547	882,473	134,342	26,678	5,850	2,295,562	500,698	21.8
1939	29,222	36,469	250,875	93,882	979,427	159,226	26,614	5,609	2,476,756	534,240	21.6

Natural gas produced and consumed in the United States in 1939, by States

State	Produced and delivered to consumers, including deliveries in other States						Consumed, including receipts from other States			
	Quantity		Estimated value at wells		Value at points of consumption		Quantity		Value at points of consumption	
	M cubic feet	Percent of total	Total	Average per M cubic feet (cents)	Total	Average per M cubic feet (cents)	M cubic feet	Percent of total	Total	Average per M cubic feet (cents)
Ala.							20,093,000	0.8	$4,935,000	24.6
Ariz.							16,643,000	.7	4,653,000	28.0
Ark.	10,107,000	0.4	$414,000	4.1	$1,996,000	19.7	35,673,000	1.4	7,043,000	19.7
Calif.	348,361,000	14.1	21,529,000	6.2	91,572,000	26.3	348,361,000	14.1	91,572,000	26.3
Colo.	2,015,000	.1	78,000	3.9	467,000	23.2	21,978,000	.9	7,621,000	34.7
D. C.							4,069,000	.2	2,913,000	71.6
Fla.							1,658,000	.1	419,000	25.3
Ga.							16,296,000	.7	6,440,000	39.5
Ill.	2,746,000	.1	88,000	3.2	1,450,000	52.8	77,134,000	3.1	40,156,000	52.1
Ind.	791,000	(1)	118,000	14.9	452,000	57.1	30,795,000	1.2	9,909,000	32.2
Iowa							21,732,000	.9	7,583,000	34.9
Kans.	80,556,000	3.3	3,367,000	4.2	29,356,000	36.4	85,865,000	3.5	19,069,000	22.2
Ky.	47,771,000	1.9	5,909,000	12.4	20,630,000	43.2	16,563,000	.7	7,371,000	44.5
La.	294,370,000	11.9	10,421,000	3.5	53,835,000	18.3	164,667,000	6.7	19,869,000	12.1
Md.							4,907,000	.2	1,759,000	35.8
Mich.	10,726,000	.4	1,123,000	10.5	7,411,000	69.1	27,316,000	1.1	24,864,000	91.0
Minn.							17,262,000	.7	7,729,000	44.8
Miss.	14,527,000	.6	655,000	4.5	3,300,000	22.7	14,207,000	.6	3,939,000	27.7
Mo.	538,000	(1)	69,000	12.8	312,000	58.0	47,157,000	1.9	17,516,000	37.1
Mont.	23,178,000	.9	1,041,000	4.5	6,486,000	28.0	[2] 19,765,000	.8	5,099,000	25.8
Nebr.							19,654,000	.8	6,863,000	34.9
N. Mex.	60,284,000	2.4	892,000	1.5	8,778,000	14.6	38,981,000	1.6	4,066,000	10.4
N. Y.	[3] 29,222,000	1.2	4,021,000	13.8	15,201,000	52.0	46,877,000	1.9	20,560,000	43.9
N. Dak.	76,000	(1)	2,300	3.0	29,000	38.2	1,607,000	.1	622,000	38.7
Ohio	36,469,000	1.5	6,094,000	16.7	18,818,000	51.6	114,720,000	4.6	59,287,000	51.7
Okla.	250,875,000	10.1	5,720,000	2.3	28,103,000	11.2	231,005,000	9.3	20,883,000	9.0
Pa.	[4] 93,882,000	3.8	17,368,000	18.5	35,268,000	37.6	109,746,000	4.4	43,585,000	39.7
S. Dak.	10,000	(1)	500	5.0	3,000	30.0	5,712,000	.2	1,974,000	34.6
Tenn.	8,000	(1)	1,200	15.0	3,000	37.5	[5] 15,558,000	.6	4,924,000	31.6
Tex.	[6] 979,427,000	39.6	20,176,000	2.1	141,535,000	14.5	796,561,000	32.2	57,105,000	7.2
Utah	4,854,000	.2	167,000	3.4	1,033,000	21.3	13,172,000	.5	2,816,000	21.4
Va.	60,000	(1)	6,000	10.0	48,000	80.0	[5] 788,000	(1)	756,000	95.9
Wash.	63,000	(1)	5,000	7.9	59,000	93.7	63,000	(1)	59,000	93.7
W. Va.	159,226,000	6.4	20,190,000	12.7	63,194,000	39.7	69,394,000	2.8	17,022,000	24.5
Wyo.	26,614,000	1.1	788,000	3.0	4,901,000	18.4	17,786,000	.7	2,740,000	15.4
Total:										
1939	2,476,756,000	100.0	120,243,000	4.9	534,240,000	21.6	2,473,765,000	100.0	533,721,000	21.6
1938	2,295,562,000	100.0	113,571,000	4.9	500,698,000	21.8	2,294,097,000	100.0	500,550,000	21.8

[1] Less than 0.05 percent.
[2] Includes 131,000 M cubic feet piped from Canada.
[3] Includes 28,000 M cubic feet piped to Canada.
[4] Includes 48,000 M cubic feet piped to Canada.
[5] A small amount of gas produced in Virginia and consumed in Tennessee included with Virginia; separate figures not available.
[6] Includes 3,046,000 M cubic feet piped to Mexico.

WELLS

Gas-well completions increased 11 percent in 1940 to 2,382, reversing a declining trend evident since 1937. More active drilling for gas was reported in 11 States and moderate declines in 5. The greatest stimulus was felt in the Appalachian region, where an expanded demand for gas has caused local shortages in supply. A strong upward trend in gas completions was reported in Indiana, Missouri, Montana, and Oklahoma as well. In the first two States known gas supplies are very limited, and drilling activity usually is dominated by the status of development in one or two fields.

The number of producing gas wells reported as of December 31, 1939, was 53,530—a net reduction of 240 during that year. Adding 240 to the total gas completions—2,145—makes a total of 2,385 gas wells abandoned in 1939, a 32-percent reduction from 1938 but still above other recent years. Abandonments continued to be very numerous in Pennsylvania and Ohio and in most of the southwest region, probably hastened by higher market prices for scrap iron and steel.

Gas wells in the United States, 1938–40

State	Producing Dec. 31, 1938	Drilled during 1939 [1]	Producing Dec. 31, 1939	Drilled during 1940 [1]
Arkansas	190	6	190	13
California	70	15	80	15
Colorado	20	1	20	1
Illinois	80	18	80	15
Indiana	1,010	44	960	77
Kansas	2,290	150	2,140	130
Kentucky	[2] 2,340	110	[2] 2,340	128
Louisiana	1,560	98	1,520	99
Michigan	260	52	310	59
Mississippi	60	1	30	1
Missouri	120	15	110	30
Montana	350	26	370	49
New Mexico	70	18	90	19
New York	2,000	(3)	2,040	20
Ohio	6,200	497	6,270	491
Oklahoma	2,480	151	2,420	176
Pennsylvania	18,540	[3] 200	18,100	273
South Dakota, Utah, and Washington	30	----------	30	2
Tennessee	(2)	----------	(2)	----------
Texas	3,160	314	3,120	289
West Virginia	12,840	419	13,200	487
Wyoming	100	10	110	8
	53,770	2,145	53,530	2,382

[1] From Oil and Gas Journal and State sources.
[2] Tennessee included with Kentucky.
[3] New York included with Pennsylvania.

In a few States the figures used for gas-well completions in 1940 were taken from data compiled by the Geological Survey, United States Department of the Interior. The 1940 total for New York includes only producers from the Oriskany sand.

TECHNICAL DEVELOPMENTS

An outstanding achievement in gas engineering was the construction in 1940 of the first large-scale commercial equipment for storage of natural gas in liquid form. After several years of research and experimental operation of a small plant a successful process for liquefying natural gas by refrigeration to minus 250° F. was evolved, and suitable containers and auxiliary equipment were designed to store the liquid and regasify it as required. A number of interesting technical problems were introduced by the extreme physical conditions imposed, involving behavior of the gas as well as of the materials comprising the processing equipment.

Three spherical tanks were built at Cleveland, each of 600,000 gallons capacity and insulated with a 3-foot layer of cork. As 1 cubic foot of liquefied gas is equivalent to about 600 cubic feet in gaseous form the total storage space provides for 150 million cubic feet of gas, a volume that could not be stored above ground economically by any other known method. The plant is designed to liquefy and store gas at 4 million cubic feet a day and to regasify the liquid at a rate of 3 million cubic feet an hour when the demand for gas is heavy.

The investment in and operating costs of the plant are moderate, and its effect is to substantially improve the ability of the system to meet peak-load demands for gas in Cleveland, thus eliminating the need for a much larger investment in pipe-line facilities to accomplish the same purpose. The availability of this large storage at the point of market demand makes it a valuable stand-by for emergencies and helps to maintain more constant conditions of flow and pressure in the pipe-line system. Essentially, therefore, the plant provides the same benefits as would underground storage of gas in a natural reservoir, where such storage facilities are not available.

Problems of transportation and storage of liquefied natural gas are being investigated to determine possible commercial uses and methods of handling. Increased transportation range for natural gas and added use for many purposes are possible results. The following trends are evident. Dehydration processes are being employed more widely to prevent trouble from gas hydrates and moisture in high-pressure lines. An increasing number of gas companies are utilizing butane and propane to supplement their gas supplies during periods of peak load. Quick-setting gypsum cements are finding more favor in wells in high-pressure gas areas because their action is not affected by gas.

The importance of natural gas in defense and other industries is growing rapidly both as a source of controlled heat in a great variety of applications and as a raw material in the production of such commodities as plastics, textile fibers, explosives, and industrial chemicals.

REVIEW OF FIELD DEVELOPMENTS BY STATES

Arkansas.—According to the Arkansas Department of Revenue, natural-gas production in Arkansas during 1940 increased 19 percent to 22,409 million cubic feet, of which 1,385 million was casinghead gas from fields in Miller, Ouachita, and Union Counties. Output of the northwestern gas fields continued to increase, amounting to 5,410 million cubic feet in 1940 and 4,061 million in 1939. The southern district produced 16,998 million cubic feet in 1940—16 percent more than in 1939.

The only important gas discovery in 1940 was made on June 8 by the Bodcaw Lumber Co. No. 1 in sec. 29, T. 17 S., R. 23 W., Lafayette County, and was known as the McKamie field. Initial production was about 2 million cubic feet of gas with 240 barrels of condensate from the Smackover limestone at about 9,200 feet. Two additional producing wells drilled in 1940 indicated an important reserve.

In Union County one well in sec. 3, T. 18 S., R. 13 W., was completed for 6 million cubic feet of gas a day from a total depth of 3,255 feet. A well in sec. 27, T. 15 S., R. 18 W., Ouachita County, was reported with an initial daily capacity of 15 million cubic feet from 1,660 feet. Two small gas wells were drilled in secs. 4 and 9, T. 14 S., R. 20 W., Nevada County.

The northwestern counties reported six gas completions—four were in Franklin County and two in Sebastian. All of the Franklin County wells were in the southern part of T. 10 N., R. 26 W., in a newly developed area that was connected to the Fayetteville-Little Rock trunk gas line in 1940. The total daily initial capacity was 58 million cubic feet from depths of 1,280 to 3,960 feet. In Sebastian County one well with a total depth of 2,690 feet and an initial daily production of 1.5 million cubic feet was drilled in sec. 21, T. 8 N., R. 29 W. Another in sec.

15, T. 9 N., R. 29 W., was completed for 2 million cubic feet daily from 2,480 feet.

State officials are making vigorous attempts to find economic uses for the large volume of natural gas now available in southern Arkansas. The high sulfur content of this gas has retarded its commercial utilization, although proved reserves have been estimated at 732 billion cubic feet.

California.—Natural-gas production in California increased about 1 percent to 189.4 billion cubic feet in the first half of 1940 over the same period in 1939. Information for the second half of 1940 is not yet available, according to a report from E. F. McNaughton, California Railroad Commission. Gas was blown to the air in 1940 at approximately the same rate as in 1939 (17 billion cubic feet in the first half of 1940).

Sixteen gas completions were reported in 1940, including one discovery well. Gas wells drilled in proved gas fields were as follows: Buena Vista Lake, 1; Rio Vista, 4; and Trico (Delano), 10. The proved area at Trico was expanded about 2,300 acres. In December 1940 the Blewett No. 1 in San Joaquin County near Vernalis and 9 miles southeast of the Tracy gas field discovered gas at a total depth of 3,873 feet. It made 10 million cubic feet a day from 32 feet of "pay" formation, believed to be Cretaceous. The well is situated close to two large gas lines. Early in 1940 the Paloma field in the south end of the San Joaquin Valley near Buena Vista Lake was proved to be a condensate field, the first in California, and plans were made to unitize operations if possible.

In the Los Angeles Basin available casinghead gas was increased by discovery of the Del Valle field and new deep zones at Aliso Canyon and Inglewood. Gas production at Montebello, much of which was wasted in 1939 and 1940, declined, so that less waste is probable in 1941. To reduce waste of gas an arrangement was made to store about 20 million cubic feet of Montebello gas a day during summer months in another field.

Gas production increased from most fields in the Coastal district, and gas waste rose from 8 percent in 1939 to 12 in 1940 owing to development of the Santa Maria Valley field. Plans were made to utilize the La Goleta field as a gas storage reservoir.

Defense activities are having a very material effect on the gas markets, particularly in the San Francisco Bay, Los Angeles, and San Diego areas. New and expanded military camps, large housing projects, and sharply accelerated activity in aviation, shipbuilding, and related industries are adding important new loads to gas systems. Several minor gas-line extensions were made to serve the new markets, and additional line construction is expected soon. The gas-utility systems at San Diego and San Luis Obispo probably will find it necessary to contract for new gas supplies to fulfill heavy new requirements.

Colorado.—Production of natural gas in 1940 increased 21 percent to 2,082 million cubic feet, as reported by L. G. Snow, acting supervisor, Geological Survey, United States Department of the Interior, Casper, Wyo. The gain was due to larger withdrawals from the Hiawatha field, amounting to 1,843 million cubic feet. Other fields produced as follows: Berthoud, 54.9 million; Craig, 4.5 million; Garcia, 82.4; and Thornburg, 97. In addition, 60.6 million cubic feet of gas were produced with oil (gas-oil ratio, 252 cubic feet a barrel) in the Wilson

Creek field, and 3 million were used for drilling and field purposes at Hiawatha.

One gas well was completed in the Hiawatha field, with an initial daily production of 675,000 cubic feet. There were no new gas discoveries, extensions, or gas-line construction.

Illinois.—Natural gas was marketed in 1940 from two gas fields in Illinois—Ayers and Russellville—and two oil fields—Salem and Louden—according to a report from A. H. Bell and G. V. Cohee, Illinois Geological Survey. Marketed production increased about 20 percent to 1,165 million cubic feet, including 247 million of casinghead.

Production from the Ayers field (Bond County) was 13,777,300 cubic feet in 1940 and that from Russellville 890,400,000. Continued development at Russellville (Lawrence County) raised the productive acreage to 1,600, an increase of 680 acres over 1939. As of January 1, 1941, 41 wells were producing from about 10 feet of Buchanan sand at a depth of 1,090 feet. The total output through 1940 was 1,955,500 thousand cubic feet.

The gross production of gas from Illinois oil fields in 1940 is estimated as 130 billion cubic feet. The Louden field supplied approximately 11 billion. Two gasoline plants in the field processed 10 million cubic feet of gas a day and extracted 3.2 gallons of liquid products per thousand cubic feet. 2.5 million cubic feet a day of residue gas were injected into the oil sands through 63 input wells. The town of St. Elmo and local industries were supplied with 215,376 thousand cubic feet of residue gas and 13,575 thousand cubic feet of dry gas from one lease in the Louden field. In December 1940 about 3 million cubic feet of wet gas were used daily for field purposes and 15 million burned in flares.

Approximately 71 billion cubic feet of natural gas were produced from the Salem field in 1940, the December production being 117 million cubic feet a day. Fifty-two million daily were handled by three gasoline plants, which extracted an average of 2.6 gallons of liquid hydrocarbons a thousand cubic feet of gas. Beginning about October 1, 1940, the city of Salem was supplied with approximately 350,000 cubic feet of residue gas daily. Small quantities of gas are used for field operations and for return to the oil reservoir, and the remainder is burned in flares.

Production of gas in the Centralia field in 1940 totaled about 10 billion cubic feet, chiefly from the Devonian limestone. Output declined sharply to about 4 million cubic feet daily in December 1940 after the peak in flush oil production was passed. About 100,000 cubic feet daily are injected into the Bethel sandstone through three input wells, and 60,000 daily are pumped into the Cypress sand through one well.

The Storms field, White County, where gas-oil ratios are generally high, is estimated to have produced 22 billion cubic feet of gas in 1940. Daily production slumped from about 100 million cubic feet in January to 18 million in December. As yet no gas has been marketed from this field.

The Central Basin fields of Jasper, Richland, Clay, Wayne, and northwest White Counties produced about 16 billion cubic feet of gas in 1940, much of which was used in lease operations and heat treatment of oil.

Gas was discovered on the Panama dome by No. 1 Sharf in sec. 27, T. 7 N., R. 4 W., Bond County. Initial daily production was 500,000 cubic feet from a sand of lower Pennsylvanian age at 556 to 595 feet. An offset well was completed for about 1 million cubic feet, and further drilling is planned.

Indiana.—Natural-gas production in Indiana in 1940 recovered the 30-percent decrease experienced in 1939, as reported by G. F. Fix, State gas supervisor. The total volume was 1,244 million cubic feet, almost the exact amount produced in 1938. Most of the increase was due to flush output from the Rockport field, a 1939 discovery in Spencer County, which yielded 394.5 million cubic feet of gas from 45 wells. The Oaktown field—the other major gas area of the southwest part of the State—produced 119.8 million cubic feet in 1940 as against 92 million in 1939. The output of most other fields declined in 1940, as many of them have virtually reached economic limits.

No important new developments in natural gas occurred in 1940, but interest was revived in the old Trenton gas field in Randolph County, by completion of four gas wells on the east flank ranging up to 1 million cubic feet in initial daily capacity and having a rock pressure about equal to that originally found in the Trenton area. Considerable gas has been found in the new Buffkin oil pool, Posey County, but none has been marketed as yet.

Gas-well completions increased from 44 in 1939 to 77 in 1940; 7 were wildcats or extensions of productive areas. New gas wells, by fields, included Blairsville, 2 (no market); Greensburg, 17; Harrison County, 5; Rockport, 27; Shelburne-Graysville, 3; Old Trenton, 6; Buffkin, 5; and Randolph County, 4.

Production in 1940 by fields, in millions of cubic feet, was: Alford, 65; Francisco, 5; Greensburg, 185.4; Harmon, 15; Harrison County, 182.5; Hudsonville, 22; Loogootee, 7; Oaktown, 119.8; Rockport, 394.5; Shelburne-Graysville, 35.8; Old Trenton, 200; and Troy-Tell City, 12.2.

A small pipe line was built from the Unionville gas field in Monroe County to intercept a trunk line north of Bloomington which serves several towns with gas from the Texas Panhandle field. The Unionville field, which has 15 wells, has been shut in since its discovery about 10 years ago. It will now serve as a stand-by source of gas.

Kansas.—The volume of natural gas produced and marketed in Kansas reached an all-time peak of about 85 billion cubic feet in 1940, according to data supplied by J. H. Page, engineer, State Corporation Commission. Production from most of the important fields increased, the sharpest gain being shown by the Cunningham-Cairo area, which quadrupled its output to 11,934 million cubic feet to rank second in the State. The output of other major fields was reported as follows: Hugoton, 33,127 million cubic feet; Otis, 9,710 million; Medicine Lodge, 7,676; McPherson County, 5,123; Burrton, 4,675; Lyons, 2,956; and Eastern Kansas, 6,872.

Ninety-eight gas completions were reported with a total initial daily capacity of 1,330,859,000 cubic feet, slightly more than in 1939. Of these wells 72, with a capacity of 1,288,959,000 cubic feet, were in western Kansas and 26, with only 41,900,000 cubic feet, in eastern Kansas. Development information is taken from a report by R. P. Keroher, geologist, Kansas Geological Survey.

The most important addition to production in western Kansas was in the Cunningham-Cairo area in Pratt and Kingman Counties, where

813.9 million cubic feet—59 percent of the new potential in the State—were developed from 22 wells. In the Hugoton field 17 wells were drilled with a total initial production of 209.5 million cubic feet. Nine of these, with 105.8 million cubic feet open flow, were in Grant County. Eight new wells were drilled in the Otis-Albert pool in Barton and Rush Counties, with a total daily potential of 164.6 million cubic feet.

Four new gas pools were discovered in 1940, only one—the Coons pool, McPherson County—being in western Kansas. The discovery well, Coons No. 1, in sec. 13, T. 19 S., R. 1 W., made 3 million cubic feet from the Mississippi lime. The Kath field, Johnson County, was opened by Kath No. 1 in sec. 33, T. 13 S., R. 22 E., with gas from the Squirrel (upper Cherokee) sand. Four additional small wells were drilled in 1940, giving the entire pool a daily potential of about 1 million cubic feet.

The Lemert No. 1, in sec. 11, T. 34 S., R. 4 E., Cowley County, discovered the Lemert pool. It made 2.3 million cubic feet from the Mississippi lime. The Nice pool, Douglas County, was discovered by Nice No. 1 in sec. 3, T. 13 S., R. 21 E., which was completed for about 250,000 cubic feet daily from the Squirrel sand. Two additional gas wells were drilled in 1940.

Other gas completions were reported in 1940 in the following fields: Iola, Allen County, 5; Strong City, Chase County, 4; McLouth, Jefferson County, 4 (32 million cubic feet open flow waiting for pipe-line connection); Medicine Lodge, Barber County, 2 (74 million); Krier and Silica pools, Barton County, 1 each; Zenith, Stafford County, 6; Lyons, Rice County, 2; Kipp, Stafford County, 1; Thurber, Rice County, 1. Several wells that produced substantial volumes of gas with oil were drilled in pools in the Barton arch area.

Kentucky.—Gas drilling and leasing were substantially more active in 1940 than in the preceding 3 years, according to a report by C. D. Hunter and G. M. Straughan of the Kentucky West Virginia Gas Co. Most important was the extensive gas development in eastern Kentucky, chiefly in the Big Sandy gas field in Floyd, Pike, Knott, and Martin Counties. In this area 103 gas completions were reported out of a total of 113 in eastern Kentucky.

During 1940 four deep tests were drilled in eastern counties. One in Knox County was dry in the Knox dolomite, having missed the St. Peter sand. Some gas was reported in both the St. Peter and the Knox dolomite in a Lee County well. Four deep tests were being drilled to the Knox dolomite in Ellicott, Magoffin, Clark, and Laurel Counties in search of production from the Trenton, St. Peter, or Knox. The success of any of these may cause a marked increase in deep development. The demand for gas from outside markets increased in 1940 and promises to expand further in 1941.

The year 1940 was uneventful in western Kentucky, where only 12 gas wells were reported. Exploratory drilling had little success.

Louisiana.—About 75 gas and condensate wells were reported in north Louisiana in 1940—11 less than in 1939. The most active field was Monroe, where 53 completions had total initial daily capacity of 125 million cubic feet. The average capacity of new wells at Monroe is declining materially as depletion lowers the pressure in the producing sand. Eighteen wells with a large gas and condensate capacity were drilled in the Cotton Valley field. Plans were nearing completion to exploit, upon a cooperative basis, the great condensate reserve in the Cotton Valley structure.

At Logansport, De Soto Parish, a gas well was reported that produced 68 million cubic feet. This field, which covers a large area in Louisiana and in adjoining Shelby County, Tex., contains an important gas reserve. A large pipe line is projected to connect it with a system that serves markets in States as far east as Georgia.

Three gas fields and one gas-condensate area were discovered in northern Louisiana in 1940. In La Salle Parish the Standard and Summerville fields, producing gas from the Wilcox at moderate depths, were opened by wells that made 20 and 12 million cubic feet initially. The Greenwood field, Caddo Parish, was discovered by No. 1 Dunn, which made 3.3 million cubic feet of gas from the Ozan sand at 2,543 to 2,551 feet. At Athens, Claiborne Parish, the No. 1 Valentine produced 3 million cubic feet of gas and 50 barrels of condensate from a sand in the Hosston formation (Travis Peak). Deep exploration at Lisbon resulted in gas-condensate production from the Cotton Valley formation, which may indicate important reserves.

In southern Louisiana 39 completions were reported as producing considerable volumes of gas; of these, 17 were classified as gas wells. Ville Platte was the most active area, with 16 wells. Others were scattered in 17 fields, principally in the Lake Charles and Houma districts.

A gas discovery was made in June at Ritchie (East Tepetate), Acadia Parish, by No. 1 McManus, which produced from the Miocene at 3,525 to 3,535 feet. A deep gas-condensate discovery was reported at Section 28 Dome, St. Martin Parish, in December 1940. The No. 1 Steuart was completed in the Miocene at a depth of 9,300 to 9,330 feet. Additional gas reserves were developed in connection with discoveries of oil on the flanks of several salt-dome structures in the Gulf Coast area.

The quantity of gas marketed from Louisiana fields in 1940 is estimated to have increased 10 percent over 1939 to 324 billion cubic feet. Gas processed for extraction of gasoline probably increased about 15 percent to approximately 130 billion cubic feet.

The prospect is for enlarged markets for Louisiana gas in other States because of expansion in the facilities of interstate gas pipe-line systems originating within the State.

Michigan.—Discoveries in 1940 added materially to Michigan's natural-gas reserves and improved the prospects of developing production at greater depths, according to a review by F. R. Frye, petroleum engineer, Michigan Department of Conservation.

The Marion pool in Clare and Osceola Counties was discovered on June 25, 1940, by the Woodin & Baughan No. 30 in sec. 19, T. 20 N., R. 6 W. Its initial daily open-flow capacity was 6.7 million cubic feet from the Michigan Stray sand at 1,419 feet. During 1940, 14 gas wells were drilled in this field, proving several thousand acres for production.

On June 19, 1940, the Quist No. 29, in sec. 22, T. 21 N., R. 7 W., Missaukee County, opened the Riverside pool. Its initial daily production was 7.3 million cubic feet from the Michigan Stray sand at a depth of 1,415 feet, with a closed pressure of 640 pounds. Three additional gas wells were completed in the area during 1940, indicating a pool of considerable size. Market outlets for these two pools were provided by pipe lines.

Another pool in the Michigan Stray sand apparently was discovered on November 15, 1940, near Reed City, Osceola County, by the Cornell-Lomp No. 55, in sec. 30, T. 18 N., R. 10 W. It came in for 7.5 million cubic feet daily from 1,245 feet. A second well in the same section was reported to have been completed for 12 million cubic feet. Active development is planned during 1941.

Interest in deep drilling for oil and gas in strata below the Monroe formation was stimulated by the appearance of wet gas in the Bateson No. 1, in sec. 2, T. 14 N., R. 4 E., Bay County. The well was intended as a test of the St. Peter sand, expected below 9,500 feet, but a gas blow-out occurred at 7,776 feet, causing a fire that destroyed the rig. The gas pressure at the wellhead was about 3,100 pounds. During a period of several months, while attempts were made to recover lost drill pipe, the well made 50 to 100 barrels daily of 71° B. condensate.

Gas-well completions numbered 59 in 1940—an increase of 3 over 1939; 34 gas wells were abandoned, leaving 503 producing gas wells in the State on January 1, 1941.

Reported natural-gas production in 1940 was 14,126,364,000 cubic feet—almost 40 percent more than in 1939 and the largest on record. Of the total production 3,362,025,000 cubic feet were casinghead gas, approximately three times the amount reported for 1939.

A gasoline plant in the Walker field near Grand Rapids, which began operations in December 1939, processed 1,750 million cubic feet of casinghead gas in 1940. A new gasoline plant was put in operation in March 1940 in the Redding oil pool, Clare County.

Mississippi.—The sharp decline in natural-gas output from the 1939 peak of 15,233 million cubic feet to 6,449 million in 1940 was due to declining capacity of the State's only producing gas field at Jackson. Data have been furnished by H. M. Morse, supervisor, Mississippi State Oil and Gas Board.

The number of productive gas wells in the Jackson field declined 10 percent further to 27 at the end of 1940; 19 of these were making salt water. Two wells were drilled on the Jackson structure; one was a dry hole, and the other was completed as a gas well in early 1941. Two dry holes were drilled during the year in the Amory gas field. Active wildcatting in 1940, which resulted in 79 completions, failed to locate commercial gas production.

Missouri.—The following data were received from Frank C. Green, geologist, Missouri Geological Survey. Wildcatting in northern and northwestern Missouri, which was begun in 1939, continued in 1940. Two new gas fields were found, and one discovered in 1939 was extended further. The total number of completions was 94; 30 were gas wells, with an initial open-flow capacity of 37,655,000 cubic feet.

The outstanding discovery was the Polo gas field in Caldwell County. Wells in a sand, now believed to be a lens in the Bandera shale, yielded flows of more than 12,000,000 cubic feet at a depth of 400 feet. Ten wells, with 31,490,000 cubic feet total initial capacity, were drilled. The rock pressure was 80 pounds. At present no arrangements have been made for an outlet.

In Platte County the Prairie Point gas pool in sec. 7, T. 51 N., R. 33 W., and sec. 12, T. 51 N., R. 34 W., and the Lakeside pool in secs. 5 and 6, T. 50 N., R. 33 W., were developed further; both oil and gas have been found in the latter. Six gas wells were drilled, with a total capacity of 2,775,000 cubic feet.

Drilling for gas continued in proved areas in Clay County, where five gas wells were completed, and for both oil and gas in proved areas in Jackson and Cass Counties, where five and four new gas wells, respectively, were reported.

Montana.—Forty-nine gas wells were completed in old fields in 1940 with a total initial daily capacity of 119.4 million cubic feet. Information has been supplied by L. G. Snow, acting supervisor, Geological Survey, United States Department of the Interior, Casper, Wyo. About 30 shallow gas wells were drilled in the Bowdoin and Cedar Creek fields, which were linked by a 135-mile gas line. Bowdoin now shares the markets supplied by Cedar Creek and will furnish a considerable part of the steady consumption, so that Cedar Creek may be conserved to supply peak demands.

Devon, a shallow gas field in Toole County, was placed on production in June 1940 after being shut in since 1929. The field had four gas wells, and two more were drilled in 1940.

Gas production increased 14 percent in 1940 to 25,544,047,000 cubic feet; all fields except Bowes and Boxelder showed larger output.

A total of 10,051,367,000 cubic feet of gas was processed at two gasoline plants—182,062,000 at Dry Creek and the remainder at Cut Bank. It was estimated that 60 million cubic feet of gas were wasted in oil and gas fields.

Source and distribution of natural gas in Montana in 1940 [1]

Field	Utilization				Location of principal markets
	Total production (M cubic feet)	Domestic and commercial (M cubic feet)	Industrial		
			M cubic feet	Consumer	
Bowdoin	718,946	239,986	958,932	Steam boilers	Glasgow, Malta, Fort Peck, etc.
Bowes	311,611	311,611	623,222	Sugar refinery	Havre and Chinook.
Boxelder	231,303	77,101	308,404	Cement and sugar factories.	Miles City, Sydney, Glendive, Montana; Rapid City, S. Dak.; Bismarck, Bowman, Williston, N. Dak., etc.
Cedar Creek	2,672,886	4,852,356	7,525,242	Electric power plants	
Cut Bank	4,290,668	6,436,003	10,726,671	Smelter and steam boilers.	Anaconda, Butte, Helena, etc.
Devon	40,188	40,187	80,375	do	Great Falls, Shelby, etc.
Dry Creek	980,259		980,259		Big Timber, Bozeman, Livingstone, etc.
Hardin	83,519		83,519		Hardin.
Kevin-Sunburst	1,733,982	1,733,981	3,467,963	Smelters, steam boilers.	Great Falls, Shelby, etc.
Whitlash	526,306	263,154	789,460	do	Great Falls, etc.
Total	11,589,668	13,954,379	25,544,047		

[1] Data supplied by H. J. Duncan ,supervisor, Geological Survey, U. S. Department of the Interior.

New Mexico.—In southeastern New Mexico seven gas wells were completed in 1940 with a total initial daily capacity of 77.3 million cubic feet, according to a report from T. G. Taylor, acting supervisor, Geological Survey, United States Department of the Interior, Roswell, N. Mex.

Natural gas marketed by distributing companies totaled 28,079 million cubic feet—an increase of 1,723 million over 1939. About 4 billion cubic feet were used for producing petroleum by gas lift and 2 billion for other oil-field purposes. Gasoline plants processed 96,392 million cubic feet of casinghead gas in 1940—an increase of 7,721 million over the 1939 throughput.

Three gas discoveries were reported in trade papers. On February 10, 1940, the Johnson No. 1 in sec. 24, T. 15 S., R. 28 E., Chaves County, made 800,000 cubic feet of gas a day from a Permian sand at 1,456 to 1,500 feet. In sec. 25, T. 16 S., R. 30 W., northern Eddy County, the Etz No. 1 was completed in Permian sand at 2,553 to 3,082 feet with an initial gas production of 2.4 million cubic feet on October 28. Farther south, in sec. 12, T. 20 S., R. 30 E., Eddy County, 5 million cubic feet of gas were found in Permian lime at 1,540 to 1,553 feet in Hale No. 1 early in December.

Gas production from fields in the northwestern district increased about 11 percent in 1940 to 2,862 million cubic feet, of which 1,942 million were withdrawn from the Kutz Canyon field, 762 million from Ute Dome, 125 million from Fulger Basin, and 34 million from Blanco. In previous reports the Fulger Basin production has been included in that from Kutz Canyon.

One new gas well was completed in the Kutz Canyon field, one at Fulger Basin, and two at unreported locations.

New York.—The more important drilling operations for natural gas were in the Oriskany sandstone area of southwestern New York. Data have been furnished by C. A. Hartnagel, State geologist. In all, 50 wells were drilled, of which 20 were listed as producers with total initial daily capacity of 100.9 million cubic feet in 1940—an increase of 2 producers but a slight drop in capacity compared to 1939.

In 15 of the wells drilled in 1940 the daily capacity ranged from 1 to 16 million cubic feet. The spectacular well of the year was a wildcat on the Crandall farm in the town of Independence, Allegany County. An estimated flow of 44 million cubic feet was struck at 4,912 feet. The well blew wild for 19 days, and when brought under control the daily volume was only 1.5 million cubic feet.

Only 6 of the 50 wells drilled were in developed fields—5 at Beech Hill, Allegany County, and 1 at Greenwood, Steuben County. About two-thirds of the new production was from wildcat wells, but it is evident that a still wider search will be necessary if production is to be maintained at the 1935–38 level.

Two successful wells in the town of Allen, Allegany County—one with an initial flow of 8 million cubic feet—and important new production in the Independence-Andover area indicate further developments in these localities. One well drilled near Elmira in Chemung County had an initial production of 1.5 million cubic feet. Two other wells produced smaller amounts. Late in the year two of these wells were connected to the Elmira City gas mains and were reported to have supplied about 1 million cubic feet daily for the pipe lines during most of the winter. One well in the town of Erwin was dry in the Oriskany and was deepened to 6,825 feet, where it was abandoned as a dry hole in the Medina (Queenston) red shale.

A new pipe line was built to bring additional gas from West Virginia fields. Its northern terminus is near Olean, where it joins the old gas line which crosses the southern tier of counties and reaches a point not far north of New York City.

Ohio.—Although drilling in Ohio increased about 20 percent in 1940 the number of gas-well completions reported was 491—10 less than in 1939, according to a report by Kenneth Cottingham, chief geologist, Ohio Fuel Gas Co. The average initial volume declined slightly to 581,900 cubic feet a well in 1940 from 596,000 in 1939, because there were smaller wells in all strata under active development, except those above the Berea, which averaged about 20 percent larger than to 1939.

Clinton sand gas completions increased about 35 percent to 229 in 1940 with a total volume of 221.4 million cubic feet, equal to 77 percent of all new output in the State (287.3 million). Shallow sand completions numbered 92, with 29.9 million cubic feet of total capacity; Berea completions, 125 with 13.0 million cubic feet; Ohio shale, 18 with 1.5 million; Oriskany, 3 with 0.4 million; Newburg, 21 with 20.5 million; Trenton, 3 with 0.6 million.

New gas wells were reported in 30 counties; the most active were Licking (90), Athens (57), Noble (30), Washington (29), Muskingum (27), Knox (25), and Guernsey (22). The greatest Clinton gas activity continued to be in the pool northeast of Newark in Licking County.

The largest well drilled in Ohio in 1940 was in sec. 5, Butler township, Knox County, which made 12 million cubic feet initially from the Clinton sand at 2,792 feet, with a rock pressure of 935 pounds. Other large Clinton sand wells were reported in sec. 4, Wayne township, Muskingum County (depth, 3,800 feet, and rock pressure, 518 pounds); and in sec. 15 and 16, Brush Creek township, Muskingum County (depth, 4,200 feet, and rock pressure, 1,150 pounds).

Drilling to the Trenton lime in northwestern Ohio has declined steadily in recent years. In 1940 only 18 completions were reported; 3 were small gas wells. The search for production from the horizon, 500 to 700 feet below the top of the Trenton—known as the "Green sand" in western Ohio and as the St. Peter in the eastern part of the State—continued in 1940, but results were not encouraging. Eight wells were drilled in Allen, Franklin, Medina, Clinton, Greene, Putnam, and Union Counties. Seven were dry, and one in Allen county was a very small oil well.

A dry hole drilled through the Clinton sand at 5,620 to 5,689 feet in sec. 23, Center township, Noble County, reached a total depth of 5,800 feet. Early in 1941 an unsuccessful test of the Clinton was completed in sec. 19, Smith township, Belmont County, at a depth of 7,887 feet.

In eastern and northeastern Ohio several large companies were conducting active geophysical exploration. Test wells drilled thus far upon the basis of this work have been unsuccessful.

Oklahoma.—Natural-gas production in 1940, as reported to the Oklahoma Tax Commission, declined about 1 percent to 272,584 million cubic feet owing to continued shrinkage in the output of casinghead gas. Dry-gas production (from gas wells) increased 17 percent to 87,404 million cubic feet, reflecting larger demand for gas for most purposes.

About 180 gas wells were drilled in 1940 with a total initial daily capacity exceeding 1,000 million cubic feet. Completions were scattered in 34 counties with the largest number in the old eastern belt of fields. Seventeen new discoveries and 5 new pay horizons were reported; 4 were in Hughes County, 3 in Okfuskee, 3 in Pontotoc, 2 in Caddo, and 1 each in 10 other counties.

Important added gas reserves were developed in the Chickasha field, Grady County, where seven very large wells were completed in the "Charlson zone." In the Cement field, Caddo County, the productive area was extended, and a new deep horizon is thought to have been opened by No. 2 Wagner which made 18 million cubic feet daily from sand at 4,332 feet.

In Texas County, Okla., nine wells with a total capacity of 170 million cubic feet were completed in a south extension of the vast Hugoton field. More than 100 square miles of new productive area appear proved.

The total gas capacity of the wells in the recently developed Hobart oil field in T. 7 N., R. 17 W., Kiowa County, probably exceeds 50 million cubic feet a day, but no outlet for this gas is available.

The Cumberland oil field in Marshall and Bryan Counties, opened in April 1940 and since proved the most important oil discovery of the year in Oklahoma, has very large reserves of gas in several horizons below the Viola lime. A gasoline plant is planned that will make several million cubic feet of residue gas available daily for an extended period.

Shows of wet gas at great depths in several wildcat wells completed in 1940 in the Anadarko Basin of western Oklahoma may have important implications for future development of that great region. Such shows were reported in deep tests in western Washita County, southeastern Woods County, and southeastern Dewey County near Oakwood. At the latter location efforts may be made to unitize a large block of acreage with the purpose of instituting the first high-pressure recycling project in the State for recovery of liquid condensate while returning stripped gas to the reservoir.

As of October 1940 Oklahoma Conservation Department tests indicate that there were 107 gas wells in the Oklahoma City field with a total daily open-flow capacity of 274 million cubic feet. This represents an increase of 6 wells in a 1-year interval and a decrease of 148 million cubic feet in daily capacity. One company in this field has begun withdrawing gas from a partly depleted gas sand that is subject to competitive drainage and storing the gas in another sand at 400 pounds pressure where it can be effectively held against future market demand.

No large gas lines were built in 1940. Enlargement of military activity at Fort Sill prompted the laying of 15 miles of 8⅝-inch line in the vicinity of Lawton to handle the increased demand for gas.

Pennsylvania.—Drilling for gas increased in 1940 under the stimulus of more active market demand and declining productive capacity in Pennsylvania. Information has been supplied by J. G. Montgomery, Jr., vice president, United Natural Gas Co. Perhaps the most significant development was the slump in production from Oriskany sand fields in Potter and Tioga Counties to only 6.5 billion cubic feet in 1940 from 30 billion in 1939, foreshadowing total exhaustion of these gas reserves.

In the Potter-Tioga County fields 19 wells were drilled to the Oriskany sand, of which only 7 were productive. Their aggregate daily open-flow capacity was less than 6 million cubic feet; rock pressures ranged from 287 to 2,200 pounds. All were within the limits of previously discovered pools except one, which was separated from the south edge of the Hebron field by a fault. Inasmuch as the reported initial daily capacity of this well was only 143,000 cubic feet, its value appears slight. No drilling was being done at the end of the year.

In the South Union township field, Fayette County, two additional wells were completed which produced from both the Onondaga chert zone and the Oriskany sand with a volume of 2.4 and 2.5 million cubic feet daily and a rock pressure of about 2,950 pounds. Two wells previously completed in the Onondaga chert beds were deepened and found added gas in the Oriskany. Three more wells were being drilled in the area, and a fourth (on Laurel ridge east of the field) had reached a depth of 8,002 feet without encountering the Onondaga lime.

Two dry holes in McKean County were the only other completions to the Oriskany sand. Late in the year a test scheduled for the Oriskany was begun in New Sewickley township, Beaver County. In northwestern Beaver County an exhausted Oriskany sand well was deepened through the Lockport dolomite and Medina or Clinton sand horizons without obtaining new commercial production.

Increased leasing and geophysical activity in 1940 points to early future exploration of deeper and previously untested strata. In extreme northwestern Erie County a well was being drilled below 1,500 feet to test the Trenton lime.

Drilling for gas from the shallow horizons increased sharply in 1940, but much of it was confined to proved territory. Wildcatting along Muddy Creek in Crawford County developed several small producers. One failure was drilled in the Union City area of Erie County. Several wells with a daily capacity exceeding 1 million cubic feet from the Injun sand rewarded prospecting in Menallen township, Fayette County, and Monongahela township, Greene County. This production is reported as very spotty, however.

Withdrawals of gas from shallow sands increased sharply to meet growing demand as the Oriskany production declined. A new pipe line from Monaca, Pa., to Olean, N. Y., was put in service in the fall of 1940 and provided increased facilities for moving gas from West Virginia to northern market areas.

All drilling in 1940 was done with cable tools. One small Oriskany sand well in Potter County was treated experimentally with hydrofluoric acid, but results were not encouraging.

South Dakota.—There was no change in the natural-gas situation in South Dakota in 1940, according to E. P. Rothrock, State geologist. The small gas production at Fort Pierre, estimated at 7.8 million cubic feet, continued to be marketed in Pierre. A small flow of gas with water was struck at Cheyenne Crossing, Potter County, and was utilized at a tourist camp, although considerable waste resulted from rapid corrosion of pipe and fittings. One dry hole was reported in Harding County.

Texas.—Reports of the Texas Railroad Commission show that the pronounced upward trend in production of natural gas continued in 1940, attaining new high levels. The reported total was 1,566.4 billion cubic feet—20 percent above 1939. Production of gas wells increased 26 percent to 1,095 billion, and gas from oil wells increased 10 percent over 1939 to 466.6 billion.

Most of the gain in gas-well production is attributable to recycling-plant operations, which almost tripled their throughput in 1940 to total 318.6 billion cubic feet. Of this quantity, about 286 billion were returned to the high-pressure reservoirs to minimize pressure drop. In December 1940, 32 recycling plants were operating (an increase of 10 during the year) using a daily average of 1,234.6 billion cubic feet of gas. These plants processed an average daily volume of 38.6 million cubic feet in December 1940 compared to 21.4 million in December 1939. The number of producing wells connected to plants was 87 at the end of 1939 and 243 a year later.

Carbon-black plants consumed 326.1 billion cubic feet of gas in 1940—a 3-percent increase over 1939. Pipe lines increased their takings 7 percent in 1940 to 494.9 billion, and gas used on leases and as plant fuel was reported as 24 percent higher in 1940 at 211.8 billion.

Reported gas-well completions in 1940 totaled 289—a decline from 314 in 1939. The only areas showing gains were eastern Texas, where 38 gas wells were reported in 1939 and 59 in 1940, and West Texas, where 4 and 11 were drilled, respectively. The Panhandle continued to lead with 81 new wells, the same number as in 1939. Activity declined in other areas, particularly the Gulf Coast, which reported only 31 gas wells in 1940, or just half the 1939 total. Southwest Texas had 70 gas completions in 1940 (87 in 1939) and West Central and North Texas 37 (42 in 1939).

Three gas discoveries were reported in West Texas—the Hayes and South Magnolia fields in Ward County and the Embar field in Andrews County. The Hayes field produced from the Delaware and the other two from Permian lime.

In Shackelford County, West Central Texas, the No. 1 Kendrick discovered 9.7 million cubic feet of gas in the Cisco series at 1,605 to 1,612 feet. The Lee field, producing gas from the Strawn at 2,900 feet, was discovered in Coleman County in February, and a new gas pay was opened in the Triplett field, Palo Pinto County, at 4,330 feet in the Bend formation.

In the Panhandle district an important wildcat in Sherman County—the No. 1–A Bryant—found 33 million cubic feet of gas in lime at 2,868 to 3,343 feet after plugging back from 5,138 feet. The location is several miles from the nearest production of gas.

Twenty-five gas or condensate fields were discovered in 1940, and 14 new gas horizons were opened in old fields. South Texas had the greatest number of additions to gas reserves with eight new fields, of which two were of the condensate type and nine new pay horizons, including two condensate. In the Thomaston area, DeWitt County, condensate was discovered in April by No. 1 Conwell, which produced from the Wilcox at 7,855 to 7,885 feet. This is the first production from the Wilcox in southwest Texas. In Victoria County three new pay horizons were found in the McFadden field, and the Bloomington and Edwards condensate fields were opened. The Nueces Bay gas field and East Agua Dulce condensate field were opened in Nueces County. Important extensions and new productive sands were found at Rincon, Starr County, as well as new pay sands at Hayden and Arroyo Grande. Discoveries were reported in seven other counties.

On the Gulf coast nine condensate fields were discovered in 1940 in eight counties. Discovery of the Sheridan pool (condensate) in Colorado County extended Wilcox-trend production 100 miles westward. The Shepherd pool was the first discovery in San Jacinto County. It also produced condensate from the Wilcox at 8,215 feet.

Utah.—Natural-gas production increased about 3 percent in 1940 to a new peak of 4,301 million cubic feet, according to a report by L. G. Snow, acting supervisor, Geological Survey, United States Department of the Interior, Casper, Wyo. Except for 35.6 million cubic feet produced from the Ashley Valley field, the State's entire production was from the Clay Basin field.

Two gas wells with a total daily open-flow capacity of 21.5 million cubic feet were drilled at Clay Basin in 1940. These more fully outlined the productive area of the field and helped to equalize withdrawals.

About 35 million cubic feet of gas, in addition to that recorded above, were used in the Clay Basin field for drilling and field operations.

The production of carbon dioxide gas from the Farnham dome increased 33 percent in 1940 to 67.9 million cubic feet.

Washington.—Information from Sheldon L. Glover, assistant supervisor, department of conservation and development, Pullman, Wash., indicates a continued sharp decline in natural-gas production from the Rattlesnake Hills field, the only commercial source in the State. The 1940 output—39 million cubic feet—was 42 percent less than in 1939. Actual sales were 36,323,000 cubic feet valued at $30,370.

One test well was begun in an attempt to find gas production on the nonproducing flank of the Rattlesnake Hills arch. A wildcat near Yakima, on an anticlinal fold in basalt, was reported to have struck gas at 800 feet with higher rock pressure than the original pressure in the Rattlesnake Hills field.

Production of carbon dioxide from wells near Klickitat increased almost 20 percent to 26 million cubic feet; 2,559,638 pounds of dry ice with a value of $75,000 were made from it. The daily capacity of the dry-ice plant was enlarged in 1940 to 10 tons from 6 tons in 1939.

West Virginia.—The largest demand of recent years for West Virginia gas stimulated drilling activity in 1940, resulting in 468 gas-well completions compared to 366 in 1939. Data have been supplied by David B. Reger, consulting geologist, Morgantown, W. Va.

The total new daily gas capacity developed was 678 million cubic feet, including 44.8 million from deepening operations. Completions in the Oriskany sand represented 452.4 million cubic feet (67 percent of the total). In Kanawha County 66 producers were completed in the Oriskany sand, with a total daily capacity of 217.8 million cubic feet. Activity increased sharply in Jackson County, where 39 Oriskany wells had an initial daily production of 233 million cubic feet. About 8,000 additional acres were proved in the Elk-Poca pool.

An important wildcat—the Riggs No. 1—was completed in Ravenswood district, Jackson County, with an initial capacity of 6 million cubic feet from the Oriskany sand at 5,042 feet. The Riggs is 3 miles south of Oriskany production in the Buttermilk pool. Another wildcat in the Ripley district 7 miles northwest of the Elk-Poca pool made 455,000 cubic feet from the Oriskany sand in January 1941. Large additions to gas reserves in Jackson County are indicated by these wells and nearby developments.

Two Oriskany sand wells of 450,000 and 959,000 cubic feet capacity were drilled in 1940 in the Bull Creek pool in Peytona district, Boone County. A well northwest of Saulsbury, Wood County, made 119,000 cubic feet from the Oriskany; and in Teays Valley district, Putnam County, 40,000 cubic feet of gas were found in this formation.

An old well in southern Kanawha County was deepened from the Oriskany sand and found 733,000 cubic feet of gas in the White Clinton sand (Silurian) with a rock pressure of 1,800 pounds. This well is 6.5 miles northeast of a small Clinton sand well completed in 1939 in

Boone County and is similarly placed on the western limb of the Warfield anticline. Farther north, two more wells in the Charleston field are being deepened to the Clinton sand.

The old Porter Knob gas pool in Cabell County was actively developed in 1940. About 4,000 acres now appear to be proved for production, mostly from the Berea sand with some gas from the Brown shale. The Bowen Creek gas pool in Cabell and Wayne Counties—a 1939 discovery—was expanded by completing 23 wells in the Brown shale, which proved about 10,000 acres. Scattered wells to the north suggest a very large productive area.

The Villa Nova gas pool in Clay and Braxton Counties—another 1939 discovery—reported about 35 completions in 1940, including 18 gas wells with an average capacity of 2.8 million cubic feet and rock pressure of 500 pounds. The field now includes about 3,500 acres.

In Putnam County, Curry district, the Trace Fork gas pool—a late 1939 discovery—had 26 producing wells by the end of 1940, which proved approximately 10,000 acres for gas production from the Salt sand, Big Lime, Berea, and Devonian Brown Shale. Initial capacity averages 800,000 cubic feet a well, with a rock pressure of about 500 pounds. Eleven wells were being drilled at the end of 1940.

The Lorentz gas pool in Buckhannon district, Upshur County, was opened in 1940 by Marple No. 1, which produced 243,000 cubic feet from the Benson sand. Four gas wells were drilled in 1940, producing from the Benson and Gordon sands and indicating a productive area of about 1,000 acres.

Other gas areas were extended or discovered in 11 counties. The leading counties in gas-well completions were: Boone, 36; Braxton, 17; Cabell, 25; Calhoun, 16; Clay, 22; Gilmer, 47; Jackson, 38; Kanawha, 77; Lincoln, 18; Putnam, 32; Ritchie, 40; and Wayne, 31.

In Grant district, Harrison County, a test well is being drilled with rotary tools below a depth of 9,800 feet—the deepest hole ever drilled in the Appalachian region. The Oriskany sand was topped at 7,290 feet (probably unproductive), and the White Clinton may be tested not far below present depth.

Several small gas lines were laid in the Oriskany sand area near Charleston, but none of major importance was reported. However, industrial development in States to the north and east forecast greater demand for gas from West Virginia wells.

Wyoming.—Because the supply of gas, except in the Buffalo-Sheridan region, is ample for present markets drilling for gas in Wyoming was at low ebb during 1940, according to information compiled by L. G. Snow, acting supervisor, Geological Survey, United States Department of the Interior, Casper, Wyo. Only four gas wells were drilled, all in old fields, with a total initial volume of 56.1 million cubic feet. Three old wells were plugged back and recompleted with a total volume of 1.8 million cubic feet. The Hiawatha gas field was apparently extended three-quarters of a mile north by a well that made 8.6 million cubic feet daily.

The gross production of gas in 1940 increased 4 percent to 38,943 million cubic feet, including an estimated use of 880 million cubic feet in the field and a waste of 503 million. Production of the eight major fields increased 639 million cubic feet, a marked decline at Big Medicine Bow being largely offset by higher production and use of gas at

Lance Creek. Production from the Baxter Basin-Clay Basin-Hiawatha area (Wyoming, Utah, Colorado), most of which is consumed in Salt Lake City and vicinity, increased from 11,937 million cubic feet in 1939 to 13,152 million in 1940.

Production of gas in the principal fields was as follows: Salt Creek, 9,379 million cubic feet; Baxter Basin (entire field), 6,409 million; Lance Creek, 5,803 million; Big Sand Draw, 4,019 million; Muskrat, 2,231 million; Little Buffalo Basin, 1,792 million; Elk Basin, 1,697 million; and Big Medicine Bow, 1,437 million.

Of the gross measured production, approximately 20.4 billion cubic feet were utilized for domestic, commercial, and industrial purposes, 10.9 billion for recycling and repressuring, and 6.2 billion for other field purposes. At Salt Creek 6.4 billion cubic feet of gas were returned to formations for repressuring and recycling, at Lance Creek 3.4 billion, and at Rock Creek, Elk Basin, Grass Creek, and La Barge comparatively small amounts.

About 20 billion cubic feet of gas were processed at gasoline plants—9.4 billion at Salt Creek, 5.7 billion at Lance Creek, 4 billion at Big Sand Draw, 615 million at Rock Creek, 169 million at Elk Basin, and 118 million at Grass Creek.

In August 1940 the Billy Creek field south of Buffalo and Sheridan was shut in after producing about 250 million cubic feet of gas in 1940. Depletion had reduced the productive capacity of the field below requirements of the two towns, and a new gas supply from the Big Sand Draw-Muskrat trunk line was made available.

CONSUMPTION

All classes of consumers except petroleum refineries increased their takings of gas in 1939 over 1938. Less gas was used at refineries in 1939 because of sharp curtailment in California owing to substitution of fuel oil for natural gas at several plants. The "other industrial" load gained most sharply (19 percent), followed by gas burned at electric power plants (12 percent). The latter was abnormally stimulated by drought in some sections of the country, which curtailed the available supply of hydroelectric power.

The average consumption per domestic and commercial meter rose in 1939 to 53,100 cubic feet from 52,000 in 1938, whereas the average value of such gas decreased four-tenths cent to 67.9 cents per thousand cubic feet. These two related items have changed little since 1932. The small decline in average value of domestic and commercial gas outweighed the rise in the industrial average value from 9.4 to 9.6 cents and caused the average for all gas consumed to drop from 21.8 cents in 1938 to 21.6 cents per thousand cubic feet in 1939.

Treated for natural gasoline.—The volume of gas processed at natural-gasoline plants in 1940 is estimated to have been 2,380 billion cubic feet, 11 percent more than in 1939. The largest gain was in Texas, where recycling-plant throughput (which is included) was about three times as large as the 1939 record. These operations also caused a probable small decline in average gasoline recovery for the entire country. Gas treated equaled about 89 percent of the natural-gas consumption in the United States in 1940 and 87 percent in 1939.

Natural gas consumed in the United States, 1935–39

Year	Domestic and commercial consumption							
	Consumers (thousands) [1]			Billions of cubic feet			Average number of M cubic feet used per domestic and commercial consumer	Average value at points of consumption per M cubic feet (cents)
	Domestic	Commercial	Total	Domestic	Commercial	Total		
1935	7,391	613	8,004	314	100	414	51.7	68.5
1936	8,017	657	8,674	343	112	455	52.5	67.1
1937	8,348	680	9,028	372	117	489	54.2	67.6
1938	[2] 8,570	[2] 695	[2] 9,265	368	114	482	[2] 52.0	68.3
1939	8,888	715	9,603	391	119	510	53.1	67.9

Year	Industrial consumption								Total consumption	
	Billions of cubic feet							Average value at points of consumption per M cubic feet (cents)	Billions of cubic feet	Average value at points of consumption per M cubic feet (cents)
	Field	Carbon-black manufacture	Petroleum refineries	Electric public-utility power plants [3]	Portland-cement plants [4]	Other industrial	Total industrial			
1935	580	242	80	125	27	442	1,496	9.7	1,910	22.4
1936	619	283	93	156	37	518	1,706	10.0	2,161	22.0
1937	651	341	113	171	41	597	1,914	10.3	2,403	22.0
1938	659	325	110	170	37	511	1,812	9.4	2,294	21.8
1939	681	347	98	191	40	607	1,964	9.6	2,474	21.6

[1] Includes consumers served with mixed gas.
[2] Revised figures.
[3] Federal Power Commission.
[4] Chapters on Cement in Minerals Yearbook.

Gasoline-plant operations increased in six States in 1939, particularly in Texas, West Virginia, and Ohio. From 1935 to 1939 the most pronounced expansion of gasoline-plant activity was in New Mexico, Kansas, and Arkansas.

Domestic and commercial.—Domestic consumers are estimated to have used 442 billion cubic feet of natural gas in 1940—13 percent more than in 1939 and the highest volume on record. Factors contributing to the larger demand were rising national income, an unusually cold January and February in 1940, and continued growth in the number of domestic meters. Commercial consumption in 1940, similarly stimulated, increased 12 percent to 132 billion cubic feet. Average values of domestic and commercial gas are estimated to have declined slightly in 1940 to 73.0 and 49.2 cents per thousand cubic feet, respectively.

The average value of gas used for domestic and commercial purposes was lower in 1939 than in 1938 in the majority of States. Significant declines were recorded in Arizona, Minnesota, Michigan, Tennessee, California, and New Mexico. Substantial increases took place in Ohio and Wyoming.

Natural gas consumed in the United States, 1935–39, by States, in millions of cubic feet

State	1935	1936	1937	1938	1939
Alabama	10, 563	16, 630	16, 593	14, 796	20, 093
Arizona	5, 603	8, 232	12, 857	12, 660	16, 643
Arkansas	26, 476	30, 986	35, 074	34, 833	35, 673
California	284, 109	320, 406	329, 769	315, 168	348, 361
Colorado	17, 233	19, 713	20, 816	19, 212	21, 978
District of Columbia	2, 707	3, 104	3, 458	3, 826	4, 069
Florida	692	1, 005	1, 389	1, 469	1, 658
Georgia	8, 082	11, 575	13, 893	14, 783	16, 296
Illinois	57, 319	72, 516	78, 650	66, 500	77, 134
Indiana	15, 613	18, 564	23, 551	26, 706	30, 795
Iowa	19, 077	20, 918	21, 354	20, 109	21, 732
Kansas	72. 806	82, 025	96, 822	86, 105	85, 865
Kentucky	15, 826	18, 159	18, 154	15, 350	16, 563
Louisiana	151, 934	166, 485	174, 153	162, 260	164, 667
Maryland	784	915	1, 011	1, 247	4, 907
Michigan	4, 203	11, 142	24, 112	24, 697	27, 316
Minnesota	10, 579	11, 918	13, 111	14, 641	17, 262
Mississippi	8, 765	11, 368	13, 327	12, 785	14, 207
Missouri	33, 060	40, 124	46, 898	42, 505	47, 157
Montana [1]	16, 832	19, 894	21, 594	18, 225	19, 765
Nebraska	14, 310	16, 780	17, 263	17, 539	19, 654
New Mexico	18, 419	19, 814	28, 056	32, 890	38, 981
New York	35, 705	40, 638	50, 080	47, 950	46, 877
North Dakota	1, 382	1, 578	1, 641	1, 533	1, 607
Ohio	105, 896	121, 381	125, 133	108, 013	114, 720
Oklahoma	258, 598	260, 120	269, 604	244, 443	231, 005
Pennsylvania	91, 601	110, 195	119, 501	96, 285	109, 746
South Dakota	4, 656	5, 061	5, 519	5, 354	5, 712
Tennessee	9, 479	11, 913	13, 353	14, 047	15, 558
Texas	525, 697	598, 088	706, 120	729, 603	796, 561
Utah	8, 747	10, 552	12, 449	11, 699	13, 172
Virginia	343	447	550	615	[2] 788
Washington	138	141	143	117	63
West Virginia	53, 763	57, 978	65, 395	57, 478	69, 394
Wyoming	18, 904	20, 153	21, 648	18, 654	17, 786
Total United States	1, 909, 901	2, 160, 518	2, 403, 041	2, 294, 097	2, 473, 765

[1] Includes natural gas piped from Canada.
[2] Includes a small amount of gas consumed in Tennessee; separate figures not available.

Natural gas treated at natural-gasoline plants in the United States, 1935–39, by States, in millions of cubic feet

State	1935	1936	1937	1938	1939
Arkansas	3, 371	2, 955	4, 031	21, 377	19, 171
California	310, 016	372, 118	381, 568	398, 187	377, 041
Colorado	222	228	153	145	130
Illinois	1, 076	971	1, 027	1, 110	2, 440
Kansas	87, 669	106, 230	153, 416	144, 631	141, 945
Kentucky	29, 772	35, 493	34, 981	38, 446	36, 817
Louisiana	81, 868	115, 606	144, 474	116, 331	114, 960
Michigan	1, 755	1, 419	1, 381	1, 395	1, 019
Montana	6, 382	8, 238	9, 062	7, 126	8, 116
New Mexico	11, 786	29, 489	61, 625	97, 830	97, 010
New York	27	22	50	65	65
Ohio	29, 622	33, 103	33, 625	28, 488	32, 703
Oklahoma	260, 757	255, 433	338, 007	265, 746	219, 755
Pennsylvania	33, 348	34, 168	31, 508	22, 600	26, 662
Texas	828, 570	673, 483	754, 696	752, 784	914, 701
West Virginia	118, 789	128, 488	140, 512	122, 301	140, 982
Wyoming	16, 970	17, 561	18, 684	17, 000	16, 483
	1, 822, 000	1, 815, 000	2, 108, 800	2, 035, 562	2, 150, 000
Percentage of total consumption	95	84	88	89	87

Domestic and commercial consumption of natural gas in the United States in 1939, by States [1]

State	Domestic				Commercial				Total			
	Consumers	M cubic feet	Value at points of consumption		Consumers	M cubic feet	Value at points of consumption		Consumers	M cubic feet	Value at points of consumption	
			Total	Average (cents)			Total	Average (cents)			Total	Average (cents)
Alabama	29,850	1,419,000	$1,577,000	111.1	3,790	648,000	$361,000	55.7	33,640	2,067,000	$1,938,000	93.8
Arizona	32,140	1,056,000	1,365,000	129.3	3,450	857,000	474,000	55.3	35,590	1,913,000	1,839,000	96.1
Arkansas	68,980	5,492,000	3,045,000	55.4	11,940	3,268,000	1,157,000	35.4	80,920	8,760,000	4,202,000	48.0
California	1,611,490	72,459,000	56,633,000	78.2	91,500	16,270,000	8,538,000	52.5	1,702,990	88,729,000	65,171,000	73.4
Colorado	93,890	5,487,000	4,353,000	79.3	9,470	1,711,000	988,000	57.8	103,360	7,198,000	5,341,000	74.2
District of Columbia	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Florida	3,580	115,000	168,000	146.1	430	39,000	34,000	87.2	4,010	154,000	202,000	131.2
Georgia	80,920	4,137,000	3,780,000	91.4	6,760	2,184,000	852,000	39.0	87,680	6,321,000	4,632,000	73.3
Illinois	1,206,210	18,325,000	25,166,000	137.3	65,410	4,794,000	4,434,000	92.5	1,271,620	23,119,000	29,600,000	128.0
Indiana	132,250	2,875,000	3,417,000	118.9	7,370	578,000	557,000	96.4	139,620	3,453,000	3,974,000	115.1
Iowa	125,900	4,011,000	4,198,000	104.7	10,310	1,247,000	893,000	71.6	136,210	5,258,000	5,091,000	96.8
Kansas	207,570	15,299,000	9,281,000	60.7	25,890	8,212,000	2,747,000	33.5	233,460	23,511,000	12,028,000	51.2
Kentucky	167,930	8,503,000	4,814,000	56.6	17,280	2,088,000	1,048,000	50.2	185,210	10,591,000	5,862,000	55.3
Louisiana	179,030	8,696,000	6,237,000	71.7	21,790	5,022,000	1,987,000	39.6	200,820	13,718,000	8,224,000	60.0
Maryland	[2] 211,620	[2] 4,802,000	[2] 3,786,000	[2] 78.8	[2] 9,680	[2] 587,000	[2] 408,000	[2] 69.5	[2] 221,300	[2] 5,389,000	[2] 4,194,000	[2] 77.8
Michigan	550,640	16,760,000	18,601,000	111.0	23,390	2,448,000	2,504,000	102.3	574,030	19,208,000	21,105,000	109.9
Minnesota	150,210	4,873,000	4,802,000	98.5	7,900	1,470,000	859,000	58.4	158,110	6,343,000	5,661,000	89.2
Mississippi	42,110	3,096,000	2,053,000	66.3	7,280	2,167,000	717,000	33.1	49,390	5,263,000	2,770,000	52.6
Missouri	377,400	11,462,000	10,007,000	87.3	35,310	3,259,000	1,991,000	61.1	412,710	14,721,000	11,998,000	81.5
Montana	40,070	5,629,000	2,644,000	47.0	5,020	3,557,000	1,051,000	29.5	45,090	9,186,000	3,695,000	40.2
Nebraska	117,790	4,676,000	3,667,000	78.4	8,140	1,442,000	838,000	58.1	125,930	6,118,000	4,505,000	73.6
New Mexico	24,780	1,905,000	1,332,000	69.9	3,010	1,253,000	480,000	38.3	27,790	3,158,000	1,812,000	57.4
New York	402,160	15,332,000	12,627,000	82.4	33,550	3,025,000	2,200,000	72.7	435,710	18,357,000	14,827,000	80.8
North Dakota	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Ohio	1,190,730	58,374,000	37,610,000	64.4	113,140	11,914,000	6,713,000	56.3	1,303,870	70,288,000	44,323,000	63.1
Oklahoma	246,390	19,744,000	9,061,000	45.9	32,610	8,625,000	2,720,000	31.5	279,000	28,369,000	11,781,000	41.5
Pennsylvania	678,310	35,647,000	20,386,000	57.2	56,030	7,929,000	4,261,000	53.7	734,340	43,576,000	24,647,000	56.6
South Dakota	15,460	1,152,000	916,000	79.5	1,730	1,087,000	456,000	42.0	17,190	2,239,000	1,372,000	61.3
Tennessee [4]	42,200	2,644,000	2,247,000	85.0	5,690	1,991,000	819,000	41.1	47,890	4,635,000	3,066,000	66.1
Texas	620,850	32,823,000	23,845,000	72.6	73,600	13,368,000	5,951,000	44.5	694,450	46,191,000	29,796,000	64.5
Utah	[3] 30,940	[3] 2,899,000	[3] 1,886,000	[3] 65.1	[3] 1,540	[3] 1,158,000	[3] 411,000	[3] 35.5	[3] 32,480	[3] 4,057,000	[3] 2,297,000	[3] 56.6
Virginia [4]	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Washington	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)

West Virginia	184, 920	18, 282, 000	6, 636, 000	36. 3	19, 670	4, 912, 000	1, 645, 000	33. 5	204, 590	23, 194, 000	8, 281, 000	35. 7
Wyoming	21, 140	3, 179, 000	1, 460, 000	45. 9	2, 710	1, 224, 000	400, 000	32. 7	23, 850	4, 403, 000	1, 860, 000	42. 2
Total: 1939	8, 887, 460	391, 153, 000	287, 600, 000	73. 5	715, 390	118, 334, 000	58, 494, 000	49. 4	9, 602, 850	509, 487, 000	346, 094, 000	67. 9
1938	[5] 8, 570, 200	367, 772, 000	273, 070, 000	74. 2	[5] 694, 460	114, 296, 000	56, 247, 000	49. 2	[5] 9, 264, 660	482, 068, 000	329, 317, 000	68. 3

[1] Includes natural gas used with manufactured gas.
[2] Maryland includes District of Columbia and Virginia.
[3] Utah includes North Dakota and Washington.
[4] A small amount of gas distributed in Tennessee is included with Virginia; separate figures not available.
[5] Revised figures caused by revising Texas to the following: Domestic consumers, 585,690; commercial consumers, 70,610; total domestic and commercial consumers, 656,300.

Industrial consumption of natural gas in the United States in 1939, by States and uses

State	Field (drilling, pumping, and operating gasoline-recovery plants)		Carbon-black manufacture			Fuel at petroleum refineries, electric public-utility power plants, portland-cement plants, and other industrial							Total industrial		
	M cubic feet (estimated)	Value at points of consumption (estimated)	M cubic feet	Value at points of consumption		M cubic feet					Value at points of consumption		M cubic feet	Value at points of consumption	
				Total	Average (cents)	Petroleum refineries	Electric public utility power plants	Portland-cement plants	Other industrial	Total	Total	Average (cents)		Total	Average (cents)
Alabama							804,000	(1)	[1] 17,222,000	18,026,000	$2,997,000	16.6	18,026,000	$2,997,000	16.6
Arizona							2,886,000		11,844,000	14,730,000	2,814,000	19.1	14,730,000	2,814,000	19.1
Arkansas	10,103,000	$812,000				3,501,000	2,122,000	(1)	[1] 11,187,000	16,810,000	2,029,000	12.1	26,913,000	2,841,000	10.6
California	130,331,000	8,223,000				16,952,000	23,161,000	(1)	[1] 89,188,000	129,301,000	18,178,000	14.1	259,632,000	26,401,000	10.2
Colorado	300,000	17,000				1,000	709,000	(1)	[1] 13,770,000	14,480,000	2,263,000	15.6	14,780,000	2,280,000	15.4
District of Columbia									(2)	(2)	(2)	(2)	(2)	(2)	(2)
Florida									1,504,000	1,504,000	217,000	14.4	1,504,000	217,000	14.4
Georgia							3,586,000		6,389,000	9,975,000	1,808,000	18.1	9,975,000	1,808,000	18.1
Illinois	2,190,000	86,000				126,000	3,421,000		48,278,000	51,825,000	10,470,000	20.2	54,015,000	10,556,000	19.5
Indiana	142,000	8,000				579,000	10,573,000		16,048,000	27,200,000	5,927,000	21.8	27,342,000	5,935,000	21.7
Iowa							5,547,000	(1)	[1] 10,927,000	16,474,000	2,492,000	15.1	16,474,000	2,492,000	15.1
Kansas	15,876,000	1,159,000	(3)	(3)	(3)	1,274,000	16,540,000	6,246,000	[3] 22,418,000	[3] 46,478,000	[3] 5,882,000	[3] 12.7	62,354,000	7,041,000	11.3
Kentucky	1,187,000	153,000				169,000			4,616,000	4,785,000	1,356,000	28.3	5,972,000	1,509,000	25.3
Louisiana	36,668,000	1,608,000	21,777,000	$631,000	2.9	10,230,000	24,118,000	(1)	[1] 58,156,000	92,504,000	9,406,000	12.2	150,949,000	11,645,000	7.7
Maryland									[2] 4,375,000	[2] 4,375,000	[2] 1,234,000	[2] 28.2	[2] 4,375,000	[2] 1,234,000	[2] 28.2
Michigan	1,543,000	150,000				11,000	10,000		6,544,000	6,565,000	3,609,000	55.0	8,108,000	3,759,000	46.4
Minnesota							1,829,000		9,090,000	10,919,000	2,068,000	18.9	10,919,000	2,068,000	18.9
Mississippi	140,000	16,000					1,307,000		7,497,000	8,804,000	1,153,000	13.1	8,944,000	1,169,000	13.1
Missouri	391,000	34,000					10,774,000	(1)	[1] 21,271,000	32,045,000	5,484,000	17.1	32,436,000	5,518,000	17.0
Montana	1,303,000	79,000				920,000	754,000		7,602,000	9,276,000	1,325,000	14.3	10,579,000	1,404,000	13.3
Nebraska							5,479,000	(1)	[1] 8,057,000	13,536,000	2,358,000	17.4	13,536,000	2,358,000	17.4
New Mexico	23,607,000	447,000				100,000	4,312,000		7,804,000	12,216,000	1,807,000	14.8	35,823,000	2,254,000	6.3
New York	255,000	51,000				1,812,000	2,784,000		23,669,000	28,265,000	5,682,000	20.1	28,520,000	5,733,000	20.1
North Dakota							(4)		(4)	(4)	(4)	(4)	(4)	(4)	(4)
Ohio	1,227,000	208,000				1,000	1,998,000		41,206,000	43,205,000	14,756,000	34.2	44,432,000	14,964,000	33.7
Oklahoma	147,179,000	4,324,000	(3)	(3)	(3)	8,874,000	11,490,000	(1)	[1 3] 35,093,000	[3] 55,457,000	[3] 4,778,000	[3] 8.6	202,636,000	9,102,000	4.5
Pennsylvania	5,451,000	1,278,000				2,668,000	1,668,000		56,383,000	60,719,000	17,660,000	29.1	66,170,000	18,938,000	28.6
South Dakota							1,165,000	(1)	[1] 2,308,000	3,473,000	602,000	17.3	3,473,000	602,000	17.3
Tennessee [5]						1,000	5,346,000		5,576,000	10,923,000	1,858,000	17.0	10,923,000	1,858,000	17.0
Texas	281,288,000	7,452,000	313,621,000	2,469,000	.8	46,892,000	47,572,000	9,803,000	51,194,000	155,461,000	17,388,000	11.2	750,370,000	27,309,000	3.6
Utah	20,000	1,000				11,000	[4] 248,000		[4] 10,506,000	[4] 10,765,000	[4] 1,199,000	[4] 11.1	[4] 10,785,000	[4] 1,200,000	[4] 11.1

Virginia [5]	----------	----------	----------	----------	------	----------	----------	----------	(2)	(2)	(2)	(2)	(2)	(2)	(2)
West Virginia	14,179,000	2,270,000	----------	----------	------	489,000	95,000	----------	31,437,000	32,021,000	6,471,000	20.2	46,200,000	8,741,000	18.9
Wyoming	7,504,000	234,000	----------	----------	------	3,074,000	833,000	----------	1,972,000	5,879,000	646,000	11.0	13,383,000	880,000	6.6
Miscellaneous	----------	----------	11,872,000	163,000	1.4	----------	----------	24,184,000	----------	----------	----------	------	----------	----------	------
Total, 1939	680,884,000	28,610,000	347,270,000	3,263,000	.9	97,685,000	191,131,000	40,233,000	607,075,000	936,124,000	155,754,000	16.6	1,964,278,000	187,627,000	9.6
1938	659,203,000	29,628,000	324,950,000	2,892,000	.9	109,741,000	169,988,000	37,336,000	510,811,000	827,876,000	138,713,000	16.8	1,812,029,000	171,233,000	9.4

[1] Gas used at portland-cement plants included under "Miscellaneous" for United States total and under "Other industrial" for State total to avoid disclosing figures of individual operators.

[2] Maryland includes District of Columbia and Virginia.

[3] Gas used in carbon-black manufacture included under "Miscellaneous" for United States total, and under "Other industrial" for State total to avoid disclosing figures of individual operators.

[4] Utah includes North Dakota.

[5] A small amount of gas distributed in Tennessee included with Virginia; separate figures not available.

Field.—Gas reported as used for field purposes is estimated to have risen to a new high in 1940 at 700 billion cubic feet—3 percent above 1939. Sharp expansion in field gas in Texas has dominated the national trend for several years, and this condition probably continued in 1940. Exploitation of Texas condensate fields now adds substantially to the total use in the field.

Among other producing States, definite upward trends in volume of field gas were evident in 1938 and 1939 in New Mexico, Illinois, and Wyoming; however, decreases were noted in Oklahoma, California, and Kansas. The curtailment in the use of field gas in Oklahoma has been particularly sharp since the peak of flush production from the Oklahoma City and Fitts fields passed.

Carbon-black manufacture.—Gas burned in carbon-black manufacture totaled about 369 billion cubic feet in 1940 and exceeded the previous peak of 1939 by 6 percent. Larger consumption was indicated in Texas and probably in Kansas and Oklahoma, where new plants commenced operations in 1940.

Petroleum refineries.—Refineries are thought to have used about 100 billion cubic feet of natural gas as fuel in 1940—about 2 percent above the 1939 total. California refineries reduced their consumption of natural gas almost 50 percent in 1939 as a result of substitution of fuel oil for gas for part of their fuel requirements. The change was made because declining prices for heavy fuel oil made possible a reduction in fuel costs. Texas, Louisiana, and Oklahoma, which rank high in this class of gas use, showed moderate expansion over 1938 in 1939.

Kentucky was added to the list of States in which gas is consumed at petroleum refineries in 1939, making 20 States in all.

Electric public-utility power plants.—Consumption of natural gas at electric power plants in 1940 fell 8 billion cubic feet to 183 billion, despite an 11-percent increase in production of electric power.

In 1939 the use of natural gas for generating electricity was abnormally stimulated, especially in California, by drought which limited the output of hydroelectric plants. Thus a heavy load was carried by the steam power plants. Consumption at power plants was less in New York, Pennsylvania, and Ohio in 1939 than in 1938, doubtless owing to reduced gas supplies, and in a few southeastern and Rocky Mountain areas.

Portland-cement plants.—Cement production in 1940 was 8 percent above 1939, and gas consumed at cement plants increased to 41,949 million cubic feet from 40,233 million in 1939. The consumption in 1940 was slightly larger than the previous high point of 1929.

Other industrial.—Consumption of natural gas by miscellaneous industries is estimated to have gained about 15 percent in 1940, rising to 699 billion cubic feet—the largest volume on record. Demand, particularly from the metal-working trades, was heavy, as the defense program necessitated capacity operations in many types of manufacturing.

All important industrial areas within the range of natural-gas service apparently participated in the increase except western New York State. In this region many plants were compelled to change from natural gas to other fuel because of a local shortage of gas; in consequence, industrial consumption was reduced abruptly in 1940.

The market for "other industrial" gas has grown most rapidly of any of the major classes of consumption since the depression low point in 1932. The volume in 1939 was 121 percent larger than in 1932, having gained in every year since then except in 1938. In the same period the total consumption of natural gas in the United States increased 59 percent. Most of the group of States that provided the largest markets for industrial gas in 1939 have about doubled their rate of consumption since 1932. In Illinois the rate has more than quadrupled, and there have been comparable gains in a number of other States where developed markets are smaller.

Mixed gas.—After several years of recession the number of consumers served with mixed gas increased 2 percent in 1939 owing to small additions in all areas except Pennsylvania. The volume of mixed gas taken by domestic and commercial consumers increased 5 percent, but industrial consumption continued to slump to 8,039 million cubic feet from a peak of 11,532 million in 1936. Domestic use of natural gas mixed with manufactured gas increased materially in Illinois, Minnesota, and Ohio in 1939.

Consumption of natural gas used with manufactured gas in the United States in 1939, by States

State	Domestic		Commercial		Industrial (M cubic feet)	Total	
	Consumers	M cubic feet	Consumers	M cubic feet		M cubic feet	Value at points of consumption
District of Columbia	151,460	3,288,000	6,660	305,000	476,000	4,069,000	$2,913,000
Illinois	1,066,030	15,123,000	55,500	4,068,000	3,819,000	23,010,000	26,323,000
Indiana	30,670	380,000	1,510	87,000	37,000	504,000	538,000
Iowa	52,940	1,229,000	4,330	292,000	93,000	1,614,000	1,716,000
Kentucky	72,820	2,620,000	7,010	711,000	714,000	4,045,000	2,211,000
Maryland	18,840	444,000	350	11,000	17,000	472,000	409,000
Michigan					430,000	430,000	163,000
Minnesota	126,590	3,445,000	5,580	424,000	335,000	4,204,000	4,249,000
Missouri	227,150	2,726,000	11,340	328,000	221,000	3,275,000	3,275,000
Nebraska	54,880	964,000	350	48,000	116,000	1,128,000	696,000
New York	269,190	7,727,000	21,880	1,527,000	1,153,000	10,407,000	8,228,000
Ohio	154,600	1,783,000	15,420	602,000	458,000	2,843,000	1,712,000
Pennsylvania	53,720	1,465,000	2,580	268,000	157,000	1,890,000	1,279,000
Virginia	18,120	201,000	480	8,000	13,000	222,000	240,000
Total: 1939	2,297,010	41,395,000	132,990	8,679,000	8,039,000	58,113,000	53,952,000
1938	2,252,250	39,004,000	129,460	8,579,000	8,242,000	55,825,000	51,258,000

NEW MARKETS

More than 80 municipalities in 15 States were supplied with natural gas for the first time in 1940, adding about 300,000 population to the territory served. Important additions were made in Indiana, where 19 new towns were connected, including Bloomington, Bedford, and Jeffersonville. In Illinois, Kewanee, Lawrenceville, Olney, and Salem were included in 11 new markets. Smaller but substantial new areas were acquired in Iowa, Nebraska, New Mexico, Ohio, and Pennsylvania.

Important industrial consumers—chiefly connected with the mining, chemical, and clay industries—were reached by new pipe lines in Arizona, Arkansas, Michigan, New Mexico, and Texas.

In many parts of the country minor extensions were made to meet the gas requirements of new or expanded military establishments and industrial plants involved in the national defense effort. Most of these projects are of only local importance to the gas industry, but in the aggregate they will be a substantial addition to gross sales of gas.

INTERSTATE SHIPMENTS

Interstate shipments of natural gas in 1939 recovered the volume lost in 1938 and advanced to a new peak—689,795 million cubic feet. Increased withdrawals from the three leading source States (Texas, Louisiana, and West Virginia) accounted for almost the entire net gain and continued the trend toward larger shares of the total market for these areas. Exports from most States increased, however, with the conspicuous exception of New York, whose shipments declined almost 50 percent after an abrupt rise in 1938. The Oriskany sand fields of New York, which supplied the flush gas production, have been quickly depleted by competitive drilling and pipe-line activities.

The movement from Kentucky to Maryland increased sharply, and Oklahoma gas in some volume began supplying markets in Iowa, Minnesota, and South Dakota. The movement from Kentucky to Illinois was reversed in 1939 after new gas supplies were developed in Illinois.

Most importing States consumed more out-of-State gas in 1939 than in 1938. Pennsylvania and West Virginia imported much less gas from New York and Kentucky, respectively. The Kentucky shipments were curtailed because of large available gas supplies in West Virginia.

Interstate transportation of natural gas in 1939 [1]

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Colorado	Wyoming	Utah	1,577,000
		Wyoming	106,000
			1,683,000
Illinois		Indiana	489,000
	Indiana	Kentucky	441,000
			930,000
Indiana		Illinois	5,000
		Kentucky	140,000
			145,000
Kansas		Colorado	503,000
	Missouri	Illinois	2,455,000
	do Illinois	Indiana	3,793,000
	Nebraska	Iowa	6,189,000
	do South Dakota	do	8,000
	Missouri Illinois Indiana	Michigan	5,314,000
	Nebraska Iowa	Minnesota	7,266,000
		Missouri	7,591,000
		Nebraska	9,109,000
	Nebraska Iowa	do	4,000

[1] Includes exports to Canada and Mexico.

Interstate transportation of natural gas in 1939—Continued

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Kansas—Continued	Missouri Illinois Indiana	Ohio	15,000
		Oklahoma	554,000
	Nebraska	South Dakota	915,000
			43,716,000
Kentucky	West Virginia Virginia Maryland	District of Columbia	4,069,000
		Indiana	111,000
	West Virginia Virginia	Maryland	3,512,000
	West Virginia Virginia Maryland District of Columbia	do	476,000
		Ohio	4,264,000
	West Virginia	do	3,018,000
	do	Pennsylvania	8,538,000
	do Maryland	do	2,618,000
	West Virginia	Virginia	506,000
	do Virginia Maryland District of Columbia	Virginia	222,000
		West Virginia	9,506,000
			36,840,000
Louisiana	Mississippi	Alabama	17,892,000
		Arkansas	24,944,000
	Mississippi Alabama	Georgia	16,296,000
	Arkansas Missouri	Illinois	17,413,000
		Mississippi	5,677,000
	Arkansas	do	2,170,000
	do	Missouri	13,476,000
	do Mississippi	Tennessee	15,550,000
		Texas	39,003,000
			152,421,000
Mississippi		Alabama	2,201,000
	Alabama	Florida	1,658,000
		Louisiana	4,308,000
			8,167,000
Missouri		Illinois	40,000
	Illinois	Indiana	63,000
	do Indiana	Michigan	86,000
			189,000
Montana		North Dakota	1,535,000
		South Dakota	3,448,000
	North Dakota	do	76,000
			5,059,000
New Mexico	Texas New Mexico	Arizona	16,643,000
		Colorado	163,000
		Texas	6,045,000
			22,851,000
New York		Canada	28,000
		Pennsylvania	11,927,000
			11,955,000
North Dakota		South Dakota	4,000

Interstate transportation of natural gas in 1939—Continued

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Ohio		Indiana	6,000
		Pennsylvania	1,000
		West Virginia	106,000
			113,000
Oklahoma		Arkansas	622,000
	Kansas Missouri	Illinois	80,0000
	Kansas Missouri Illinois	Indiana	123,000
	Kansas Nebraska	Iowa	980,000
	Kansas Nebraska South Dakota	do	1,000
		Kansas	16,704,000
	Kansas Missouri Illinois Indiana	Michigan	173,000
	Kansas Nebraska Iowa	Minnesota	1,150,000
	Kansas	Missouri	7,292,000
	do	Nebraska	875,000
	do Missouri	do	394,000
	Kansas Nebraska	South Dakota	145,000
		Texas	2,182,000
			30,721,000
Pennsylvania	New York	Canada	48,000
		New York	29,610,000
		Ohio	67,000
	West Virginia	do	391,000
		West Virginia	2,870,000
			32,986,000
Texas	New Mexico	Colorado	20,888,000
	Oklahoma Kansas Missouri	Illinois	5,089,000
	Oklahoma Kansas Nebraska Iowa	do	50,236,000
	Oklahoma Kansas Missouri Illinois	Indiana	7,865,000
	Oklahoma Kansas Nebraska Iowa Illinois	do	17,699,000
	Oklahoma Kansas Nebraska	Iowa	14,544,000
	Oklahoma Kansas Nebraska South Dakota	do	10,000
	Oklahoma	Kansas	32,321,000
		Louisiana	18,410,000
		Mexico	3,046,000
	Oklahoma Kansas Missouri Illinois Indiana	Michigan	11,017,000
	Oklahoma Kansas Nebraska Iowa	Minnesota	8,846,000
	Oklahoma Kansas	Missouri	18,449,000

Interstate transportation of natural gas in 1939—Continued

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Texas—Continued	Oklahoma Kansas	Nebraska	8,162,000
	Oklahoma Kansas Nebraska Iowa	do	5,000
		New Mexico	1,548,000
	Oklahoma Kansas Missouri Illinois Indiana	Ohio	31,000
		Oklahoma	10,297,000
	Oklahoma Kansas Nebraska	South Dakota	1,114,000
	New Mexico Colorado	Wyoming	519,000
			230,096,000
Utah		Wyoming	76,000
West Virginia		Kentucky	5,051,000
		Maryland	919,000
		Ohio	67,106,000
	Kentucky	do	3,472,000
		Pennslyvania	25,766,000
			102,314,000
Wyoming		Colorado	92,000
		Montana	1,515,000
		Nebraska	1,105,000
		Utah	6,817,000
			9,529,000
			689,795,000

PIPE-LINE DEVELOPMENTS

Vigorous expansion of natural-gas pipe-line facilities continued in 1940 under the stimulus of growing markets. About 2,000 miles of new line were laid in 1940—30 percent more than in 1939.

Almost a third of the mileage constructed was devoted to looping projects on major lines originating in the Southwestern States. The largest installation involved 160 miles of 20- to 24-inch pipe in several loops along the Texas-Detroit transmission system. The capacity of the Louisiana-Memphis line was augmented by addition of 92 miles of 18-inch. Loops with a total length of 80 miles of 22-inch pipe were installed in the Southern line, which carries gas eastward from northern Louisiana to points in central Georgia and intervening States.

Fuel requirements for enlarged mining and smelting operations in Arizona and New Mexico were supplied by construction of 78 miles of 6⅝- to 16-inch loop lines along trunklines of the system serving these areas from southeast New Mexico fields. The carrying capacity of the line to Minneapolis from the Texas Panhandle was enlarged by adding 75 miles of looped line in Kansas and Nebraska, mostly 24-inch diameter. Smaller loop programs increased the capacity of lines near Beaumont, Tex.; Farmington, N. Mex.; and Lawton, Okla.

In Montana 120 miles of 8-inch line were laid from Fort Peck to Wolf Point and Glendive to carry gas from the Bowdoin field, supplementing supplies of the Baker-Glendive district. An additional 56 miles of branch and gathering lines were installed. A 20-inch line was started northward from Geneseo, Ill., as a branch of the Texas-Chicago trunk line, with Milwaukee as the intended terminus. Work on the Wisconsin portion of the project was halted, however, in January 1940 because of legal difficulties. A new line of 8- to 16-inch pipe laid from connections at Monaca, Pa., northeastward 117 miles to Olean, N. Y., will bring a substantial volume of West Virginia gas to established markets in western New York, where local supplies became inadequate.

In Michigan several new lines were constructed to tap gas reserves of the Lake George, North Star, Temple, and other fields in Missaukee, Osceola, and Clare Counties. The largest of these consisted of 58 miles of 12-inch discharging into a trunk line 6 miles west of Midland and 55 miles of 6-inch used to supply gas to a Midland chemical plant.

In Wyoming 100 miles of 4-, 6-, and 8-inch line were laid to bring gas to the depleted Billy Creek field from the Big Sand Draw and Muskrat fields via Casper. In New Mexico four extensions totaling 59 miles in length were built to serve new markets at Lordsburg, Belen, Los Lunas, Isleta, and potash mines near Carlsbad.

In Texas 18 minor pipe-line projects were reported which connected 11 fields to new or established markets. The total length of new lines was about 300 miles, the longest—48 miles of 8-inch—running from the Page field to San Angelo. Another important line consisted of 41 miles of 8- and 10-inch pipe laid from the Bay City field to serve a new chemical plant at Freeport.

Four lines of 90 miles total length were laid in Louisiana to connect the Abbeville, Lirette, Sligo, and Terrebonne Parish fields to markets. The largest—35 miles of 12-inch—brings gas from Lirette to New Orleans.

In Kansas 65 miles of 12-inch were run from the Cunningham pool to Wichita, 30 miles of 8-inch from Hutchinson to Lyons, and 12 miles of 6-inch from Finney County wells to Garden City.

Minor extensions and gathering lines were built in Arizona, Arkansas, California, Indiana, Kentucky, Minnesota, Nebraska, Oklahoma, and Ohio. In many localities connections were made to military establishments, flying fields, or manufacturing plants connected with the national defense program.

Construction of several important interstate gas lines was proposed during 1940, but actual work must await approval of the Federal Power Commission. Prospective market areas to be served with gas from southwestern fields include southern Wisconsin, eastern Tennessee and western North Carolina, New Jersey, and metropolitan New York. A new line from eastern Kentucky toward Pittsburgh, Pa., is also reported to be under consideration.

NATURAL GASOLINE

AND LIQUIFIED PETROLEUM GASES [1]

By G. R. Hopkins and A. T. Coumbe [2]

SUMMARY OUTLINE

NATURAL GASOLINE

A new record for production—2,320,458,000 gallons—was established by the natural-gasoline industry in 1940. This output was 86,770,000 gallons (4 percent) above the previous record of 1929, which included one less day. In spite of this peak output, the industry did not experience a particularly profitable year compared with 1929 or 1939, because the average value at the plants fell from 7.1 cents a gallon in 1929 to 4.2 cents in 1939 and then to 3.0 cents (estimated) in 1940. The recycling division of the industry expanded rapidly in 1940, with considerable evidence of prosperity, but profits at the conventional plants must have declined to low levels in consequence of the abnormally low prices for refinery gasoline.

Although the proportion of natural gasoline in refinery gasoline changed little in 1940 there was an actual loss in refinery deliveries from 1,663,452,000 gallons in 1939 to 1,651,860,000 in 1940. This loss in business with the premier customer, in spite of lower prices, probably reflected the results of reduction in the yield of gasoline in favor of fuel oils. This situation, in conjunction with the gain in production, reversed the trend of stocks from a net withdrawal in 1939 to a sizable gain in 1940. As a further depressing factor, exports continued to drop as a result of the war and totaled only 71,694,000 gallons in 1940 compared with 172,662,000 in 1939.

The average vapor pressure of the deliveries of natural gasoline fell to a new low of 19.3 pounds in 1940, probably an effect of the installation of stabilizing equipment at recycling plants, although the older establishments doubtless were forced to produce a more stable commodity to compete with them.

[1] Data for 1940 are preliminary; detailed statistics with final revisions will be released later.
[2] Tables compiled by E. M. Seeley, Petroleum Economics Division, Bureau of Mines.

Salient statistics of the natural-gasoline industry in the United States, 1936–40, in thousands of gallons

	1936	1937	1938	1939	1940 [1]	Percent of change in 1940 from 1939
Production:						
Appalachian	65,669	72,056	68,541	71,507	80,000	+11.9
Illinois, Kentucky, and Michigan	10,361	12,319	13,057	14,768	35,234	+238.6
Oklahoma City	128,783	166,188	141,516	104,268	81,558	−21.8
Seminole	115,557	121,839	122,144	127,214	115,554	−9.2
Texas Panhandle	218,703	230,405	249,968	260,488	268,258	+3.0
East Texas	140,091	185,313	188,117	190,267	172,304	−9.4
Rocky Mountain	65,337	74,868	82,397	88,719	92,789	+4.6
Kettleman Hills	171,052	182,894	186,780	156,514	127,742	−18.4
Long Beach	89,366	84,297	92,675	86,213	90,529	+5.0
All other districts	791,421	935,255	1,011,379	1,069,342	1,256,490	+17.5
Total production	1,796,340	2,065,434	2,156,574	2,169,300	2,320,458	+7.0
Stocks:						
Total at plants, terminals, and refineries, Jan. 1	155,316	170,310	199,836	202,860	185,682	
Total at plants, terminals, and refineries, Dec. 31	170,310	199,836	202,860	185,682	239,568	+29.0
Net change	+14,994	+29,526	+3,024	−17,178	+53,886	
Total supply [2]	1,781,346	2,035,908	2,153,550	2,186,478	2,266,572	+3.7
Distribution:						
Used at refineries [3]	1,420,314	1,654,002	1,678,362	1,663,452	1,651,860	−.7
Refinery-owned bulk plants	(4)	27,888	39,270	49,938	64,596	+29.4
Exports	107,058	148,428	256,914	172,662	71,694	−58.5
Jobbers and retailers	[4] 139,230	143,640	137,970	121,128	218,694	+80.5
Losses	114,744	61,950	11,034	179,298	259,728	+44.9
Total distribution	1,781,346	2,035,908	2,153,550	2,186,478	2,266,572	+3.7

[1] Subject to revision.
[2] Production plus or minus changes in stocks.
[3] Including quantities run through crude-oil pipe lines.
[4] Deliveries to refinery-owned bulk plants included in "jobbers and retailers."

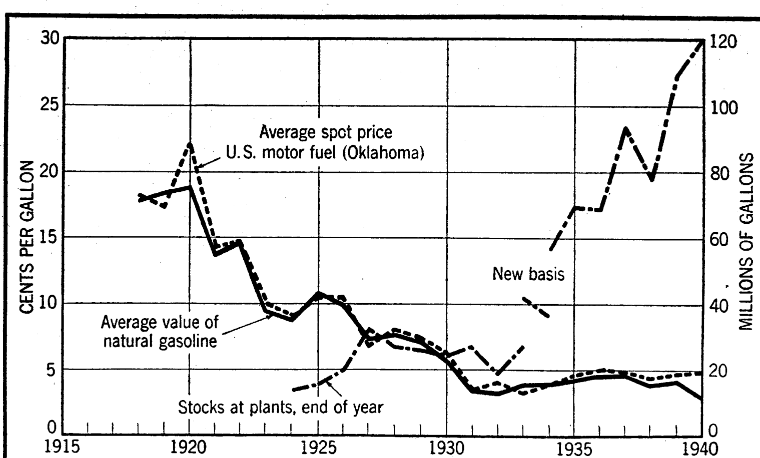

FIGURE 1.—Trends in average value of natural gasoline, spot price of gasoline, and stocks of natural gasoline, 1918–40.

PRICES AND MARKET CONDITIONS

Natural gasoline sold at record low prices in 1940. The average for 26–70 grade in the Mid-Continent area was 1.94 cents a gallon compared with 3.19 cents in 1939. The average for June was only 1.5 cents, from which the price advanced to a high of 3.0 cents late in October.

Figure 1 shows that the average value of natural gasoline (estimated for 1940) has dropped far below the refinery price of gasoline in Oklahoma.

Prices to blenders of Mid-Continent natural gasoline, grade 26–70, with dates of price changes in 1940 and monthly and yearly average in cents per gallon

[National Petroleum News]

Date	Cents
Jan. 1	2.75
2	2.50
13	2.25
24	2.00-2.25
26	2.00
Average	2.30
Feb. 20	2.00-2.25
21	2.00
Average	2.00
Mar. 14	1.75
23	1.50-1.75
26	1.75
27	1.50-1.75
29	1.50
Average	1.81
Apr. 5	1.50-1.75
6	1.50
9	1.50-1.75
10	1.50-2.00
12	1.50
Average	1.53
May 8	1.50-2.00
9	1.50
Average	1.51
June Average	1.50
July 12	1.50-2.00
13	1.50
20	1.50-2.00
22	1.50
24	1.50-2.00
26	1.50
31	1.50-2.00
Average	1.55
Aug. 1	1.50
2	1.50-2.00
5	1.50
6	1.50-2.00
7	1.50
15	1.52-2.00
16	1.50
20	1.50-2.00
21	1.50
23	1.75
27	1.75-2.00
28	1.75
29	1.75-2.00
Average	1.64
Sept. 4	1.75
6	1.75-2.00
9	1.75
10	1.75-2.00
Sept. 13	2.00
17	2.25
21	2.25-2.50
23	2.25
25	2.25-2.50
26	2.25
29	2.25-2.50
30	2.50
Average	2.08
Oct. 1	2.25-2.50
2	2.25-2.75
3	2.50
10	2.75
30	2.75-3.00
31	2.75
Average	2.60
Nov. 14	2.25-2.50
15	2.25
Average	2.47
Dec. 20	2.38
Average	2.30
Average, 1940	1.94
1939	3.19

EMPLOYMENT AND PRODUCTIVITY

The discussion of employment and productivity included in this chapter for several years cannot be given for 1939, as the Bureau of Mines did not compile employment data for that year; however, complete information for 1939 was collected by the Bureau of the Census as part of its Decennial Census of Mines and Quarries, and the results should be published before the end of 1941.

PRODUCTION

Trends in total output.—Although the respective percentage increases in the production of crude oil and natural gasoline in 1940 tallied (both increased 7 percent over 1939) the monthly trends for the two differed markedly (see fig. 2). Daily average production of crude oil was at its peak in March and April, but the highest months for natural gasoline were October and November. This diversity of trends is explainable largely in Illinois (where crude-oil production was highest in June but where natural-gasoline production increased steadily throughout the year) and in Texas (where crude-oil production was highest in March but where the output of natural gasoline was much higher in December than in January because of the growth in recycling).

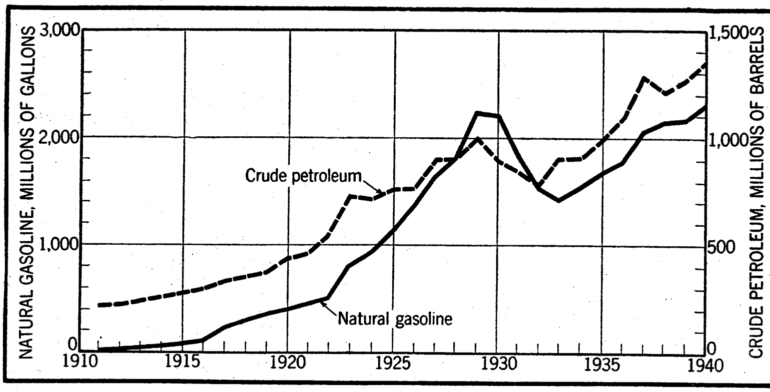

FIGURE 2.—Annual production of natural gasoline and crude petroleum, 1911–40.

Natural gasoline produced in the United States, 1936–40, by States, in thousands of gallons

Year	Arkansas	California	Colorado	Illinois	Kansas	Kentucky	Louisiana	Michigan	Montana	New Mexico
1936	11,957	593,416	451	2,337	37,775	6,009	72,687	2,015	2,071	28,921
1937	11,285	623,894	404	2,567	57,026	7,344	106,415	2,408	2,296	38,253
1938	25,648	660,890	386	2,436	55,988	7,040	95,634	3,581	1,768	49,596
1939	24,634	607,237	390	4,012	62,175	7,785	94,090	2,971	2,161	54,707
1940 [1]	33,336	585,995	285	21,432	64,229	9,847	109,082	3,955	2,604	55,360

Year	New York	Ohio	Oklahoma	Pennsylvania	Texas	West Virginia	Wyoming	Total: Thousands of gallons	Total: Value at plant: Thousands of dollars	Total: Value at plant: Average per gallon (cents)
1936	22	6,991	418,591	14,267	520,547	44,389	33,894	1,796,340	84,572	4.7
1937	33	7,704	492,290	13,940	615,281	50,379	[2] 33,915	2,065,434	97,125	4.7
1938	27	7,382	468,499	10,734	685,920	50,398	[2] 30,647	2,156,574	87,266	4.0
1939	34	7,445	436,123	11,756	770,047	52,272	[2] 31,461	2,169,300	90,050	4.2
1940 [1]	17	7,583	399,156	15,554	920,637	56,846	[2] 34,540	2,320,458	70,000	3.0

[1] Subject to revision.
[2] Includes Utah.

California.—The newer and smaller fields of California, designated "Rest of State" as separate from Kettleman Hills and several other large fields, gained sharply in output in 1940; but most of the larger fields decreased, and the State total dropped from 607,200,000 gallons in 1939 to 586,000,000 in 1940. Nearly all the production is from casinghead gas, so there was close relationship between the production of natural gasoline and crude oil; neither fluctuated much in 1940.

Monthly production of natural gasoline in the United States, 1939–40, by fields, in millions of gallons

Field	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1939													
Appalachian	7.6	6.9	7.1	6.1	5.1	3.8	3.8	4.1	4.6	6.2	7.7	8.5	71.5
Illinois, Kentucky, and Michigan	1.3	1.1	1.1	1.1	1.0	1.0	1.0	1.1	1.2	1.4	1.7	1.8	14.8
Oklahoma:													
Oklahoma City	9.6	8.2	9.4	9.2	9.2	9.3	8.6	5.8	7.9	9.4	8.7	9.0	104.3
Osage County	4.9	4.1	4.9	4.9	5.1	5.1	5.1	3.6	4.9	5.0	5.0	5.2	57.8
Seminole	10.6	9.5	11.0	11.4	12.1	11.5	11.4	7.6	10.2	10.8	10.4	10.7	127.2
Rest of State	13.6	11.7	13.2	12.5	13.0	12.2	12.4	8.4	11.6	13.0	12.5	12.7	146.8
Total, Oklahoma	38.7	33.5	38.5	38.0	39.4	38.1	37.5	25.4	34.6	38.2	36.6	37.6	436.1
Kansas	5.7	5.1	5.0	5.3	5.1	4.5	4.3	4.1	4.8	5.7	6.3	6.3	62.2
Texas:													
Gulf Coast	6.2	6.0	6.7	7.1	8.1	8.9	9.4	7.2	9.6	9.4	9.1	10.6	98.3
East Texas	14.6	13.1	15.3	17.2	17.9	17.2	18.6	9.6	16.8	18.6	16.1	15.3	190.3
North Texas	2.8	2.5	2.9	2.9	3.0	2.7	2.8	2.6	2.9	2.9	2.8	2.9	33.7
Panhandle	22.3	19.1	21.1	21.8	20.9	20.0	20.5	18.4	22.0	24.7	25.7	24.0	260.5
West Central	6.1	5.3	6.1	5.9	5.5	5.4	5.5	4.9	5.6	5.9	5.9	5.6	67.7
West Texas	5.0	4.4	5.4	5.8	6.1	6.2	6.7	4.0	6.3	6.2	5.2	5.5	66.8
Rest of State	2.8	3.0	3.3	3.7	4.7	4.6	4.8	3.5	5.3	6.1	5.3	5.7	52.8
Total, Texas	59.8	53.4	60.8	64.4	66.2	65.0	68.3	50.2	68.5	73.8	70.1	69.6	770.1
Louisiana	7.7	6.6	6.9	7.1	7.3	7.7	7.9	7.3	8.4	8.9	9.3	9.0	94.1
Arkansas	2.1	1.9	2.5	2.2	2.2	2.0	2.1	2.0	2.1	2.1	1.7	1.7	24.6
Rocky Mountain	7.1	6.3	7.7	7.6	8.1	8.0	8.0	5.4	7.5	8.3	7.5	7.2	88.7
California:													
Huntington Beach	3.1	2.8	3.0	2.9	3.0	2.7	2.8	2.8	2.7	2.8	2.6	2.7	33.9
Kettleman Hills	16.3	13.5	15.0	14.1	14.2	12.6	12.6	12.5	10.9	11.5	11.6	11.7	156.5
Long Beach	7.2	6.5	7.5	7.3	7.2	7.0	7.2	7.3	7.3	7.4	7.0	7.3	86.2
Santa Fe Springs	5.1	4.7	5.1	4.8	4.9	4.8	4.8	4.9	4.6	4.9	4.6	4.8	58.0
Ventura Avenue	5.6	5.2	5.7	5.2	5.5	5.6	5.6	5.6	5.5	6.0	6.0	6.0	67.5
Rest of State	16.8	15.6	17.6	16.9	17.7	16.5	16.8	17.2	17.2	17.7	17.1	18.0	205.1
Total, California	54.1	48.3	53.9	51.2	52.5	49.2	49.8	50.3	48.2	50.3	48.9	50.5	607.2
Total, United States	184.1	163.1	183.5	183.0	186.9	179.3	182.7	149.9	179.9	194.9	189.8	192.2	2,169.3
Daily average	5.9	5.8	5.9	6.1	6.0	6.0	5.9	4.8	6.0	6.3	6.3	6.2	5.9
1940 [1]													
Appalachian	9.1	8.1	7.8	6.8	5.6	4.6	4.6	4.5	5.3	6.8	8.1	8.7	80.0
Illinois, Kentucky, and Michigan	2.3	2.0	2.1	2.2	2.1	2.5	2.8	2.8	3.2	3.9	4.4	4.9	35.2
Oklahoma:													
Oklahoma City	7.4	6.9	6.7	6.8	6.9	6.3	6.4	6.6	7.0	7.8	6.7	6.1	81.6
Osage County	3.7	4.1	4.4	4.2	4.9	4.5	4.6	4.6	4.4	4.8	4.6	4.4	53.2
Seminole	8.1	9.0	10.1	10.0	10.4	9.9	10.2	10.1	9.9	10.0	8.9	8.9	115.5
Rest of State	12.1	11.7	12.7	12.5	12.9	12.3	12.4	12.4	12.0	13.0	12.4	12.5	148.9
Total, Oklahoma	31.3	31.7	33.9	33.5	35.1	33.0	33.6	33.7	33.3	35.6	32.6	31.9	399.2
Kansas	6.0	5.6	5.4	5.2	5.1	4.8	4.6	4.8	4.8	5.7	5.9	6.3	64.2
Texas:													
Gulf Coast	11.0	12.2	15.9	16.1	16.7	16.1	19.9	20.5	21.8	23.7	24.1	24.3	222.3
East Texas	13.3	13.1	14.7	14.8	15.0	14.5	16.2	15.5	14.6	14.8	13.2	12.6	172.3
North Texas	2.2	2.4	2.6	2.7	2.5	2.3	2.3	2.4	2.3	2.5	2.3	2.2	28.7
Panhandle	22.3	21.4	22.2	21.4	22.8	20.7	22.9	20.9	23.4	23.2	22.6	24.5	268.3
West Central	5.3	5.3	5.6	5.2	5.3	5.0	5.2	5.1	5.3	5.5	5.3	5.2	63.3
West Texas	5.0	5.1	6.7	7.1	7.2	7.2	7.3	7.4	7.5	7.4	5.8	5.8	79.5
Rest of State	4.6	5.5	4.9	5.5	5.8	6.2	6.9	7.3	7.7	10.2	10.1	11.6	86.3
Total, Texas	63.7	65.0	72.6	72.8	75.3	72.0	80.7	79.1	82.6	87.3	83.4	86.2	920.7
Louisiana	9.2	8.8	7.9	8.1	9.2	8.8	9.0	9.7	9.3	9.3	9.8	10.0	109.1
Arkansas	1.5	1.7	2.9	2.9	3.1	3.0	3.2	3.1	3.0	3.2	2.8	2.9	33.3
Rocky Mountain	6.8	6.5	7.1	6.9	8.5	8.1	8.4	8.4	7.8	8.7	7.8	7.8	92.8
California:													
Huntington Beach	2.7	2.5	2.8	2.7	2.7	2.6	2.7	2.7	2.5	2.6	2.5	2.6	31.6
Kettleman Hills	10.6	9.9	10.5	10.2	10.7	10.5	10.6	11.0	10.6	12.0	10.7	10.5	127.8
Long Beach	7.3	7.0	7.6	7.3	7.8	7.5	7.8	7.9	7.7	7.7	7.4	7.5	90.5
Santa Fe Springs	4.8	4.5	4.8	4.6	4.7	4.8	4.9	4.9	4.6	4.9	4.6	4.8	56.9
Ventura Avenue	5.4	5.2	5.2	4.5	4.8	4.7	5.1	5.1	4.8	5.1	5.0	5.1	60.0
Rest of State	18.7	17.0	17.9	17.7	18.0	17.9	18.7	18.9	18.2	19.2	18.3	18.7	219.2
Total, California	49.5	46.1	48.8	47.0	48.7	48.0	49.8	50.5	48.4	51.5	48.5	49.2	586.0
Total, United States	179.4	175.5	188.5	185.4	192.7	184.8	196.7	196.6	197.7	212.0	203.3	207.9	2,320.5
Daily average	5.8	6.1	6.1	6.2	6.2	6.2	6.3	6.3	6.6	6.8	6.8	6.7	6.3

[1] Subject to revision.

Louisiana.—Production in Louisiana reached a new peak of 109,100,000 gallons in 1940. Most of the 15,000,000-gallon gain over 1939 was obtained in the coastal district, where deep drilling has found large reserves of gas.

Oklahoma.—The "Rest of State" in Oklahoma gained slightly in output in 1940; but Seminole and Oklahoma City, the two largest producing fields, reported a material loss, and the State total dropped from 436,100,000 gallons in 1939 to 399,200,000 in 1940—the lowest since 1935.

Texas.—Production in Texas made a new record of 920,700,000 gallons—a gain of 150,600,000 gallons (20 percent) over 1939. This increase about equaled the gain in the national total. The fact that most of the increase in 1940 was in the Gulf Coast district indicates that recycling again was largely responsible for the new record.

The Texas Panhandle output rose slightly, and the district retained its leadership, but it probably will be superseded by the Gulf Coast in the near future.

Other States.—Most of the other producing States showed increased production, and several attained new peaks. The most spectacular gain was in Illinois, where the construction of several new plants represented a step toward reducing the enormous waste of gas in flares.

Natural gasoline produced and natural gas treated in the United States in 1939, by States [1]

State	Number of operators [2]	Number of plants operating	Natural gasoline produced: Thousands of gallons	Value at plants: Thousands of dollars	Value at plants: Average per gallon (cents)	Natural gas treated: Millions of cubic feet	Natural gas treated: Average yield per M cubic feet (gallons)
Arkansas	6	8	24,634	962	3.9	19,171	1.28
California	35	95	607,237	35,454	5.8	377,041	1.61
Colorado	2	2	390	13	3.3	130	3.00
Illinois	22	54	4,012	229	5.7	2,440	1.64
Kansas	12	19	62,175	1,999	3.2	141,945	.44
Kentucky	5	7	7,785	347	4.5	36,817	.21
Louisiana	15	27	94,090	3,329	3.5	114,960	.82
Michigan	1	1	2,971	89	3.0	1,019	2.92
Montana	1	1	2,161	154	7.1	8,116	.27
New Mexico	5	6	54,707	1,696	3.1	97,010	.56
New York	1	1	34	1	2.9	65	.52
Ohio	7	11	7,445	351	4.7	32,703	.23
Oklahoma	46	122	436,123	15,502	3.6	219,755	1.98
Pennsylvania	53	83	11,756	499	4.2	26,662	.44
Texas	81	163	770,047	25,807	3.4	914,701	.84
West Virginia	22	77	52,272	2,017	3.9	140,982	.37
Wyoming	5	7	30,961	1,575	5.1	16,483	1.88
Utah			500	26	5.2		
Total, 1939	[2] 260	684	2,169,300	90,050	4.2	2,150,000	1.01
1938	[2] 266	696	2,156,574	87,266	4.0	2,035,562	1.06

[1] Complete figures for 1940 not yet available.
[2] A producer operating in more than 1 State is counted only once in arriving at the total for the United States.

CONSUMPTION AND MOVEMENTS

The demand for natural gasoline in 1940 will total about 2,300,000,000 gallons compared with 2,186,478,000 in 1939. According to company reports refinery consumption receded slightly and exports were off materially, so the gain was in "direct sales" and losses. Actually, refinery utilization probably increased, and actual losses were less than indicated, as it is virtually impossible to obtain separate figures on all natural gasoline or condensate mixed with crude oil.

Refinery utilization.—The proportion of natural gasoline in refinery gasoline during 1940 remained unchanged from the 1939 ratio of 6.6 percent. Although this marks a decline from the 7.2 percent in 1938, it is close to the average of 6.8 percent for the past 8 years.

California yielded first place to the Texas Inland district in the utilization of natural gasoline when the ratio in the former district dropped from 18.0 percent in 1939 to 15.7 in 1940 and that in the latter increased from 14.3 percent to 16.6. A further decrease of 1.7 percent in the Arkansas and Louisiana Inland district brought the ratio in this district to 3.3 percent, the lowest on record. The East Coast district, which established its peak in 1939, slumped to 2.0 percent in 1940.

"Direct" sales.—Sales of natural gasoline to jobbers and retailers increased materially in 1940, as the producers sought new outlets to replace lost refinery connections.

The intrastate movement in Texas remained the most important item in "direct sales;" the largest interstate movement was from Texas to Minnesota replacing that from Oklahoma to Illinois.

Percentage of natural gasoline in refinery gasoline in the United States, 1936–40, by districts

Year	East Coast	Appalachian	Indiana, Illinois, Kentucky	Oklahoma Kansas, Missouri	Texas Inland	Texas Gulf Coast	Louisiana Gulf Coast	Arkansas and Louisiana Inland	Rocky Mountain	California	Total
1936	1.6	1.6	4.4	9.7	11.5	3.9	1.8	5.4	7.8	15.5	6.7
1937	1.9	1.8	4.3	8.5	13.1	5.3	4.6	6.5	6.1	15.7	7.0
1938	1.6	1.4	4.7	8.8	15.5	4.3	2.2	6.8	5.8	17.6	7.2
1939	2.7	1.4	4.1	7.8	14.3	3.5	2.1	5.0	4.7	18.0	6.6
1940 [1]	2.0	1.6	4.5	8.0	16.6	4.4	1.7	3.3	4.5	15.7	6.6

[1] Subject to revision.

Water-borne shipments.—Natural gasoline suffered a greater relative recession in exports than any of the petroleum products, and the total for 1940 was only 71,694,000 gallons, or 58 percent below the total in 1939. The most severe cuts in shipments were those to Netherlands West Indies—from 63,177,000 gallons to 4,362,000; United Kingdom—from 33,629,000 gallons to 8,361,000; and Japan—from 7,611,000 gallons to 213,000. The decline in exports was due principally to the United States Government ban against exporting materials suitable for aviation fuel. Shipments to Canada increased from 33,446,000 gallons in 1939 to 44,157,000 in 1940; these comprised 62 percent of the total exports. Shipments of 4,374,000 gallons to Trinidad and of 1,354,000 gallons to Portugal, neither of which received natural gasoline from United States in 1939, constituted the only other gains in 1940 over 1939. Exports from Texas Gulf Coast ports totaled 44,000,000 gallons in 1940—a 63-percent loss from 120,000,000 gallons exported in 1939. Exports from California decreased 40 percent—from 30,000,000 gallons to 18,000,000.

Distribution of natural gasoline in the United States, 1939–40, by months, in thousands of gallons

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1939													
Production	184,044	163,086	183,456	182,994	186,942	179,256	182,742	149,940	179,928	194,922	189,756	192,234	2,169,300
Decrease in all stocks	7,686							20,958	30,786	31,542	23,562	6,636	17,178
	191,730	163,086	183,456	182,994	186,942	179,256	182,742	170,898	210,714	226,464	213,318	198,870	2,186,478
Used at refineries [1]	145,404	127,806	128,016	118,650	111,132	112,644	122,178	129,864	135,954	183,036	180,012	168,756	1,663,452
Refinery-owned bulk plants	7,644	3,780	2,856	3,066	2,814	2,436	2,352	1,932	7,014	4,620	5,124	6,300	49,938
Jobbers and retailers	9,240	8,904	12,138	9,996	10,962	9,450	10,122	8,694	9,660	11,214	11,130	9,618	121,128
Exports [2]	21,924	5,880	24,570	20,748	9,366	14,952	19,614	16,422	18,732	12,810	3,864	3,780	172,662
Increase in all stocks		2,562	546	32,046	30,576	22,554	15,708						
Losses	7,518	14,154	15,330	−1,512	22,092	17,220	12,768	13,986	39,354	14,784	13,188	10,416	179,298
	191,730	163,086	183,456	182,994	186,942	179,256	182,742	170,898	210,714	226,464	213,318	198,870	2,186,478
1940 [3]													
Production	179,382	175,518	188,538	185,388	192,654	184,842	196,728	196,560	197,652	211,974	203,322	207,900	2,320,458
Decrease in all stocks									27,888	19,698	19,614	16,716	
	179,382	175,518	188,538	185,388	192,654	184,842	196,728	196,560	225,540	231,672	222,936	224,616	2,320,458
Used at refineries [1]	137,970	128,814	125,412	116,886	129,150	109,200	115,248	129,402	157,248	174,552	169,092	158,886	1,651,860
Refinery-owned bulk plants	6,552	4,200	6,132	4,536	4,746	6,342	5,040	4,410	6,594	4,746	4,494	6,804	64,596
Jobbers and retailers	11,214	10,710	15,582	15,078	14,448	14,490	16,968	18,018	22,302	29,190	25,704	24,990	218,694
Exports [2]	7,728	3,024	8,904	2,856	7,224	11,424	5,292	6,090	6,804	2,940	2,772	6,636	71,694
Increase in all stocks	2,310	11,802	26,712	30,198	16,884	20,412	24,528	4,956					53,886
Losses	13,608	16,968	5,796	15,834	20,202	22,974	29,652	33,684	32,592	20,244	20,874	27,300	259,728
	179,382	175,518	188,538	185,388	192,654	184,842	196,728	196,560	225,540	231,672	222,936	224,616	2,320,458

[1] Includes quantities run through pipe lines.
[2] Figures compiled by the Bureau of Foreign and Domestic Commerce.
[3] Subject to revision.

Natural gasoline utilized at refineries in the United States, 1939–40, by districts and months, in thousands of gallons

District	January	February	March	April	May	June	July	August	September	October	November	December	Total
1939													
East Coast	7,182	5,964	5,712	5,124	5,460	6,132	8,484	7,392	8,442	9,240	11,172	9,576	89,880
Appalachian	966	756	1,596	756	588	756	714	672	1,008	1,386	1,512	1,764	12,474
Indiana, Illinois, Kentucky, etc.	15,498	12,474	13,020	11,298	15,246	13,734	14,910	12,306	18,774	21,966	21,630	18,816	189,672
Oklahoma, Kansas, and Missouri	19,236	16,170	15,876	14,154	15,414	15,288	15,330	17,388	16,926	22,932	22,218	23,772	214,704
Texas:													
Gulf Coast	15,876	11,844	8,610	20,748	12,600	9,870	12,516	18,312	20,370	36,918	30,702	28,476	226,842
Inland	24,990	21,168	20,454	17,514	18,774	17,556	18,396	17,724	13,902	33,264	29,148	27,048	259,938
Total, Texas	40,866	33,012	29,064	38,262	31,374	27,426	30,912	36,036	34,272	70,182	59,850	55,524	486,780
Louisiana-Arkansas:													
Louisiana Gulf Coast	1,596	798	882	1,260	966	1,386	1,386	1,218	1,302	1,218	1,092	756	13,860
Arkansas and Louisiana Inland	1,386	1,638	1,764	1,344	1,302	1,596	2,058	1,638	1,806	2,856	2,646	2,352	22,386
Total, Louisiana-Arkansas	2,982	2,436	2,646	2,604	2,268	2,982	3,444	2,856	3,108	4,074	3,738	3,108	36,246
Rocky Mountain	3,234	2,646	2,982	2,184	1,260	1,134	1,008	1,596	2,100	3,444	4,326	3,948	29,862
California	55,440	54,348	57,120	44,268	39,522	45,192	47,376	51,618	51,324	49,812	55,566	52,248	603,834
Total, United States	145,404	127,806	128,016	118,650	111,132	112,644	122,178	129,864	135,954	183,036	180,012	168,756	1,663,452
1940 [1]													
East Coast	6,762	3,066	3,192	3,444	5,082	4,830	3,780	3,486	6,552	8,484	8,442	8,988	66,108
Appalachian	1,428	1,512	1,596	1,176	840	1,008	1,344	1,050	1,470	1,512	1,638	1,554	16,128
Indiana, Illinois, Kentucky, etc.	17,220	18,858	17,892	15,876	17,010	16,212	17,472	19,614	22,260	26,292	26,628	23,436	238,770
Oklahoma, Kansas, and Missouri	21,000	17,472	17,094	16,506	16,296	14,868	15,414	18,060	20,748	21,840	20,538	20,160	219,996
Texas:													
Gulf Coast	18,732	17,094	17,934	16,254	27,972	17,220	17,136	22,092	29,190	25,536	34,020	23,520	266,700
Inland	25,116	24,780	23,394	21,966	21,378	17,136	18,228	21,126	27,048	29,484	23,646	26,040	279,342
Total, Texas	43,848	41,874	41,328	38,220	49,350	34,356	35,364	43,218	56,238	55,020	57,666	49,560	546,042
Louisiana-Arkansas:													
Louisiana Gulf Coast	714	462	756	924	630	588	672	630	1,344	2,478	1,008	1,470	11,676
Arkansas and Louisiana Inland	1,512	1,470	1,470	882	1,134	966	756	966	1,008	1,428	1,470	2,100	15,162
Total, Louisiana-Arkansas	2,226	1,932	2,226	1,806	1,764	1,554	1,428	1,596	2,352	3,906	2,478	3,570	26,838
Rocky Mountain	3,444	3,150	3,318	1,974	924	1,512	1,554	1,638	2,226	3,192	4,074	3,738	30,744
California	42,042	40,950	38,766	37,884	37,884	34,860	38,892	40,740	45,402	54,306	47,628	47,880	507,234
Total, United States	137,970	128,814	125,412	116,886	129,150	109,200	115,248	129,402	157,248	174,552	169,092	158,886	1,651,860

[1] Subject to revision.

Shipments of natural gasoline to jobbers, retailers, and refinery-owned bulk plants in the United States in 1940, by States, in thousands of gallons [1]

State from which natural gasoline was transported	State to which natural gasoline was transported							Total
	Texas	Illinois	Minnesota	Arkansas	Oklahoma	Iowa	Other States	
Texas	113,015	12,646	16,382		137	10,333	16,927	169,440
Oklahoma	770	9,602	4,424		13,661	369	6,644	35,470
Arkansas			16	17,008			1,267	18,291
Louisiana	1,222	656	1,879	897	895	2,462	9,648	17,659
West Virginia							16,863	16,863
Ohio							6,964	6,964
Other States		1,671	1,495		1,589	429	13,419	18,603
	115,007	24,575	24,196	17,905	16,282	13,593	71,732	283,290

[1] Subject to revision.

STOCKS

The situation as regards natural-gasoline stocks was not as favorable in 1940 as in 1939; in place of a net withdrawal of 17,178,000 gallons in 1939 there was a net increase of 53,886,000 gallons. This reversal probably was related to the shift in refinery yields from gasoline to distillate fuel oil; in other words, the refiners did not need to buy as much natural gasoline in the fall for winter volatility. California refinery stocks again held the key to the general situation, and a substantial decline in 1939 was followed by almost as large a gain in 1940.

Stocks of natural gasoline in the United States, 1939–40, by months, in thousands of gallons

Date	At refineries				At plants and terminals				Total	
	California		Other States		Texas		Other States			
	1939	1940 [1]	1939	1940 [1]	1939	1940 [1]	1939	1940 [1]	1939	1940 [1]
Jan. 1	108,696	59,136	17,136	17,430	48,397	78,492	28,631	30,624	202,860	185,682
Jan. 31	102,942	64,638	16,044	17,262	46,306	78,954	29,882	27,138	195,174	187,992
Feb. 28	92,022	67,494	12,348	19,110	61,095	82,268	32,271	30,922	197,736	199,794
Mar. 31	83,958	74,172	17,262	20,874	58,597	93,347	38,465	38,113	198,282	226,506
Apr. 30	87,570	79,758	19,572	32,928	72,316	97,587	50,870	46,431	230,328	256,704
May 31	96,852	87,864	22,260	33,054	81,413	97,355	60,379	55,315	260,904	273,588
June 30	95,298	95,928	24,234	37,758	97,068	104,167	66,858	56,147	283,458	294,000
July 31	93,156	106,974	26,082	43,386	110,681	116,340	69,247	51,828	299,166	318,528
Aug. 31	88,200	111,930	26,712	40,614	106,680	122,601	56,616	48,339	278,208	323,484
Sept. 30	81,270	110,670	26,040	33,810	96,022	110,924	44,090	40,192	247,422	295,596
Oct. 31	73,416	104,790	22,932	32,298	82,896	103,273	36,636	35,537	215,880	275,898
Nov. 30	64,512	102,522	22,680	24,276	72,800	95,125	32,326	34,361	192,318	256,284
Dec. 31	59,136	99,624	17,430	19,614	78,492	86,045	30,624	34,285	185,682	239,568

[1] Subject to revision.

TECHNICAL DEVELOPMENTS

Recycling plants.—Rapid expansion of recycling-plant operations in Texas continued in 1940. Reports of the Texas Railroad Commission indicate that the number of active plants increased from 21 to 32 and that the volume of gas processed in December 1940 was 1,235 million cubic feet a day—almost three times the December (1939) average. Producing wells connected to plants numbered 243 at the end of 1940 contrasted with 86 a year earlier.

The daily output of liquid products was 22,357 barrels in December 1940 compared with 6,487 in December 1939. The tendency is to install fractionating equipment to make a higher percentage of finished products; thus in December 1940 about half of the output was gasoline.

There are several recycling projects in other States, either contemplated or active, but complete information is not available.

Natural gasoline produced in the United States in 1939 by States and by methods of manufacture [1]

State	Number of plants operating			Production (thousands of gallons)		
	Compression [2]	Absorption [3]	Charcoal	Compression [2]	Absorption [3]	Charcoal
Arkansas	----------	8	----------	----------	24,634	----------
California	3	92	----------	12,011	595,226	----------
Colorado	1	1	----------	166	224	----------
Illinois	52	2	----------	2,024	1,988	----------
Kansas	5	14	----------	2,582	59,593	----------
Kentucky	3	3	1	5	7,155	625
Louisiana	3	24	----------	2,653	91,437	----------
Michigan	----------	1	----------	----------	2,971	----------
Montana	----------	1	----------	----------	2,161	----------
New Mexico	----------	6	----------	----------	54,707	----------
New York	1	----------	----------	34	----------	----------
Ohio	4	6	1	49	5,836	1,560
Oklahoma	31	91	----------	60,362	375,761	----------
Pennsylvania	71	11	1	2,316	9,268	172
Texas	40	123	----------	161,168	608,879	----------
West Virginia	52	19	6	14,038	34,620	3,614
Wyoming	3	4	----------	338	30,623	----------
Utah	----------	----------	----------	----------	[4] 500	----------
Total: 1939	269	406	9	257,746	1,905,583	5,971
1938	264	423	9	208,898	1,940,845	6,831

[1] Figures for 1940 not yet available.
[2] Includes recycling.
[3] Includes combination of absorption process with compression and charcoal processes.
[4] Drip gasoline.

Yield.—The average yield of natural gasoline declined from 1.06 gallons per thousand cubic feet of gas treated in 1938 to 1.01 gallons in 1939. There was probably a further small decrease in 1940 as recycling continued to expand; recovery by this process is well below that of the conventional plant.

The yield in Oklahoma rose to 1.98 gallons in 1939, but that in both Texas and California—the two leading producing States—decreased. Colorado again had the highest average yield (3.00 gallons in 1939), but the output is very small.

Production, by processes.—In 1940 the number of compression plants increased as the number of recycling plants added exceeded the number of old units dismantled. On the other hand, the number of absorption (and combination) plants decreased in 1939 for the first time since 1935. Production by processes followed the trend in number of plants, except that the output of charcoal plants dropped in 1939, even though the number stayed at 9.

Trends in vapor pressures.—The average vapor pressure, which had increased in 1939, fell to a new low of 19.3 pounds in 1940. The average for refinery shipments in 1940 was 20.2 pounds and for shipments to jobbers and retailers 13.8 pounds, both lower than in 1939.

Technical improvements.—Progress in the chemistry of the lighter hydrocarbons continued, particularly in relation to aviation gasoline.

Although the production of aviation gasoline is centered at refineries, increasing quantities of certain natural-gasoline fractions such as isopentane are being utilized. Considerable advance was noted in projects relating to the high-pressure characteristics of the lighter hydrocarbons.

NUMBER AND CAPACITY OF PLANTS

The concentration of natural-gasoline manufacture in fewer establishments, which has been under way for more than 10 years, lost some of its impetus in 1938 and 1939, as on January 1, 1940, there were 729 plants—only 12 fewer than on January 1, 1938. The number of plants in Oklahoma continued to decrease rapidly, but this was largely offset by a sizable gain in Texas and a smaller gain in Illinois, which had shown a steady decline until the oil boom of recent years.

Number and capacity of natural-gasoline and recycling plants as of January 1, 1940, by States, with biennial summary for January 1, 1928–38

State	Number of plants								Capacity per day, in thousands of gallons							
	Operating	Shut-down	Total	Absorption	Compression	Combination	Charcoal	Recycling	Operating	Shut-down	Total	Absorption	Compression	Combination	Charcoal	Recycling
Ark.	7	2	9	5	----	4	----	----	68	7	75	25	------	50	----	----
Calif.[1]	88	15	103	101	2	----	----	----	2,948	219	3,167	3,126	41	------	----	----
Colo.	2	----	2	1	1	----	----	----	7	----	7	6	1	------	----	----
Ill.	52	1	53	2	51	----	----	----	54	(2)	54	36	18	------	----	----
Kans.	16	1	17	13	4	----	----	----	294	15	309	297	12	------	----	----
Ky.	7	----	7	3	3	----	1	----	45	----	45	42	(2)	------	3	----
La.	26	----	26	21	3	2	----	----	524	----	524	499	11	14	----	----
Mich.	1	----	1	----	----	1	----	----	12	----	12	------	------	12	----	----
Mont.	1	----	1	1	----	----	----	----	16	----	16	16	------	------	----	----
N. Mex.	6	----	6	6	----	----	----	----	188	----	188	188	------	------	----	----
N. Y.	1	1	2	2	----	----	----	----	(2)	(2)	(2)	(2)	------	------	----	----
Ohio.	12	----	12	6	5	----	1	----	49	----	49	42	1	------	6	----
Okla.	115	4	119	71	31	17	----	----	2,161	75	2,236	1,624	169	443	----	----
Pa.	93	16	109	19	88	----	2	----	129	28	157	103	48	------	6	----
Texas	157	5	162	103	30	19	----	10	4,281	28	4,309	2,775	515	773	----	246
W. Va.	80	12	92	27	57	----	8	----	329	49	378	223	74	------	81	----
Wyo.	7	1	8	5	3	----	----	----	130	6	136	61	75	------	----	----
Total: 1940	671	58	729	386	278	43	12	10	11,235	427	11,662	9,063	965	1,292	96	246
1938	679	62	741	416	283	31	11	----	10,732	351	11,083	9,430	1,012	550	91	----
1936	694	99	793	430	333	18	12	----	9,043	620	9,663	8,064	1,244	276	79	----
1934	741	128	869	441	373	39	16	----	9,181	879	10,060	8,563	973	429	95	----
1932	859	100	959	476	398	68	17	----	10,657	730	11,387	9,135	1,185	945	122	----
1930	999	36	1,035	486	411	115	23	----	10,278	238	10,516	7,956	1,063	1,311	186	----
1928	1,060	95	1,155	526	497	105	27	----	7,754	294	8,048	5,476	1,398	960	214	----

[1] Data compiled by E. T. Knudsen, Los Angeles office, Bureau of Mines.
[2] 500 gallons or less.

The total daily capacity of the plants on January 1, 1940, was 11,662,000 gallons—the highest ever recorded. Part of the gain was due to the construction of recycling plants, which are classed as natural-gasoline plants. A much larger gain in capacity probably will be recorded in the next 2 years—1940 and 1941—as the construction of recycling plants has by no means reached a stalemate. The low prices of natural gasoline in 1940 probably were unfavorable to the smaller conventional establishments, so the number of such plants may continue to decline.

LIQUEFIED PETROLEUM GASES

The rapidly growing interest in liquefied petroleum gases, stimulated by their numerous uses as fuels, is evidenced in a 40-percent gain in sales in 1940, when deliveries increased to 313,456,000 gallons compared with 223,580,000 in 1939. The expansion of approximately 90 million gallons in sales during 1940 is remarkable, when it is observed that this increment nearly equals the total requirements in 1936 and that the volume of the marketed production of liquefied petroleum gases has about trebled in 4 years.

Sales of liquefied petroleum gases in the United States, 1934–40, in thousands of gallons

Year	Propane	Butane	Propane-butane mixtures	Pentane	Total
1934	18,681	25,553	10,271	1,922	56,427
1935	26,814	34,084	13,493	2,464	76,855
1936	36,502	40,200	27,375	2,575	106,652
1937	46,474	45,399	46,694	2,833	141,400
1938	54,130	52,768	56,050	2,253	165,201
1939	79,323	71,351	69,020	3,886	223,580
1940 [1]	109,216	77,056	123,348	3,836	313,456

[1] Subject to revision.

All principal uses of liquefied petroleum gases made important gains in 1940 compared with requirements in 1939. Sales for domestic consumption or in the "bottled-gas" trade increased 53 percent, while gas-manufacturing companies purchased 31 percent more liquefied petroleum gases in 1940 than in 1939 for mixture with their manufactured gas and for direct distribution through their lines to consumers. Deliveries of liquefied petroleum gases for consumption as industrial fuel, which made an outstanding gain of 59 percent in 1939 in contrast to a loss in 1938, increased only 12 percent in 1940 over 1939—the lowest rate of expansion for the several principal uses. Manufacturers of chemicals, who bought smaller quantities of liquefied petroleum gases in 1939 than in 1938 (due partly to overstocking in the latter year) purchased 29 percent more of these gases in 1940 than in the preceding year. The rapidly increasing use of liquefied petroleum gases as fuel for internal-combustion engines is indicated by the 81-percent gain in sales for this purpose in 1940 compared with 1939.

Exports of liquefied petroleum gases, as reported by the producers, totaled 1,616,000 gallons in 1940—a 3-percent gain over the 1939 quantity of 1,570,000 gallons.

Sales of liquefied petroleum gases in recent years have, broadly speaking, comprised nearly equal proportions of propane, butane, and propane-butane mixtures plus an unimportant percentage of pentane. Deliveries reported in 1940 show a deviation from former annual surveys in that, although there was little change in the propane share (about 35 percent of total sales in both 1939 and 1940), the relative percentages of butane and propane-butane mixtures in the total have changed noticeably. Butane declined from 31.9 percent of the total sales in 1939 to 24.6 percent in 1940, while propane-butane mixtures gained correspondingly from 30.9 percent in 1939 to 39.4 percent in 1940. It is believed that this shift in the percentages of butane and propane-butane mixtures in total deliveries probably is due to the fact that distributors were asked to follow specifications for liquefied petroleum gases adopted by the Natural Gasoline Association of America, effective September 1, 1940, in reporting 1940 sales, while for preceding years no agreed-upon or exact specifications were used to separate the several gases covered in the survey. The fact that, under the newly adopted specifications, the proportion of propane in the 1940 total remained virtually the same as in recent years and that conversely there was quite a change in the relative percentages of the butane and propane-butane mixtures reported is not surprising, as previously nearly all producers and distributors of liquefied petroleum gases agreed fairly well as to the specifications for propane but were at some variance as to the dividing line between butane and propane-butane mixtures.

Deliveries of propane increased from 79,323,000 gallons in 1939 to 109,216,000 in 1940 or by 38 percent compared to a 47-percent gain in 1939 over 1938. Sales of butane under the newly adopted specifications mentioned in the paragraph above showed an 8-percent expansion from 71,351,000 gallons in 1939 to 77,056,000 in 1940, while the demand for propane-butane mixtures rose from 69,020,000 gallons in 1939 to 123,348,000 in 1940 or by 79 percent. Until comparative statistics become available under the new specifications a better idea of the increase in the demand for butane and propane-butane mixtures can be obtained by grouping them; then it is found that the total sales for these two items increased from 140,371,000 gallons in 1939 to 200,404,000 in 1940—a gain of 43 percent. The pentane marketed in 1940—3,836,000 gallons—was slightly below the 1939 quantity—3,886,000 gallons.

The proportion of total liquefied-petroleum-gas sales reported for domestic consumption continued its strong upward trend from 35 percent of deliveries for all purposes in 1938 to 39 percent in 1939 and to about 43 percent of the marketed production in 1940. Gas-manufacturing companies use more liquefied petroleum gases each year, but their proportionate share of the total demand has decreased from 6.8 percent for 1938 and 6.9 for 1939 to 6.5 percent in 1940. Industrial requirements for liquefied petroleum gases in 1940 failed to show a large gain, as did the other principal uses; furthermore, sales reported in this classification slumped from 27.9 percent of the total in 1939 to 22.3 percent in 1940. The chemical use of liquefied petroleum gases increased in 1940 compared with 1939; however, the percentage of this trade dropped from 12 percent of the total market in 1939 to 11.1 percent in 1940. The consumption of liquefied petroleum gases as fuel for internal-combustion engines is rapidly becoming important, as evidenced by deliveries for this purpose, which increased from approximately 13.3 percent of the total sales in 1938 and 1939 to 17.2 percent in 1940.

Sales of liquefied petroleum gases in the United States, 1939–40, by uses, methods of transportation, and regional distribution, in thousands of gallons

	Propane	Butane	Propane-butane mixtures	Pentane	Total	Percent
1939						
By uses:						
Domestic	52,533	17,881	16,093	1,023	87,530	39.2
Gas manufacturing	2,083	9,796	3,483	73	15,435	6.9
Industrial fuel	23,685	36,388	2,155	112	62,340	27.9
Chemical manufacturing	249	42	23,957	2,644	26,892	12.0
Internal-combustion-engine fuel	663	5,850	23,279	----------	29,792	13.3
All other uses	110	1,394	53	34	1,591	.7
	79,323	71,351	69,020	3,886	223,580	100.0
Percent of total	35.5	31.9	30.9	1.7	100.0	----------
By methods of transportation:						
Bulk	36,218	69,453	61,695	3,447	170,813	76.4
Cylinders	43,105	1,898	7,325	439	52,767	23.6
	79,323	71,351	69,020	3,886	223,580	100.0
Regional distribution:						
Pacific Coast area	7,891	12,916	27,690	----------	48,497	21.7
All other areas	71,432	58,435	41,330	3,886	175,083	78.3
	79,323	71,351	69,020	3,886	223,580	100.0
1940 [1]						
By uses:						
Domestic	68,927	21,302	43,133	656	134,018	42.7
Gas manufacturing	5,201	10,847	4,191	46	20,285	6.5
Industrial fuel	33,122	33,166	3,508	96	69,892	22.3
Chemical manufacturing	987	10	30,636	3,038	34,671	11.1
Internal-combustion-engine fuel	915	11,242	41,761	----------	53,918	17.2
All other uses	64	489	119	----------	672	.2
	109,216	77,056	123,348	3,836	313,456	100.0
Percent of total	34.8	24.6	39.4	1.2	100.0	----------
By methods of transportation:						
Bulk	55,218	74,828	111,543	3,588	245,177	78.2
Cylinders and drums	53,998	2,228	11,805	248	68,279	21.8
	109,216	77,056	123,348	3,836	313,456	100.0
Regional distribution:						
Pacific Coast area	9,088	18,675	44,834	----------	72,597	23.2
All other areas	100,128	58,381	78,514	3,836	240,859	76.8
	109,216	77,056	123,348	3,836	313,456	100.0

[1] Subject to revision.

Deliveries of propane increased from 79,323,000 gallons in 1939 to 109,216,000 in 1940. Propane is in greatest demand as a domestic fuel, and the quantity sold for household use was reported as 68,927,000 gallons in 1940—31 percent above the 1939 total of 52,533,000 gallons. Although the domestic consumption of propane is expanding rapidly, the proportionate share of propane sales credited to this particular use has fallen from 69 percent of the total in 1938 to 66 percent in 1939 and to 63 percent in 1940. Propane is gaining in importance as an industrial fuel; deliveries for this purpose increased to 33,122,000 gallons in 1940—a quantity 40 percent over the 1939 total of 23,685,000 gallons. Incidentally, the industrial consumption of propane represented 30 percent of all deliveries in both 1939 and 1940. Additional uses for propane are now of minor importance; however, it should be mentioned that purchases of propane by gas manufacturers increased from 2,083,000 gallons in 1939 to 5,201,000 in 1940—an outstanding gain for this trade.

As sales of butane reported under the new specifications showed only an 8-percent increase to 77,056,000 gallons in 1940 compared with a demand of 71,351,000 gallons in 1939 and deliveries of propane-butane mixtures expanded disproportionately from 69,020,000 gallons in 1939 to 123,348,000 in 1940—a 79-percent gain—the 1939 and 1940 quantities are not considered comparable; therefore, no comments will be attempted until a second year's distribution of sales under the present specifications becomes available.

The demand for pentane declined slightly from 3,886,000 gallons in 1939 to 3,836,000 in 1940. The chemical-manufacturing industry absorbs the larger share of the marketed pentane, and sales reported in that trade increased from 2,644,000 gallons in 1939 to 3,038,000 in 1940. Some pentane is used for domestic fuel; however, the quantity fell sharply from 1,023,000 gallons in 1939 to 656,000 in 1940.

The American Gas Association cooperates each year in furnishing the Bureau with statistics pertaining to the distribution of liquefied petroleum gases by manufactured-gas companies. Details for 1940 are as follows:

At the end of 1940, liquefied petroleum gas was being delivered through mains to consumers in 168 communities in 31 States by 87 companies supplying 57,900 customers.

Butane-air gas with heating value ranging from 520 to 1,300 B. t. u. per cubic foot was supplied to 136 communities in 30 States by 69 companies. A mixture of undiluted butane and propane gas, with a heating value of 2,800 to 3,000 B. t. u. per cubic foot, was supplied to 15 communities in Arizona, California, and Nevada by 6 companies. Undiluted propane gas, with a heating value of 2,550 B. t. u. per cubic foot, was supplied to 18 communities in Maryland, New Jersey, North Dakota, Virginia, and Wisconsin by 5 companies.

The larger proportion of liquefied petroleum gases is handled in bulk or in tank cars and tank trucks, and quantities transported in this way increased from 170,813,000 gallons in 1939 to 245,177,000 in 1940, or from 76.4 percent of total sales in 1939 to 78.2 percent in 1940. Cylinder-and-drum shipments of 52,767,000 gallons in 1939 and 68,279,000 in 1940 constituted, respectively, 23.6 percent of all sales in 1939 and 21.8 percent in 1940. The decrease in the proportionate amount of liquefied petroleum gases conveyed in cylinders is the first decline in percentage reported since 1937. Virtually all petroleum gases handled in cylinders are intended for domestic consumption; this demand absorbed 97 percent of all package shipments in 1940 compared with about 96 percent in 1939.

CARBON BLACK

By G. R. Hopkins and H. Backus

SUMMARY OUTLINE

Carbon-black production established a new record in 1940; but domestic sales declined slightly, and because of the war, exports were off 13 percent from the 1939 peak. The gain in output and the loss

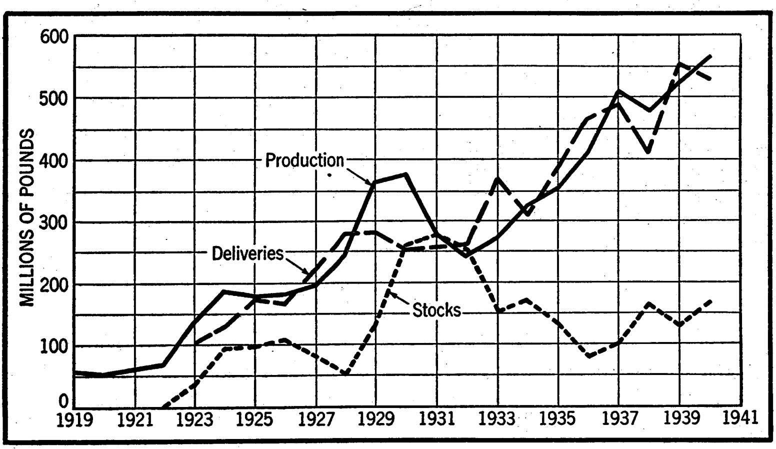

FIGURE 1.—Production, stocks, and deliveries of carbon black, 1919–40.

in sales terminated withdrawals from producers' stocks; in consequence, total stocks at the end of the year had risen to slightly above the total on hand January 1, 1939 (see fig. 1). In spite of this weakening in the market statistics prices were advanced on April 1 and on July 1 and held both gains to the end of the year.

Nearly 90 percent of the domestic sales of carbon black are used in the manufacture of rubber, an important defense commodity included in the Army and Navy Munitions Board list of strategic materials. Considerable carbon black is also being used in connection with the defense program to reduce glare on airport runways. Doubtless other special uses are being developed; hence, the expected loss in exports in 1941 may be balanced by increased domestic sales.

Salient statistics of carbon black produced from natural gas in the United States, 1936–40

	1936	1937	1938	1939	1940
Number of producers reporting	20	24	24	22	22
Number of plants	54	57	55	49	51
Quantity produced:					
By States and districts:					
Louisiana ..... pounds	59, 201, 000	66, 381, 000	39, 534, 000	51, 734, 000	55, 610, 000
Texas:					
Panhandle district ..... do	321, 576, 000	405, 247, 000	382, 369, 000	410, 130, 000	423, 908, 000
Rest of State ..... do	12, 330, 000	15, 821, 000	34, 735, 000	43, 044, 000	55, 987, 000
Total Texas ..... do	333, 906, 000	421, 068, 000	417, 104, 000	453, 174, 000	479, 895, 000
Other States ..... do	18, 238, 000	23, 157, 000	20, 401, 000	20, 258, 000	33, 287, 000
Total United States ..... do	411, 345, 000	510, 606, 000	477, 039, 000	525, 166, 000	568, 792, 000
By processes:					
Channel process ..... do	366, 876, 000	444, 427, 000	441, 284, 000	464, 588, 000	491, 765, 000
Other processes [1] ..... do	44, 469, 000	66, 179, 000	35, 755, 000	60, 578, 000	77, 027, 000
Stocks held by producers Dec. 31 ..... do	79, 582, 000	100, 497, 000	166, 159, 000	130, 792, 000	169, 587, 000
Losses ..... do	113, 000	76, 000	[2] 65, 000	.....	223, 000
Quantity sold:					
Domestic deliveries:					
To rubber companies ..... do	278, 018, 000	269, 584, 000	217, 231, 000	316, 621, 000	310, 179, 000
To ink companies ..... do	17, 787, 000	18, 116, 000	14, 131, 000	21, 929, 000	24, 159, 000
To paint companies ..... do	6, 914, 000	6, 159, 000	4, 229, 000	6, 382, 000	6, 806, 000
For miscellaneous purposes ..... do	10, 299, 000	11, 503, 000	7, 883, 000	11, 773, 000	11, 012, 000
Total domestic sold ..... do	313, 018, 000	305, 362, 000	243, 474, 000	356, 705, 000	352, 156, 000
Export ..... do	154, 718, 000	184, 253, 000	167, 968, 000	203, 828, 000	177, 618, 000
Total sold ..... do	467, 736, 000	489, 615, 000	411, 442, 000	560, 533, 000	529, 774, 000
Value (at plants) of carbon black produced:					
Total	$16, 110, 000	$17, 389, 000	$11, 486, 000	$12, 857, 000	$16, 510, 000
Average per pound ..... cents	3. 92	3. 41	2. 41	2. 45	2. 90
Estimated quantity of natural gas used M cubic feet	283, 421, 000	341, 085, 000	324, 950, 000	347, 270, 000	368, 802, 000
Average yield of carbon black per M cubic feet ..... pounds	1. 45	1. 50	1. 47	1. 51	1. 54
Average value of natural gas used per M cubic feet ..... cents	1. 30	1. 26	. 89	. 94	1. 00

[1] Lewis, roller, "special," and thermatomic.
[2] Gain.

PRODUCTION

By States.—Production in Texas during 1940 reached a new peak of 479,895,000 pounds, which is 6 percent higher than in 1939. Although this is equivalent to 84 percent of the national total, the share contributed by Texas actually declined because of larger gains in other States. The come-back in Louisiana was continued, and the State produced 55,610,000 pounds in 1940 compared with 51,734,000 pounds in 1939. One more plant was added in both Kansas and Oklahoma in 1940, and the output of the two States combined increased from 20,258,000 pounds in 1939 to 33,287,000 in 1940.

By months.—Production apparently was influenced by the loss in exports, as the highest daily average (obtained by prorating the Bureau's annual total upon the basis of monthly figures of the National Gas Products Association) was for March and the lowest for November.

Carbon black produced from natural gas in the United States in 1940, by States and by major producing districts

State and district	Producers reporting [1]	Number of plants	Production: Pounds	Production: Value at plant: Total	Production: Value at plant: Average cents	Natural gas used: M cubic feet	Natural gas used: Average yield per M cubic feet (pounds)	Natural gas used: Value: Total	Natural gas used: Value: Average per M cubic feet (cents)
Kansas	2	2	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Louisiana: Monroe-Richland district (Morehouse and Ouachita Parishes)	6	7	55,610,000	2,016,000	3.63	22,599,000	2.46	706,000	3.12
Oklahoma	4	4	[2]33,287,000	1,001,000	3.01	15,520,000	2.14	249,000	1.60
Texas:									
Panhandle district (Carson, Gray, Hutchinson, Moore, and Wheeler Counties)	18	31	423,908,000	11,917,000	2.81	296,976,000	1.43	2,534,000	.85
Rest of State (Nueces, Stephens, Ward, and Winkler Counties)	5	7	55,987,000	1,576,000	2.81	33,707,000	1.66	213,000	.63
Total, Texas	[1] 18	38	479,895,000	13,493,000	2.81	330,683,000	1.45	2,747,000	.83
Total United States	[1] 22	51	568,792,000	16,510,000	2.90	368,802,000	1.54	3,702,000	1.00

[1] In counting the total number of producers a producer operating in more than 1 State, district, or county is counted only once.
[2] Kansas included with Oklahoma.

Carbon black produced from natural gas in the United States in 1940, by months, in pounds

Month	National Gas Products Association	Bureau of Mines [1]: Total	Bureau of Mines [1]: Daily average	Month	National Gas Products Association	Bureau of Mines [1]: Total	Bureau of Mines [1]: Daily average
January	42,289,972	48,632,000	1,569,000	August	41,046,076	47,210,000	1,523,000
February	40,248,446	46,300,000	1,597,000	September	40,187,521	46,243,000	1,541,000
March	43,602,775	50,167,000	1,618,000	October	42,431,328	48,802,000	1,574,000
April	41,241,617	47,437,000	1,581,000	November	38,103,447	43,854,000	1,462,000
May	41,956,117	48,290,000	1,558,000	December	40,908,827	47,039,000	1,517,000
June	40,933,687	47,096,000	1,570,000				
July	41,503,190	47,722,000	1,539,000		494,453,003	568,792,000	1,554,000

[1] Monthly figures obtained by allocating the Bureau's annual total proportionately to the association's monthly data.

Methods and yields.—The channel process is still the most widely used method of producing carbon black, but in 1940 the output of the other processes—Lewis, roller, "Special," and thermatomic—achieved the larger relative gain. Comparison of the Bureau's channel figures with those of the National Gas Products Association (which are for contact black) indicates that the gain in other processes was made by the so-called furnace or high-yield blacks. This contention is supported by the average yield figure, which increased from 1.51 pounds a thousand cubic feet in 1939 to a new peak of 1.54 pounds in 1940.

Number and capacity of plants.—Only 2 new plants were added to the number operated in 1939; 3 were dismantled or shut down, making a total number of 48 operating at the end of the year.

The total capacity of the plants recovered the loss of 1939 and amounted to 1,735,865 pounds daily compared with 1,713,865 for 1939 and 1,735,855 for 1938. The addition of one plant in both Kansas and Oklahoma caused a small increase in the combined capacity of those two States, but most of the gain was in Texas outside of the Panhandle. The operating ratio, or the ratio of daily average production to average capacity, increased from 84 percent in 1939 to 90 percent in 1940.

Number and daily capacity of carbon-black plants operated in the United States, 1939–40, by counties or parishes

State	County or parish	Number of plants		Total daily capacity (pounds)	
		1939	1940	1939	1940
Kansas	Grant	1	2	(1)	(1)
Louisiana	Morehouse	1	1	12,000	6,000
	Ouachita	6	6	168,995	168,995
		7	7	180,995	174,995
Oklahoma	Beckham	1	1	[1] 91,750	[1] 93,750
	Pontotoc		1		
	Seminole	1	1		
	Texas	1	1		
		3	4	[1] 91,750	[1] 93,750
Texas	Carson	[2] 1	[2] 1	411,500	411,500
	Moore	6	6		
	Wheeler	2	2		
	Gray	8	8	311,150	311,150
	Hutchinson	[2] 14	[2] 14	[2] 567,670	[2] 574,670
	Nueces	1	1	150,800	169,800
	Stephens	4	4		
	Ward	1	1		
	Winkler	1	1		
		38	38	1,441,120	1,467,120
United States		49	51	1,713,865	1,735,865

[1] Kansas included with Oklahoma.
[2] 1 plant, in both Carson and Hutchinson Counties, counted in Hutchinson County.

Producers.—Changes in the list of carbon-black producers in 1940 are as follows: The Cabot Co. discontinued operations, and its plant at Skellytown, Tex., was purchased by the Cabot Carbon Co.; the Columbian Carbon Co. shut down its plant at Magic City, Tex.; the Charles Eneu Johnson & Co. began operations at a plant (channel) near Stonewall, Pontotoc County, Okla.; and the United Carbon Co. began operations at a plant (roller) near Ryus, Grant County, Kans., and dismantled plants at Phillips, La., and Borger, Tex.

The latest complete list of producers and plants (as of December 31, 1937) was published in Minerals Yearbook, 1938, page 967. Changes in 1938 and 1939 were published on page 1073 of Minerals Yearbook, 1939 and page 1099 of the 1940 volume, respectively.

DEMAND

Total deliveries.—Domestic sales in 1940 were only slightly below the total for 1939—352,156,000 pounds in 1940 compared with 356,705,000 in 1939—but exports declined 13 percent, so total sales of 529,774,000 pounds represented a decrease of 5 percent compared with the preceding year (see fig. 2).

Domestic consumption.—Domestic sales of 352,156,000 pounds in 1940 were only 1 percent below the record of 1939. Reports from producers indicate the division of domestic sales as follows: Rubber companies, 310,179,000 pounds (88 percent); ink companies, 24,159,000 pounds (7 percent); paint companies, 6,806,000 pounds (2 percent); and miscellaneous purposes, 11,012,000 pounds (3 percent). These data indicate chiefly a slight loss in the relative importance of sales to rubber companies in favor of ink.

According to E. G. Holt, of the Bureau of Foreign and Domestic Commerce, who has again supplied the data on rubber consumption, the apparent world consumption of crude rubber was 1,054,800 long tons compared with the revised figure of 1,099,400 long tons in 1939. As this was a decrease and rubber consumption was substantially higher in the United States it follows that the war is strengthening the relative position of this country as a rubber manufacturer.

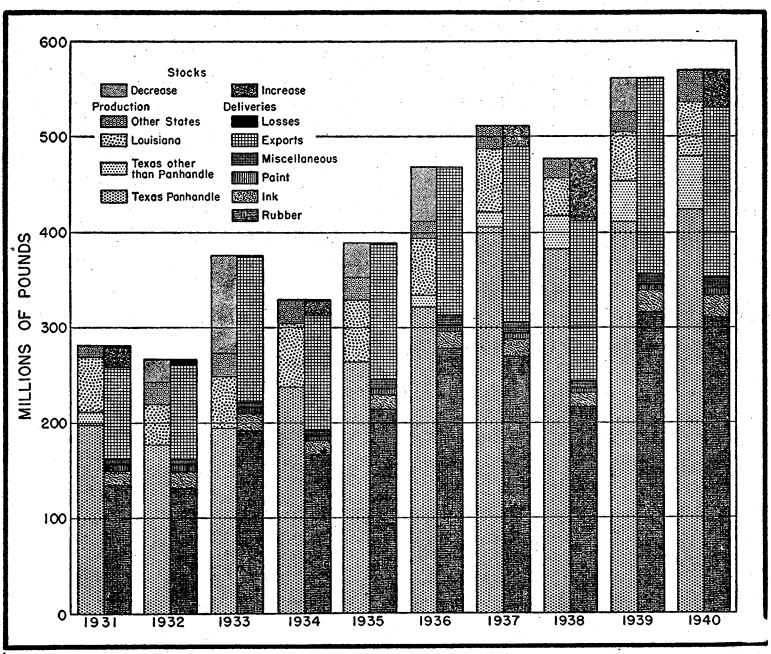

FIGURE 2.—Production and consumption of carbon black, 1931–40. Production in "Texas other than Panhandle" included in "Other States," 1932–35.

The consumption of rubber in the United States reached the record-breaking total of 842,700 long tons or 10 percent above that in 1939. Of the 1940 total, 648,500 tons were crude rubber, 190,200 tons reclaimed rubber, and 4,000 tons synthetic rubber. All amounts but that for reclaimed rubber were new peaks. According to statistics of the Rubber Manufacturers Association 59,186,000 casings were produced in 1940 compared with 57,613,000 in 1939. (The official figure of the Bureau of the Census for 1939 is 57,344,645.) Stocks of casings held by manufacturers increased from 8,665,000 on January 1, 1940, to 9,127,000 on December 31. Returns from the Federal excise tax on tires and tubes indicate that the total weight of the two products was 9.5 percent higher in 1940 than in 1939. These data indicate that the average casing was at least 5 percent heavier in 1940 than in 1939. As more casings were made in 1940 it appears that the average use of carbon black per pound of rubber must have declined appreciably. The production of camelpack for retreads, a product with a relatively high carbon-black content, reached 54,223,000 pounds in 1939, but only a small gain in 1940 is indicated.

The apparent consumption of newsprint continued to gain as, according to B. M. Frost, of the Bureau of Foreign and Domestic Commerce, the supply of newsprint available for consumption increased 5 percent in 1940 or from 3,556,000 short tons in 1939 to 3,732,000 in 1940. These data substantiate the gain in sales of carbon black to ink companies from 21,929,000 pounds in 1939 to 24,159,000 in 1940. The latter is the highest since the boom years 1928 and 1929.

Sales of carbon black to paint companies increased from 6,382,000 pounds in 1939 to 6,806,000 in 1940. This gain roughly checks the rise in value of paint sales as compiled by the Bureau of the Census, although this value covers many varieties of paint besides black paint.

Sales of carbon black for miscellaneous purposes almost held its own in 1940, when the total was 11,012,000 pounds compared with 11,773,000 in 1939. No data are available on the break-down of this item by uses.

Exports and imports.[1]—Exports of carbon black receded from the 1939 peak and totaled 177,618,000 pounds in 1940 compared with 203,828,000 in 1939. If it had not been for the war the total might have increased, as the decline was less than the loss in shipments to Europe.

Exports were valued at $7,823,820 in 1940, an average of 4.40 cents a pound compared with 4.36 cents in 1939.

Carbon black exported from the United States, 1938–40, by countries

Country	1938		1939		1940	
	Pounds	Value	Pounds	Value	Pounds	Value
Argentina	3,203,142	$151,669	4,234,248	$200,463	3,005,361	$150,558
Australia	6,952,545	324,118	9,665,979	443,192	7,264,539	327,434
Belgium	5,459,202	250,475	4,656,082	212,169	1,251,212	66,172
Brazil	744,938	35,935	1,871,434	86,351	2,181,849	99,911
Canada	13,867,345	372,752	17,933,916	486,363	19,622,401	592,885
China	673,498	32,230	1,476,897	70,344	1,860,072	90,133
Czechoslovakia [1]	1,834,572	84,395	276,500	11,425		
France	26,216,610	1,219,450	29,390,562	1,335,998	24,397,155	1,122,773
Germany [1]	23,646,635	1,076,568	19,660,805	857,907		
India, British	949,455	44,340	2,703,106	123,530	3,825,436	182,939
Italy	9,764,699	440,881	8,260,281	375,258	4,547,708	204,375
Japan	9,172,849	443,483	10,617,734	482,538	17,662,686	785,760
Mexico	1,396,870	44,444	1,750,366	55,466	1,826,648	67,187
Netherland India	1,235,515	57,142	1,422,234	63,700	1,463,111	78,327
Netherlands	3,643,185	174,052	3,034,415	145,927	1,114,599	57,919
Norway	560,789	28,088	614,977	30,086	538,454	24,138
Poland and Danzig [1]	3,166,867	151,361	2,368,187	109,336		
Portugal	92,232	5,032	330,589	14,883	1,645,097	74,474
Spain	1,332,229	59,357	2,644,577	117,075	483,770	22,243
Sweden	2,714,415	130,083	4,425,409	213,870	1,281,550	59,882
Union of South Africa	1,792,986	75,375	4,322,092	188,958	4,025,531	182,900
United Kingdom	44,429,105	2,104,878	66,214,827	2,975,028	77,308,549	3,503,191
Other countries	5,118,633	273,775	5,952,600	288,799	2,312,139	130,619
	167,968,316	7,579,883	203,827,817	8,888,666	177,617,867	7,823,820

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

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

The only gains of importance in 1940 were in exports to the United Kingdom and Japan. The United Kingdom and other parts of the British Empire took 63 percent of total exports in 1940.

The heaviest exports of 1940 were during the first quarter; after that they decreased as Belgium, France, and other countries were invaded. Nearly two-thirds of the exports in 1940 were shipped through Galveston; however, this ratio was somewhat lower than in 1939.

Imports of "gas black and carbon black" in 1940 were negligible. Imports of acetylene black (all from Canada) continued to increase; the total in 1940 was 3,235,273 pounds valued at $342,126.

Carbon black exported from the United States, 1939–40, by months and customs districts

Month	1939		1940		Customs district	1939		1940	
	Pounds	Value	Pounds	Value		Pounds	Value	Pounds	Value
Jan	14, 192, 588	$612, 887	20, 109, 979	$874, 658	Buffalo	62, 576	$8, 065	114, 458	$8, 444
Feb	19, 370, 600	847, 358	22, 885, 685	1,034,505	Dakota	397, 965	19, 110	140, 655	7, 801
Mar	19, 935, 052	874, 362	27, 026, 918	1,189,390	El Paso	1, 649, 717	48, 882	1, 682, 547	56, 855
Apr	21, 043, 569	935, 012	15, 023, 991	650, 748	Galveston	144,454,115	6, 426, 836	115,042,294	5, 251, 179
May	18, 682, 152	830, 584	8, 464, 702	381, 735	Los Angeles	1, 074, 945	40, 332	1, 471, 413	56, 923
June	14, 185, 130	620, 797	11, 862, 418	503, 178	Michigan	17, 338, 956	460, 020	19, 077, 140	568, 268
July	17, 371, 802	731, 516	19, 116, 627	811, 861	New Orleans	31, 928, 600	1, 592, 678	30, 692, 298	1, 462, 777
Aug	13, 505, 738	579, 460	8, 954, 840	394, 645	New York	303, 278	26, 888	4, 404, 540	217, 886
Sept	18, 831, 339	851, 138	10, 274, 304	452, 298	Sabine	2, 158, 650	89, 124	1, 807, 862	73, 104
Oct	17, 200, 319	737, 795	13, 579, 306	632, 906	San Francisco	3, 617, 832	137, 457	2, 773, 584	104, 893
Nov	14, 838, 550	641, 986	10, 707, 700	489, 704	Vermont	269, 240	7, 285	169, 335	6, 580
Dec	14, 670, 978	625, 771	9, 611, 397	408, 192	Other districts	571, 943	31, 989	241, 741	9, 110
	203,827,817	8,888,666	177,617,867	7,823,820		203,827,817	8 ,888 ,666	177,617,867	7, 823, 820

STOCKS

The situation as to stocks of carbon black at the plants reversed again during 1940; and in place of a decline, as in 1939, there was an increase from 130,792,000 pounds the first of the year to 169,587,000 at the close. This gain raised the total to about what it was at the end of 1938.

Stocks of carbon black in the form of finished rubber goods probably showed some increase as stocks of the most important item—casings—rose from 8,665,000 on January 1 to 9,127,000 on December 31.

PRICES AND VALUES

The average value at the plants rose from 2.45 cents a pound in 1939 to 2.90 cents in 1940. This represents a material improvement, although prices now are only about a third of what they were in the early twenties. The average value apparently conforms closely with the spot price of regular, uncompressed carbon black in bags, in carload lots, f. o. b. plants, the average of which was 2.88 cents a pound in 1940.

The Oil, Paint, and Drug Reporter—the source of the Bureau's spot prices for carbon black—discontinued reporting prices by Zones A to G and Grades 1 to 7, a series that had been established under the N. R. A. Code. The following table therefore gives the quoted prices for new grades, which appear representative. Because of the brisk demand in the first half of the year prices were generally increased about one-half cent—one-quarter cent on April 1 and the other quarter on July 1. Despite the decrease in exports in the latter half of the year prices remained firm and unchanged up to May 1, 1941.

Quoted prices on various grades of carbon black in carload lots in 1940, in cents a pound

[Oil, Paint, and Drug Reporter] [1]

Date	Regular, uncompressed, bags, f. o. b. plants	Beads, compressed, bags, f. o. b. plants	Bulk, cars	
			F. o. b. plants	F. o. b. N. Y. harbor
Jan. 1	2.55	2.425	2.30	3.18
Apr. 1	2.80	2.65	2.50	3.38
July 1	3.075	2.925	2.75	3.63
Average	2.88	2.73	2.58	3.46

[1] The Oil, Paint, and Drug Reporter ceased reporting prices by Zones A to G and Grades 1 to 7 early in 1940.

The table indicates in a general way the price differentials as a result of manufacturing the black in the form of pellets or beads and compressing before shipment. This type of black was priced at about 0.15 cent a pound less than the standard, uncompressed variety. The charge for packing in bags is apparently about the same, as the price for bulk, f. o. b. shipments was still lower by about 0.15 cent. The freight differential between the plants and New York harbor appears to be 0.88 cent a pound.

HELIUM

By R. A. Cattell and C. W. Seibel

SUMMARY OUTLINE

Operation of Amarillo plant.—During the fiscal year 1940 the Bureau of Mines helium plant near Amarillo, Tex., continued to operate at a fraction of its capacity and produced 9,450,855 cubic feet of helium; the cumulative output from April 1929 to June 30, 1940, was 99,992,000 cubic feet. During the first half of the fiscal year 1941, 6,822,000 additional cubic feet of helium were produced, making the total output at the Amarillo plant from April 1929 to December 31, 1940, 106,814,000 cubic feet of helium. As about 49 million cubic feet were produced at Fort Worth before the Amarillo plant was put in operation, the total Government output to the end of the calendar year 1940 was approximately 156 million cubic feet, or more than 90 percent of all helium that has been produced in the world.

Sales of residue natural gas, from which the helium was extracted, in the fiscal year 1940 totaled 468,059,000 cubic feet valued at $21,062. The cumulative sales of such gas for the 11-year period of operation of the Amarillo helium plant (to June 30, 1940) totaled 5,152,208,000 cubic feet, for which $266,980 was received.

Cliffside gas field.—In the fiscal year 1940, 547,674,000 cubic feet of helium-bearing natural gas were produced by the Bureau of Mines from the Government's Cliffside gas field to supply the Amarillo plant, giving a cumulative output of 5,983,889,000 cubic feet of natural gas from the field.

As the Government owns the gas mineral rights in the 50,000 acres covering the entire Cliffside geologic structure, it can operate the field according to approved engineering practice and produces the gas only when helium is required. Therefore, conservation is effected by retaining the gas in its natural underground reservoir until helium is needed to meet current demands.

The Government operates five producing gas wells and about 16 miles of pipe lines that supply the helium plant with helium-bearing natural gas. The main pipe line from the field to the plant is of heavy pipe 6 inches in diameter, and all of the pipe lines are operated at a pressure of more than 600 pounds a square inch. The gas reserve, which is estimated to have had an original content of more than 2 billion cubic feet of recoverable helium, is largely available for future use, because production of approximately 106 million cubic feet of helium during 11 years of operation has depleted the reserve only about 5 percent. The closed-in pressure of the wells—originally 723 pounds a square inch—is still more than 700 pounds a square inch.

Historical background.—Since the Civil War helium has advanced from a line in the spectrum of the sun that did not correspond with any line of known elements to a commodity, produced in millions of cubic feet, that transports man through the air, permits him to penetrate to greater depths in the sea, relieves his suffering, helps meteorologists in forecasting weather, and aids scientists in developing new information that may make life more comfortable or more interesting. The United States Army and Navy have used helium for more than 2 decades, but it became available for non-Government activities at prices that make its use practicable only about 3½ years ago.

Production of helium for military use was initiated during the World War of 1914–18 in consequence of experimental work directed by the Bureau of Mines and financed from War and Navy Department appropriations. After a process of extraction had been developed a full-scale plant was built at Fort Worth, Tex., under the jurisdiction of the Navy Department, using funds supplied jointly by the Army and Navy. This plant was placed under the control of the Bureau of Mines on July 1, 1925, by an act of Congress approved March 3, 1925.

In January 1929 the Fort Worth plant was closed because its supply of helium-bearing natural gas was approaching exhaustion, and in April 1929 the plant near Amarillo, Tex., designed and constructed by the Bureau of Mines, was put in operation. This plant is supplied with helium-bearing natural gas from the Cliffside gas field, which was brought under complete Government control by purchase of the gas rights in fee in 50,000 acres covering the entire geologic structure.

Government use of helium.—The Navy, which continues to buy the most helium, purchased 3,531,410 cubic feet during the fiscal year 1940. In addition to using helium for inflating lighter-than-air craft, the Navy employs it in observation and meteorological balloons, in diving operations, and for other purposes relating to operation of the fleet. The Navy has authorization for a much larger number of nonrigid airships than in the past, and their inflation will require a larger supply of helium.

The Weather Bureau received 2,624,355 cubic feet of helium during the fiscal year 1940 for use in inflating meteorological balloons employed to obtain three types of information. First, several thousand small balloons of 1½ cubic feet capacity are flown daily from various observation stations to determine the height of clouds or ceiling. Second, pilot balloons of 5 or 32 cubic feet capacity are used at 140 stations, where 4 observations are made each day; the rate and angle of ascent of the pilot balloon are observed through an instrument, and data are thus obtained from which the direction and velocity of the wind may be computed for any height. Third, the balloons employed in radiosonde observations hold 85 cubic feet of helium and are used at 40 stations for 2 observations each day. The radiosonde is an instrument for measuring temperature, humidity, and air pressure; it transmits automatically signals that are recorded on the ground and gives physical information for various heights. The Weather Bureau's use of helium increased from 900,000 cubic feet in the fiscal year 1939 to 2,624,000 cubic feet in the fiscal year 1940, and it is estimated that 3,600,000 cubic feet will be purchased in the fiscal year

1941. The Amarillo plant is shipping helium to 450 observation stations of the Weather Bureau (including points in Alaska and outlying possessions), and to 2 Coast Guard cutters.

The Army uses helium for inflating both captive and motorized observation balloons, as well as meteorological balloons. In addition, the Army is experimenting with barrage balloons for protecting cities and military objectives against aerial attack. The National Bureau of Standards, the Department of Agriculture, the Bureau of Mines, the Public Health Service, and other Government agencies also use helium in various types of scientific and medical research.

Sales of helium for medical, scientific, and commercial use.—From the time purchase of helium by the public was authorized by the amendatory Helium Act approved September 1, 1937, until June 30, 1940, 2,655,537 cubic feet of helium were sold for medical, scientific, and commercial use under 73 sales contracts. In the fiscal year 1940 such sales totaled 1,514,155 cubic feet, 16 percent of the plant output. More than 400,000 cubic feet of that helium were employed for medical purposes, and it is estimated that this quantity provided 34,000 hours of treatment.

Non-Government use of helium.—In 1925 the Bureau of Mines reported the results of experiments on helium-oxygen mixtures to mitigate caisson disease.[1] A little later a paper by members of the Bureau's staff on the use of such mixtures during compressed-air work appeared in a technical journal,[2] and a press release [3] on the use of helium in diving was issued. The research upon which these reports were based was the forerunner of later developments in the employment of helium-oxygen mixtures by the medical profession for treatment of asthma.[4]

In 1940 the Public Health Service issued a report on the application of helium-oxygen mixtures to alleviation of tubal and sinus blocks in compressed-air workers,[5] which is indicative of the continued research of the medical profession in the use of helium. Another phase of such research, dealing with use of helium for diluting anesthetics to prevent fires and explosions, is being conducted cooperatively by the Bureau of Mines and a committee under the direction of the Department of Industrial Hygiene, School of Medicine, University of Pittsburgh. A portion of this research dealing with helium as a diluent of cyclopropane was reported by the Bureau of Mines in May 1940.[6]

Thus, by supplying helium for medical, scientific, and commercial use at a fraction of its former cost, the Bureau of Mines is aiding commercial aeronautics, relieving those who suffer from respiratory diseases, reducing hazards in use of anesthetics, contributing to the safety and comfort of divers and caisson workers, promoting science, and fostering many industrial developments.

[1] Sayers, R. R., Yant, W. P., and Hildebrand, J. H., Possibilities in the Use of Helium-oxygen Mixtures as a Mitigation of Caisson Disease: Bureau of Mines Rept. of Investigations 2670, 1925, 17 pp.

[2] Sayers, R. R., and Yant, W. P., Helium-oxygen Mixtures for Compressed-air Work: Eng. News, vol. 95 (1925), p. 586.

[3] Bureau of Mines, Helium Helps the Diver: Press Release, November 7, 1926.

[4] Barach, Alvan L., The Use of Helium in the Treatment of Asthma and Obstructive Lesions in the Larynx and Trachea: Annals Int. Medicine, vol. 9, No. 6, December 1935, p. 739. (With the technical assistance of Morris Eckman.) The Effects of the Inhalation of Helium Mixed with Oxygen in the Mechanics of Respiration: Jour. Clinical Investigation, vol. 15, No. 1, January 1936, p. 47. The Therapeutic Use of Helium: Jour. Am. Medical Assoc., vol. 107, October 17, 1936, p. 1273.

Kernan, John D., and Barach, Alvan L., Role of Helium in Cases of Obstructive Lesions in the Trachea and Larynx: Archives Otolaryngology, vol. 26, October 1937, p. 419.

[5] Crosson, J. W., Jones, Roy R., and Sayers, R. R., Helium-oxygen Mixtures for Alleviation of Tubal and Sinus Block in Compressed-air Workers: Public Health Repts., August 16, 1940, Reprint 2191.

[6] Jones, G. W., Kennedy, R. E., and Thomas, G. J., Explosive Properties of Cyclopropane; Prevention of Explosions by Dilution with Inert Gases: Bureau of Mines Rept. of Investigations 3511, 1940, 17 pp.

Prices.—The estimated cost of producing helium for the fiscal year 1940, as approved by the Secretary of the Interior and upon which deposits for sales to the public are based, in accordance with the law and regulations, was $14.25 a thousand cubic feet. The demand was greater than had been anticipated, hence the unit cost was much less than the estimate. The actual sale prices for the fiscal year 1940, as approved by the Secretary, were therefore only $11.17 for helium to be used for medical purposes, $11.73 for helium for scientific use, and $13.14 for helium for commercial use. After the total charges against the various purchasers of helium were deducted from the deposits the surplus to their credit was refunded.

The price charged Government agencies was $8.43 a thousand cubic feet, irrespective of the use to which the helium was put.

The prices a thousand cubic feet for helium produced in the fiscal years 1938, 1939, and 1940, exclusive of service charges, are shown in the following table.

Prices charged for 1,000 cubic feet of helium

[Exclusive of service charges]

	Fiscal year		
	1938	*1939*	*1940*
Helium requisitioned by Government agencies	$11.16	$11.47	$8.43
Helium sold to non-Government purchasers:			
Medical use	13.471	12.80	11.17
Scientific use	13.471	13.44	11.73
Commercial use	15.088	15.05	13.14

Future outlook and plans.—Demands for helium by the War and Navy Departments, the Weather Bureau, and other users have increased so rapidly that production during the fiscal year 1941 is expected to be at least 1⅓ times that in the fiscal year 1940 and more than twice that in the fiscal year 1939. Although the demand is still considerably below the capacity of 24 million cubic feet a year provided by the two helium-production units now installed in the Amarillo plant and the capacity of about 20 million cubic feet a year provided by the gas wells already drilled in the Cliffside field, estimates of future demands indicate that these capacities will soon be reached and probably exceeded by the consumption.

In view of the increase in normal demand and the expected large requirements for national defense, the Congress has appropriated $175,000 to the Bureau for drilling another gas well in the Cliffside field to raise the well capacity to the plant capacity of 24 million cubic feet of helium a year, for augmenting and improving auxiliary equipment in the plant, and for renewing the Bureau's survey of fields that produce helium-bearing natural gas, which has been in abeyance since 1934. Moreover, addition of a third production unit to the Amarillo plant and the drilling of more wells to bring both plant and well capacity to 36 million cubic feet annually are being considered by the Congress.

Information to be obtained by testing gas samples for helium, making detailed studies of the characteristics of gases that have a promising helium content, and conducting engineering research in favorable areas will enable the Bureau to plan to establish other helium-production plants whenever they are needed to meet the requirements of national defense.

ASPHALT AND RELATED BITUMENS

By A. H. Redfield [1]

SUMMARY OUTLINE

Salient statistics of asphalt and related bitumens in the United States 1939–40

	1939	1940
SUPPLY		
Native asphalt and related bitumens:		
Produced .... short tons	459,848	490,665
Imported (chiefly lake asphalt) .... do	26,586	11,571
Petroleum asphalt (excluding road oil):		
Produced at refineries .... do	[1] 4,954,200	5,346,700
Imported	47,261	126,281
Stocks, Jan. 1 .... do	[1] 490,400	550,000
Total supply .... do	[1] 5,978,295	6,525,217
DISTRIBUTION		
Native asphalt and related bitumens:		
Indicated domestic demand .... short tons	446,064	479,362
Exports (unmanufactured) .... do	13,784	11,303
Petroleum asphalt (excluding road oil):		
Indicated domestic demand (including lake asphalt) .... do	[1] 4,768,752	5,161,338
Exports .... do	199,695	259,214
Stocks, Dec. 31 .... do	550,000	614,000
Total distribution	[1] 5,978,295	6,525,217
VALUES		
Native asphalt and related bitumens:		
Sales	$3,066,844	$2,725,337
Imports (chiefly lake asphalt)	362,559	142,903
Exports (unmanufactured)	577,031	443,449
Petroleum asphalt:		
Sales (excluding road oil) from—		
Domestic petroleum	28,172,396	32,534,900
Foreign petroleum	12,719,680	14,532,245
Total sales	40,892,076	47,067,145
Imports	189,052	566,154
Exports	3,097,799	4,004,173

[1] Revised figures.

The total domestic and foreign demand for petroleum asphalt (including small quantities of lake asphalt and grahamite) was 9 percent larger in 1940 than in 1939. Refinery production of pe-

[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.

troleum asphalt was enlarged sufficiently to meet the increase in domestic demand. The increase in imports of petroleum asphalt, lake asphalt, and grahamite was a little greater than the increase in exports of petroleum asphalt. Accordingly, the growth in inventories at the refineries in 1940 was a little larger than the growth during 1939. In terms of daily demand, however, the stocks held at the end of 1940 represented 43.5 days' supply compared with 42.1 days' supply at the end of 1939 and 40.6 days' supply at the end of 1938.

Total imports showed a high percentual increase from 1939 to 1940. They constituted, however, only 2.5 percent of the total domestic and foreign demand in 1940 compared with 1.5 percent (revised) during 1939.

Exports of petroleum asphalt were 30 percent greater in 1940 than in 1939 but comprised only 5 percent of the total refinery output of asphalt in the United States in 1940 compared with 4 percent in 1939.

Bituminous rock shared in the general increase in demand for asphaltic substances in 1940 over 1939 as far as quantity sold was concerned, although prices were lower. The entire increase in tonnage sold was in States west of the Mississippi.

Sales of gilsonite and wurtzilite declined as both domestic and foreign demand decreased.

NATIVE ASPHALT AND BITUMENS

Bituminous rock.—Bituminous rock shared the general increase in demand for asphaltic substances in 1940 over 1939. Sales of rock asphalt by producers in the United States increased 9 percent in quantity—from 422,484 short tons in 1939 to 458,665 tons in 1940. Prices, however, were lower in 1940; in consequence, the total sales declined 3 percent in value—from $2,007,810 in 1939 to $1,949,166 in 1940.

Operators in Texas and Oklahoma sold 221,497 tons valued at $684,808 in 1939 and 282,250 tons valued at $833,248 in 1940. More rock asphalt was sold by producers in California and in Missouri during 1940 than during 1939. None, however, was mined in New Mexico, either in 1939 or in 1940. In eastern United States, sales of rock asphalt by operators in Kentucky and Alabama dropped from 175,602 tons valued at $1,214,476 in 1939 to 150,312 tons valued at $1,031,646 in 1940.

Gilsonite and wurtzilite.—Decreased demand both in the United States and in foreign countries caused sales of gilsonite by producers in northeastern Utah to decline 14 percent in quantity—from 37,289 short tons in 1939 to 31,930 tons in 1940—and 27 percent in value—from $1,053,192 in 1939 to $770,711 in 1940. Export demand was reduced, especially from Europe. Germany was eliminated as a market by the British blockade; and France was eliminated after June by the German conquest. The United Kingdom reduced its purchases of gilsonite through licensing and exchange restrictions as well as through lack of shipping. The domestic market for gilsonite likewise receded from 1939 to 1940. Certain producers were able to maintain their prices firm; others either cut prices or sold a greater proportion of seconds. As a result, the average sales value of gilsonite at the mine or railhead decreased from $28.24 a ton in 1939 to $24.14 in 1940.

Sales of wurtzilite decreased from 75 tons valued at $5,842 in 1939 to 70 tons valued at $5,460 in 1940.

Sulfonated bitumen.—In 1940, as in 1939, a small quantity of natural sulfonated bitumen was produced near Ogden in Box Elder County, Utah.

Exports.—Exports of natural asphalt, unmanufactured, decreased from 13,784 short tons valued at $577,031 in 1939 to 11,303 tons valued at $443,449 in 1940. Of the total tonnage exported Europe took 74 percent in 1939 but only 55 percent in 1940; Canada 8 percent in 1939 but 13 percent in 1940; South America 4 percent both in 1939 and in 1940; and Asia, chiefly Japan, 10 percent in 1939 but 25 percent in 1940.

MANUFACTURED OR PETROLEUM ASPHALT

Production.—Petroleum refineries in the United States produced 8 percent more asphalt in 1940 than in 1939. Output increased most strongly west of the Mississippi. East of the Mississippi and north of the Ohio and Potomac Rivers, the increases in asphalt production of the Indiana, Illinois, Kentucky, etc., district and of the Appalachian district were small; and the asphalt output of the East Coast refineries actually declined, in contrast to the general increase in production.

Stocks.—To meet an increase of 392,586 short tons in the indicated domestic demand for asphalt and of 59,519 tons in the export demand, petroleum refineries in the United States enlarged their output of asphalt 392,500 tons in 1940. Imports of petroleum asphalt, lake asphalt, and grahamite increased 64,005 tons from 1939 to 1940. As the increase in refinery output virtually equalled the increase in domestic demand and the increase in imports exceeded the increase in exports, no reduction in inventories was possible. In fact, 64,000 tons were added to stocks during 1940 compared to an increase of 59,600 tons in stocks during 1939. Yet, in view of the increasing demand, the stocks at the end of 1940 represented only 43.5 days' supply upon the basis of the daily demand in 1940 compared with stocks representing 42 days' supply at the end of 1939 and 41 days' demand at the end of 1938.

The principal advances in inventories were in the Arkansas and Louisiana Inland district; in the Indiana, Illinois, Kentucky, etc., district; and in the Louisiana Gulf Coast district. In contrast to the general increase, stocks were reduced in the Oklahoma, Kansas, and Missouri district; in the Appalachian district; in California; and in the Texas Gulf Coast district.

Sales.—Total sales of petroleum asphalt by refineries increased 7 percent in quantity and 15 percent in value from 1939 to 1940. The average value at the refinery of asphalt sold in 1940 was $9.09 a short ton in 1940 compared with $8.47 in 1939.

Of the total sales of petroleum asphalt in 1940, 25 percent was manufactured from foreign petroleum (imported chiefly from Venezuela and Mexico), compared with 26 percent in 1939. Although runs of foreign crude to stills rose from 33,490,000 barrels in 1939 to 41,798,000 barrels in 1940, total sales of asphalt made from foreign crude remained virtually stationary—1,278,786 short tons in 1939 and 1,278,349 tons in 1940. Apparently, more of the foreign crude was run to fuel oil in 1940 than in 1939. East Coast refineries sold 96 percent of the asphalt made from foreign crude in 1939 and 91 percent in 1940.

Production, receipts, stocks, consumption, transfers and losses, and sales of asphalt (exclusive of road oil) at petroleum refineries in the United States in 1940, by districts, in short tons

District	Production	Receipts from other sources	Stocks		Consumption by companies, transfers, and losses	Sales	
			Dec. 31, 1939	Dec. 31, 1940		Domestic	Foreign
East Coast	1,777,000	84,000	129,000	137,000	80,200	1,725,000	47,800
Appalachian	169,300	1,100	20,000	13,000	6,400	171,000	
Indiana, Illinois Kentucky, etc	984,900	26,500	148,000	170,000	84,600	904,500	300
Oklahoma, Kansas, and Missouri	403,500	76,200	68,000	58,000	37,400	452,300	
Texas:							
Gulf Coast	346,100	300	19,000	17,000	128,600	157,700	62,100
Inland	194,500	23,600	8,000	19,000		207,100	
Total, Texas	540,600	23,900	27,000	36,000	128,600	364,800	62,100
Louisiana-Arkansas:							
Louisiana Gulf Coast	364,600		35,000	51,000	28,500	309,700	10,400
Arkansas and Louisiana Inland	202,000	56,000	21,000	51,000		228,000	
Total, Louisiana-Arkansas	566,600	56,000	56,000	102,000	28,500	537,700	10,400
Rocky Mountain	147,900	19,400	15,000	20,000	25,000	133,900	3,400
California	756,900	300	87,000	78,000		653,100	113,100
Total: 1940	5,346,700	287,400	550,000	614,000	390,700	4,942,300	237,100
1939	[1] 4,954,200	[1] 227,700	490,400	550,000	296,500	4,636,900	188,900

[1] Revised figures.

Sales of asphalt (exclusive of road oil) at petroleum refineries in the United States, 1939–40, by districts

District	1939		1940	
	Short tons	Value	Short tons	Value
East Coast	1,877,834	$18,417,699	1,772,791	$20,548,867
Appalachian	129,843	1,499,740	171,001	1,972,721
Indiana, Illinois, Kentucky, etc	810,985	6,847,378	904,793	8,335,137
Oklahoma, Kansas, and Missouri	365,381	2,121,986	452,314	2,729,728
Texas:				
Gulf Coast	206,840	1,570,306	219,811	2,081,096
Inland	181,959	1,330,904	207,045	1,788,661
Total, Texas	388,799	2,901,210	426,856	3,869,757
Louisiana-Arkansas:				
Louisiana Gulf Coast	244,703	2,108,695	320,055	2,924,724
Arkansas and Louisiana Inland	232,818	1,459,166	227,986	1,561,379
Total, Louisiana-Arkansas	477,521	3,567,861	548,041	4,486,103
Rocky Mountain	106,960	810,493	137,374	971,102
California	668,508	4,725,709	766,183	4,153,730
Total	4,825,831	40,892,076	5,179,353	47,067,145

Asphalt and asphaltic material (exclusive of road oil) sold at petroleum refineries in the United States in 1940, by varieties

[Value f. o. b. refinery]

Variety	From domestic petroleum		From foreign petroleum		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Solid and semisolid products of less than 200 penetration:[1]						
Asphalt for—						
Paving	847,357	$7,414,202	430,604	$4,760,761	1,277,961	$12,174,963
Roofing	669,389	5,588,314	257,648	2,957,426	927,037	8,545,740
Waterproofing	35,255	390,796	11,483	137,845	46,738	528,641
Blending with rubber	11,923	165,880	10,849	147,174	22,772	313,054
Briquetting	123,407	1,085,486	7	115	123,414	1,085,601
Mastic and mastic cake	1,744	28,215	7,647	99,174	9,391	127,389
Pipe coatings	16,379	162,930	4,110	48,901	20,489	211,831
Molding compounds	11,326	129,627	4,441	55,331	15,767	184,958
Miscellaneous uses	116,820	1,160,421	51,372	664,856	168,192	1,825,277
	1,833,600	16,125,871	778,161	8,871,583	2,611,761	24,997,454
Semisolid and liquid products of more than 200 penetration:[1]						
Flux for—						
Paving	116,622	831,613	65,902	709,618	182,524	1,541,231
Roofing	258,709	1,563,634	32,949	353,601	291,658	1,917,235
Waterproofing	6,790	77,488			6,790	77,488
Mastic	6	218			6	218
Cut-back asphalts:						
Rapid-curing	715,125	6,543,935	279,624	3,124,969	994,749	9,668,904
Medium-curing	676,310	4,834,741	51,416	607,306	727,726	5,442,047
Emulsified asphalts and fluxes	81,726	840,177	3,844	47,025	85,570	887,202
Paints, enamels, japans, and lacquers	18,596	274,776	8,452	127,713	27,048	402,489
Other liquid products	11,734	175,384	2,723	81,399	14,457	256,783
	1,885,618	15,141,966	444,910	5,051,631	2,330,528	20,193,597
Total to domestic consumers	3,719,218	31,267,837	1,223,071	13,923,214	4,942,289	45,191,051
Export sales	181,786	1,267,063	55,278	609,031	237,064	1,876,094
Total: 1940	3,901,004	32,534,900	1,278,349	14,532,245	5,179,353	47,067,145
1939	3,547,045	28,172,396	1,278,786	12,719,680	4,825,831	40,892,076

[1] DEFINITIONS

Paving asphalt.—Refined asphalt and asphaltic cement, fluxed and unfluxed, produced for direct use in the construction of sheet asphalt, asphaltic concrete, asphalt macadam, and asphalt block pavements, and also for use as joint filler, in brick, block, and monolithic pavements.
Roofing asphalt.—Asphalt and asphaltic cement used in saturating, coating, and cementing felt or other fabric and in the manufacture of asphalt shingles.
Waterproofing asphalt.—Asphalt and asphaltic cement used to waterproof and dampproof tunnels, foundations of buildings, retaining walls, bridges, culverts, etc., and for constructing built-up roofs.
Briquetting asphalt.—Asphalt and asphaltic cement used to bind coal dust or coke breeze into briquets.
Mastic and mastic cake.—Asphalt and asphaltic cement for laying foot pavements and floors, waterproofing bridges, lining reservoirs and tanks, capable of being poured and smoothed by hand troweling.
Pipe coatings.—Asphalt and asphaltic cement used to protect metal pipes from corrosion.
Molding compounds.—Asphalts used in the preparation of molded composition, such as battery boxes, electrical fittings, push buttons, knobs, handles, etc.
Miscellaneous uses.—Asphalt and asphaltic cement used as dips and in the manufacture of acid-resisting compounds, putty, saturated building paper, fiber board and floor coverings, and not included in the preceding definitions.
Flux.—Liquid asphaltic material used in softening native asphalt or solid petroleum asphalt for paving, roofing, waterproofing, and other purposes.
Cut-back asphalt.—Asphalt softened or liquefied by mixing with petroleum distillates.
Emulsified asphalt and fluxes.—Asphalts and fluxes emulsified with water for cold-patching, road laying, and other purposes.
Other liquid products.—Petroleum asphalt, exclusive of fuel oil used for heating purposes, not included in the preceding definitions.

In general, such statistics as are available indicate an increase in State highway construction in 1940 over 1939 but no comprehensive statistics are available to show the yardage of the various types of surface laid on city and town streets. It is this field of highway construction that furnishes the major demand for the harder types of paving asphalt. Domestic sales of paving asphalt of less than 200 penetration increased 9 percent from 1939 to 1940—from 1,176,534 short tons in 1939 to 1,277,961 tons in 1940. The principal increases were in the Louisiana-Arkansas, East Coast, and California districts. There was a smaller increase in the Oklahoma, Kansas, and Missouri district. In contrast, sales of paving asphalt by Texas refineries were much lower in 1940 than in 1939; and there was a slight decrease in the Indiana, Illinois, Kentucky, etc., district.

Paving asphalt sold at petroleum refineries in the United States, 1939–40, by districts, in short tons

District	1939	1940
East Coast	567,670	609,717
Appalachian	34,819	31,270
Indiana, Illinois, Kentucky, etc	111,628	110,762
Oklahoma, Kansas, and Missouri	24,561	31,753
Texas:		
Gulf Coast	43,259	26,029
Inland	68,173	58,499
Total, Texas	111,432	84,528
Louisiana-Arkansas:		
Louisiana Gulf Coast	97,166	118,586
Arkansas and Louisiana Inland	39,692	87,632
Total, Louisiana-Arkansas	136,858	206,218
Rocky Mountain	10,498	8,165
California	179,068	195,548
Total	1,176,534	1,277,961

Increased construction of the lighter types of surface, both on State highways and secondary roads, as well as continued use of cut-back asphalts for soil stabilization and revetments, is indicated by an 18-percent gain in sales of cut-back asphalts from 1,454,846 short tons in 1939 to 1,722,475 in 1940. The principal gains in sales of cut-back asphalts were made by refineries of the following districts: Indiana, Illinois, Kentucky, etc.; California; the Gulf Coasts of Louisiana and Texas; and Oklahoma, Kansas, and Missouri. In contrast to the general increase, refineries of the East Coast district and of Arkansas and Louisiana Inland sold less cut-back asphalt in 1940 than in 1939. Sales of both types of cut-back asphalt were larger in 1940 than in 1939; but the greater gain was in sales of rapid-curing cut-backs.

Petroleum refineries sold 55,881 tons (13,164,691 gallons) of asphalt emulsions valued at $635,881 in 1939 and 85,570 tons (20,162,003 gallons) valued at $887,202 in 1940. In addition, 49,826,902 gallons valued at $3,899,958 were sold in 1939 by major industrial companies that purchased asphalt from petroleum refineries and 45,924,626 gallons valued at $3,385,468 in 1940. Accordingly, total known sales of emulsified asphalts and fluxes increased in quantity from 62,991,593 gallons in 1939 to 66,086,629 gallons in 1940 but declined in value from $4,535,839 in 1939 to $4,272,670 in 1940.

Cut-back asphalts sold at petroleum refineries in the United States, 1939–40, by districts, in short tons

District	1939	1940
East Coast	533,622	449,368
Appalachian	43,947	50,940
Indiana, Illinois, Kentucky, etc.	213,199	340,173
Oklahoma, Kansas, and Missouri	220,903	253,039
Texas:		
Gulf Coast	45,003	73,908
Inland	46,083	48,520
Total, Texas	91,086	122,428
Louisiana-Arkansas:		
Louisiana Gulf Coast	70,291	125,738
Arkansas and Louisiana Inland	80,623	45,835
Total, Louisiana-Arkansas	150,914	171,573
Rocky Mountain	89,461	100,634
California	111,714	234,320
Total	1,454,846	1,722,475

Roofing manufacture made the second largest demand for asphalt, absorbing 25 percent of the total sales in 1939 and 24 percent in 1940. Shipments of prepared roofing and asphalt siding reported to the Bureau of the Census decreased slightly—from 35,099,823 squares in 1939 to 34,222,139 squares in 1940. This decrease was paralleled by a small decline in domestic sales of roofing asphalt and roofing flux combined—from 1,229,046 tons in 1939 to 1,218,695 tons in 1940. A considerable decrease in sales by refineries of the Indiana, Illinois, Kentucky, etc., district and smaller decreases in sales by refineries of the East Coast and Arkansas-Louisiana Inland districts offset increased sales in the other districts, notably in the Appalachian district and in California.

Roofing asphalt and flux sold at petroleum refineries in the United States, 1939–40, by districts, in short tons

District	1939	1940
East Coast	434,404	410,728
Appalachian	44,134	76,000
Indiana, Illinois, Kentucky, etc.	361,972	289,598
Oklahoma, Kansas, and Missouri	72,199	80,552
Texas:		
Gulf Coast	29,912	31,556
Inland	38,446	47,098
Total, Texas	68,358	78,654
Louisiana-Arkansas:		
Gulf Coast	28,437	32,443
Arkansas and Louisiana Inland	98,610	85,049
Total, Louisiana-Arkansas	127,047	117,492
Rocky Mountain	202	1,552
California	120,730	164,119
Total	1,229,046	1,218,695

FOREIGN TRADE

Imports.—Imports of natural asphalt and bitumen into the United States decreased from 26,586 short tons valued at $362,559 in 1939 to 11,571 tons valued at $142,903 in 1940. Imports of lake asphalt from Trinidad dropped from 21,440 tons valued at $227,223 in 1939 to 7,959 tons valued at $81,428 in 1940. Imports of grahamite from Cuba likewise decreased—from 4,676 tons valued at $83,734 in 1939 to 3,147 tons valued at $55,732 in 1940.

Petroleum asphalt exported from the United States, 1938–40, by countries

Country	1938		1939		1940	
	Short tons	Value	Short tons	Value	Short tons	Value
North America:						
Canada	11,565	$120,589	10,641	$149,309	15,644	$237,567
Other North America	12,015	202,144	8,099	126,468	12,264	194,574
	23,580	322,733	18,740	275,777	27,908	432,141
South America:						
Argentina	451	9,400	121	3,760	2,019	27,364
Brazil	8,459	123,633	9,070	140,966	8,980	133,815
Other South America	6,951	131,892	2,413	58,864	4,689	83,270
	15,861	264,925	11,604	203,590	15,688	244,449
Europe:						
Belgium	2,924	38,928	1,327	17,684	487	6,961
Denmark	118	3,867	289	5,929	637	11,364
Finland	65	1,677	1,021	19,246	6	363
France	4,010	52,187	300	9,491	1,343	23,456
Germany	354	8,832	253	6,590		
Italy	32	661	531	8,020	928	18,238
Netherlands	578	8,331	834	12,354	94	1,787
Spain	56	2,714	32	687	32,318	497,828
Sweden	738	12,151	2,241	34,620	1,063	48,140
United Kingdom	29,222	455,126	16,313	412,468	2,608	108,106
Other Europe	2,943	52,664	1,953	34,064	4,053	78,603
	41,040	637,138	25,094	561,153	43,537	794,846
Asia:						
British Malaya	9,508	174,017	8,338	135,458	7,993	125,242
Ceylon	3,453	49,504	2,797	35,689	5,226	65,581
China	2,153	31,699	2,400	34,322	1,774	29,938
Hong Kong	2,642	38,788	1,343	20,977	2,410	35,690
India, British, and Burma	10,427	149,979	16,162	227,575	33,815	485,780
Indochina, French	5,809	85,590	8,286	95,744	2,929	37,635
Japan	1,964	30,172	125	4,127	224	5,503
Netherlands Indies	13,022	190,183	25,210	367,810	19,242	195,047
Philippine Islands	11,367	150,427	11,946	169,454	15,985	224,467
Other Asia	2,493	42,878	2,238	48,027	2,868	47,924
	62,838	943,237	78,845	1,139,183	92,466	1,252,807
Africa:						
British East Africa	1,616	27,026	2,724	43,291	1,829	33,454
Mozambique	5,391	96,465	4,209	68,598	4,006	68,181
Union of South Africa	11,567	195,501	18,478	290,752	16,999	293,688
Other Africa	84	3,394	539	12,732	910	14,692
	18,658	322,386	25,950	415,373	23,744	410,015
Oceania:						
Australia	32,510	436,460	33,114	435,739	32,758	510,654
New Zealand	7,787	100,199	6,340	66,846	23,111	359,239
Other Oceania	225	3,084	8	138	2	22
	40,522	539,743	39,462	502,723	55,871	869,915
	202,499	3,030,162	199,695	3,097,799	259,214	4,004,173

On the other hand, imports of solid petroleum asphalt increased from 47,261 short tons valued at $189,052 in 1939 to 87,846 tons valued at $388,585 in 1940. Of the 1940 imports, 86,131 tons valued at $335,756 came from the Netherlands West Indies and 1,634 tons valued at $51,380 from Mexico. All of the imports of solid petroleum asphalt in 1939 came from the Netherlands West Indies.

In addition, 211,392 barrels (38,435 short tons), valued at $177,569, of liquid asphalt, including cut-backs and road oil, were imported from Mexico. No corresponding imports were recorded for 1939.

Exports.—Exports of petroleum asphalt increased 30 percent in quantity—from 199,695 short tons in 1939 to 259,214 tons in 1940—and 29 percent in value—from $3,097,799 in 1939 to $4,004,173 in 1940. Shipments of asphalt to all continents, except Africa were larger in 1940 than in 1939. Canada took 47 percent more asphalt from the United States in 1940 than in 1939; and work on the Pan-American Highway explained the increased asphalt sales to Mexico and Central America. In Europe, a remarkable increase in shipments to Spain more than offset a sharp drop in shipments to the United Kingdom; for other European countries, the increases and decreases in asphalt receipts from the United States virtually canceled each other. In Asia, increased exports of asphalt to British India and to Burma, Ceylon, the Philippine Islands, and Hong Kong more than counteracted decreased shipments to the Netherlands Indies and French Indochina. A sharp rise in asphalt exports to New Zealand contrasted with decreased exports to Australia.

DOMESTIC DEMAND

The indicated average monthly domestic demand for petroleum asphalt (including small quantities of imported lake asphalt and grahamite) was 8 percent greater in 1940 than in 1939, increasing from 397,396 short tons (revised figure) in 1939 to 430,112 tons in 1940.

In order to cover the most recent developments the long-time trend of monthly asphalt demand has been revised to include 1908 to 1940. The effect of including the last 4 years (which were characterized by high demand) has been to raise the general level of the trend for recent years and to lower the relation between the actual demand for these years and the expected demand according to the trend. This is illustrated by the following table, which shows the relation between the actual average monthly demand from 1925 to 1940 and the expected monthly demand for that period. This comparison indicates that the 5 years 1936–40 have been characterized by rising demand for asphalt and that the upward trend had shown no signs of downturn to the end of 1940.

In terms of the revised long-term trend, the indicated demand was 26 percent above the expected demand for 1940, whereas it was 20 percent above the expected demand for 1939; that is, if the national demand had continued the average rate of growth it manifested from 1908 to 1940, it would have averaged 331,741 tons a month in 1939 and 341,728 tons a month in 1940. If these averages are used as a standard of comparison the indicated demand of 397,396 tons a month (revised figure) in 1939 was 120 percent of the expected demand (331,741 tons), and the indicated demand of 430,112 tons a month in 1940 was 126 percent of the expected demand (341,728 tons).

Relation of indicated average monthly asphalt demand in the United States to basic trend, 1925–40, by years

Year	Long-time trend, 1908–40	Indicated average monthly demand	Relation of indicated average monthly demand to trend	Year	Long-time trend, 1908–40	Indicated average monthly demand	Relation of indicated average monthly demand to trend
	Short tons	*Short tons*	*Percent*		*Short tons*	*Short tons*	*Percent*
1925	190,518	242,502	127.3	1933	271,566	191,337	70.5
1926	200,697	266,937	133.0	1934	281,628	214,116	76.0
1927	210,867	296,340	140.5	1935	291,676	252,304	86.5
1928	221,028	260,577	117.9	1936	301,711	330,188	109.4
1929	231,167	287,550	124.4	1937	311,732	337,442	108.2
1930	241,290	238,271	98.7	1938	321,743	367,071	114.1
1931	251,397	228,711	91.0	1939	331,741	397,396	119.8
1932	261,489	191,277	73.1	1940	341,728	430,112	125.9

The demand for asphalt is seasonal to a marked degree, reaching its maximum in August and its minimum in February. From 1925 to 1940, 66.5 percent of the indicated consumption of asphalt has occurred in the 6 months from May 1 to October 31; in 1939 and 1940, as much as 71 percent of the annual total apparently was consumed in these 6 months. Consequently, to furnish an adequate standard of comparison the monthly trend values have been multiplied by a "seasonal factor" for each month, obtained by the method of "link relatives" over the 16-year period, 1925–40.

Relation of indicated asphalt demand in the United States to basic trend, multiplied by seasonal factors, 1939–40, by months

	1939			1940		
	Trend, multiplied by seasonal factors [1]	Indicated monthly demand	Relation of indicated monthly demand to trend [1]	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	182,657	198,502	108.7	188,155	151,363	80.4
February	166,335	146,917	88.3	171,342	145,084	84.7
March	222,830	230,991	103.7	229,538	256,918	111.9
April	296,344	[1] 317,550	107.2	305,266	304,231	99.7
May	384,587	[1] 483,029	125.6	396,165	469,436	118.5
June	433,121	[1] 499,269	115.3	446,160	571,857	128.2
July	460,092	[1] 546,798	118.8	473,942	660,260	139.3
August	477,276	[1] 629,708	131.9	491,644	675,752	137.4
September	457,371	[1] 594,822	130.1	471,140	700,584	148.7
October	435,111	[1] 528,533	121.5	448,210	648,586	144.7
November	272,061	[1] 351,330	129.1	280,251	325,393	116.1
December	193,106	[1] 241,303	125.0	198,920	251,874	126.6
	3,980,891	[1] 4,768,752	119.8	4,100,733	5,161,338	125.9

[1] Revised figures.

In the first quarter of 1940 the indicated demand averaged 94 percent of the long-time trend multiplied by seasonal factors compared with 101 percent in the first quarter of 1939, as revised. In the second quarter of 1940 it increased to 117 percent of the expected demand compared with 117 percent of the expected demand during the second quarter of 1939. From July to September 1940 the demand was highest, averaging 142 percent of the expected demand compared with

127 percent for the same months of 1939. In the last quarter of 1940 the indicated demand averaged 132 percent of the expected demand compared with 125 percent during the last 3 months of 1939.

DISTRIBUTION BY RAIL

The tonnage of asphalt (natural, byproduct, or petroleum) terminated by class I railroads in the United States increased from 4,826,245 short tons in 1939 to 5,279,056 tons in 1940, according to freight-commodity statistics compiled by the Interstate Commerce Commission. The largest gains were in terminations by railroads of the Western district, operating west of the Mississippi and Illinois Rivers; and of the Southern district, operating east of the Mississippi and south of the Ohio and Potomac Rivers. In the Eastern district (lying east of the Mississippi and Illinois, and north of the Ohio and Potomac) only 1 percent more asphalt was terminated by class I railroads in 1940 than in 1939. These figures do not consider terminations outside these districts by branch lines of the railroads, but they do give an approximate picture of the demand for asphalt by geographic areas. They indicate, for example, that half of the asphalt terminated in the United States is delivered to consumers in the northeastern quarter of the country.

Asphalt (natural, byproduct, or petroleum) terminated by class I railroads in the United States, 1939–40, by districts and regions, in short tons

District and region	1939	1940
Eastern district:		
New England region	224, 677	205, 093
Great Lakes region	1, 013, 442	1, 088, 482
Central Eastern region	1, 385, 614	1, 360, 132
Total, Eastern district	2, 623, 733	2, 653, 707
Southern district:		
Pocohontas region	153, 205	166, 738
Southern region	535, 431	688, 415
Total, Southern district	688, 636	855, 153
Western district:		
Northwestern region	483, 230	538, 028
Central Western region	780, 860	924, 705
Southwestern region	249, 786	307, 463
Total, Western district	1, 513, 876	1, 770, 196
Total, United States	4, 826, 245	5, 279, 056

ROAD OIL

Refinery sales of road oil increased 5 percent in quantity—from 8,108,400 barrels in 1939 to 8,500,000 barrels in 1940. Higher prices brought an increase of 13 percent in value—from $8,458,600 in 1939 to $9,543,000 in 1940.

Road oil sold by petroleum refineries in the United States, 1939–40, by districts

District	1939		1940	
	Barrels	Value	Barrels	Value
East Coast	881,900	$1,208,100	863,000	$1,499,000
Appalachian	121,400	147,000	159,000	178,000
Indiana, Illinois, Kentucky, etc	2,102,600	2,142,800	2,219,000	2,620,000
Oklahoma, Kansas, and Missouri	987,400	735,300	878,000	892,000
Texas	369,200	574,300	246,000	472,000
Louisiana-Arkansas	190,600	181,100	130,000	149,000
Rocky Mountain	1,025,800	1,373,400	1,259,000	1,433,000
California	2,429,500	2,096,600	2,746,000	2,300,000
	8,108,400	8,458,600	8,500,000	9,543,000

Of the 1940 sales of road oil, 56,000 barrels were shipped to foreign destinations compared with 19,500 barrels exported in 1939. East Coast refineries exported 17,000 barrels in 1940, Texas refineries 24,000, and California refineries 15,000.

Of the road oil sold in the United States in 1940, only 396,367 barrels valued at $679,165 were made from foreign petroleum, imported chiefly from Venezuela and Mexico. Of the road oil made from foreign crude, 93 percent was sold by refineries of the East Coast district in 1940.

Production, receipts, stocks, consumption, transfers and losses, and sales of road oil in the United States in 1940

[Thousands of barrels]

District	Production	Receipts from other sources	Stocks		Consumption by companies, transfers, and losses	Sales
			Dec 31, 1939	Dec. 31, 1940		
East Coast	271	609	59	44	32	863
Appalachian	154	1	5	1		159
Indiana, Illinois, Kentucky, etc	2,274	59	26	114	26	2,219
Oklahoma, Kansas, and Missouri	722	139	60	34	9	878
Texas	216	34	43	37	10	246
Louisiana-Arkansas	224		34	53	75	130
Rocky Mountain	1,267	95	136	107	132	1,259
California	2,641		339	234		2,746
Total: 1940	7,769	937	702	624	284	8,500
1939	7,868	1,223	680	902	960	8,109

Petroleum refineries in the United States reported the production of 7,769,000 barrels of road oil in 1940 compared with 7,868,000 barrels in 1939. The refinery production of road oil was augmented in 1940 by 937,000 barrels of other petroleum products (chiefly fuel oil) transferred to road-oil stocks compared with 1,222,700 barrels similarly transferred in 1939. Stocks of road oil and of transferred oils declined 78,000 barrels during 1940 in contrast to a stock increase of 22,000 barrels in 1939. Consumption of road oil at refineries in operations, transfers, losses, and adjustments were 284,000 barrels in 1940 compared with 960,000 barrels in 1939.

CEMENT

By Oliver Bowles and E. V. Balser

SUMMARY OUTLINE

Production of portland cement in the United States increased from 122,259,154 barrels (376 pounds) in 1939 to 130,216,511 barrels in 1940—a 7-percent gain—according to final annual returns submitted by cement companies to the Bureau of Mines. Shipments increased from 122,651,459 barrels valued at $180,893,208 to 130,349,786 barrels valued at $190,078,068—a gain of 6 percent in quantity and 5 percent in value. The preliminary figures on production for 1940 (published by the Bureau of Mines in January 1941) were 0.06 percent more and shipments 0.03 percent less than the final figures. For the first 3 months of 1940, shipments were considerably lower than for the corresponding period in 1939, but in each month thereafter they were higher.

The Federal Reserve Board annual index (1935–39=100) for cement production in 1940 was 122 compared with 135 for the durable-goods industries and 141 for the construction industries. Corresponding figures for 1939 were: Cement 114, durable-goods industries 108, and construction industries 125.

In 1940 portland cement was manufactured at, and shipments were made from, 152 plants compared with 150 plants producing and shipping in 1939.

The average factory value was $1.46 a barrel in 1940 compared with $1.47 in 1939.

Shipments included 4,401,274 barrels of high-early-strength portland cement valued at $8,241,879 (an average of $1.87 a barrel) in 1940 compared with 3,693,460 barrels valued at $6,964,608 (an average of $1.89 a barrel) in 1939 (revised figures).

The quantity of natural, masonry (natural), and puzzolan cements produced increased 4 percent and shipments 5 percent compared with 1939. The value of shipments of these varieties gained 0.7 percent.

The preceding data give a brief survey of conditions in the cement industry in 1940, and the following tables present its outstanding features during recent years.

Salient statistics of the cement industry in the United States, 1937–40

	1937	1938	1939 [1]	1940 [1]
Domestic production:				
Portland .... barrels	116,174,708	105,357,000	122,259,154	130,216,511
Masonry, natural, and puzzolan (slag-lime) barrels	1,900,643	1,820,795	2,439,110	2,534,566
Total production .... do	118,075,351	107,177,795	124,698,264	132,751,077
Active plants:				
Portland	150	151	150	152
Masonry, natural, and puzzolan (slag-lime)	12	12	12	12
Domestic shipments:				
Portland .... barrels	113,804,782	106,324,127	122,651,459	130,349,786
Value	$168,835,208	$153,977,226	$180,893,208	$190,078,068
Masonry, natural, and puzzolan (slag-lime) barrels	1,873,400	1,867,949	2,405,135	2,514,597
Value	$2,578,885	$2,725,776	$3,361,724	$3,386,801
Total shipments .... barrels	115,678,182	108,192,076	125,056,594	132,864,383
Value	$171,414,093	$156,703,002	$184,254,932	$193,464,869
Imports .... barrels	1,803,932	1,727,411	1,913,853	538,060
Exports .... do	378,554	558,226	1,146,339	1,667,595
Apparent consumption .... do	117,103,560	109,361,261	125,824,108	131,734,848
Stocks at mills at end of year:				
Portland:				
Finished cement .... do	24,913,245	23,992,939	[2] 23,645,583	23,512,308
Clinker .... do	6,342,000	5,286,000	5,165,000	4,886,000
Masonry, natural, and puzzolan (slag-lime) barrels	253,518	373,816	[2] 239,938	259,907

[1] Includes Puerto Rico.
[2] Revised figures.

Principal hydraulic cements produced and shipped in the United States, 1936–40

Year	Active plants	Production: Portland cement (barrels)	Masonry, natural, and puzzolan (slag-lime) cements: Active plants	Masonry, natural, and puzzolan (slag-lime) cements: Barrels	Total: Active plants	Total: Barrels
1936	149	112,649,782	13	1,819,488	162	114,469,270
1937	150	116,174,708	12	1,900,643	162	118,075,351
1938	151	105,357,000	12	1,820,795	163	107,177,795
1939	[1] 150	[1] 122,259,154	12	2,439,110	[1] 162	[1] 124,698,264
1940	[1] 152	[1] 130,216,511	12	2,534,566	[1] 164	[1] 132,751,077

Year	Shipments: Portland cement: Barrels	Portland cement: Value	Masonry, natural, and puzzolan (slag-lime) cements: Barrels	Masonry, natural, and puzzolan (slag-lime) cements: Value	Total: Barrels	Total: Value
1936	112,849,979	$170,415,302	1,760,993	$2,362,396	114,610,972	$172,777,698
1937	113,804,782	168,835,208	1,873,400	2,578,885	115,678,182	171,414,093
1938	106,324,127	153,977,226	1,867,949	2,725,776	108,192,076	156,703,002
1939	[1] 122,651,459	[1] 180,893,208	2,405,135	3,361,724	[1] 125,056,594	[1] 184,254,932
1940	[1] 130,349,786	[1] 190,078,068	2,514,597	3,386,801	[1] 132,864,383	[1] 193,464,869

[1] Includes Puerto Rico.

PORTLAND CEMENT

PRODUCTION, SHIPMENTS, AND STOCKS

The process of making portland cement was discovered in 1824, but the crude product then made has been improved immeasurably through years of research and experimentation. Its uses have expanded until today it is one of the principal building materials and is regarded as indispensable to modern construction activities.

Portland cement is obtained by pulverizing to a fine consistency a clinker produced by calcining, to incipient fusion, an intimate mixture of properly proportioned argillaceous and calcareous substances, with only such additions after calcining as may be necessary to control setting and certain other properties. Such additions, which usually comprise about 3 to 3½ percent by weight of the calcined product, consist largely of gypsum or mixtures of gypsum and anhydrite. The principal combinations of raw materials are (1) limestone with clay or shale, (2) cement rock (argillaceous limestone) either alone or with high-calcium limestone, (3) blast-furnace slag and limestone, (4) marl and clay, and (5) oyster shells and clay.

Some years ago all portland cement had fairly constant and uniform properties; in other words, there was only one standard portland cement. In recent years, however, several distinct types have been developed to meet specialized uses and to satisfy new conditions that have arisen in construction. These include high-early-strength, masonry, low-heat, and oil-well cements. Statistics for all varieties are given in the general portland-cement tables, and the special varieties are discussed in more detail, with statistics wherever available, in a later section of this report. The special portland cements are to be distinguished from certain other types, such as natural and slag-lime cements, which are not true portland cements, and are covered in a separate section of this chapter.

The following tables present the principal statistics for portland cement. In the first, which relates to production, shipments, and stocks by States and districts, the term "active plant" is applied to a mill or group of mills situated at one place and operated by one company. If a company has establishments at different places, its mill or group of mills at each place is counted as one plant. The districts are groups of States related geographically and commercially.

The tables giving data by months, compiled from monthly reports of the producers, include figures on clinker or unground cement produced and in reserve at the mills awaiting manufacture into finished cement. Although the figures may differ slightly from those based upon annual reports of the producers, they reflect accurately seasonal fluctuations in the industry.

Cement shipments usually fluctuate widely. Figure 1 (page 1113) shows the estimated volume of portland cement shipped each month compared with the monthly average shipments for each year. Cement shipments reflect the movement of cement to construction projects, either directly from the mill to the construction job or to dealers for replenishment of stocks. As this chart clearly shows, the large variations in the volume of shipments are gradually lessening, and, with improvement of cements and continued effort of the construction industry to overcome prejudice against winter building, seasonal fluctuations probably will continue to decrease.

Portland cement produced, shipped, and in stock in the United States and Puerto Rico, 1939–40, by States and districts

	Active plants		Production			Shipments							Stock at mills (Dec. 31)		
			Barrels		Increase (+) or decrease (−) in 1940 (percent)	1939		1940		Average factory value per barrel		Increase (+) or decrease (−) in quantity in 1940 (per cent)	Barrels		Increase (+) or decrease (−) in 1940 (percent)
	1939	1940	1939	1940		Barrels	Value	Barrels	Value	1939	1940		1939	1940[1]	
STATE															
Alabama	6	6	5, 038, 400	5, 122, 307	+2	5, 042, 921	$6, 690, 765	5, 249, 759	$7, 617, 405	$1. 33	$1. 45	+4	670, 999	543, 547	−19
California	10	11	10, 990, 079	14, 215, 745	+29	11, 293, 989	15, 889, 395	13, 813, 362	17, 296, 522	1. 41	1. 25	+22	[2] 1, 208, 180	1, 610, 563	+33
Illinois	4	4	4, 648, 834	4, 974, 917	+7	4, 801, 292	7, 056, 746	4, 937, 127	7, 209, 431	1. 47	1. 46	+3	680, 559	718, 349	+6
Iowa	5	5	4, 718, 024	4, 605, 886	−2	4, 717, 295	7, 771, 503	4, 597, 781	7, 641, 163	1. 65	1. 66	−3	1, 542, 680	1, 550, 785	+1
Kansas	6	6	3, 739, 004	3, 433, 033	−8	3, 746, 370	5, 614, 112	3, 441, 612	5, 192, 160	1. 50	1. 51	−8	[2] 1, 076, 709	1, 068, 130	−1
Michigan	9	9	8, 218, 760	8, 603, 188	+5	8, 327, 479	10, 891, 978	8, 519, 416	11, 389, 191	1. 31	1. 34	+2	1, 958, 993	2, 042, 765	+4
Missouri	5	5	4, 785, 594	4, 968, 106	+4	4, 702, 259	7, 420, 013	4, 867, 799	7, 616, 247	1. 58	1. 56	+4	[2] 1, 060, 209	1, 160, 516	+9
New York	10	11	6, 867, 614	8, 437, 368	+23	6, 853, 796	9, 866, 102	8, 251, 038	11, 687, 089	1. 44	1. 42	+20	[2] 1, 611, 992	1, 798, 322	+12
Ohio	9	9	5, 799, 726	6, 664, 115	+15	6, 140, 125	8, 233, 817	6, 841, 129	9, 202, 414	1. 34	1. 35	+11	[2] 1, 296, 009	1, 118, 995	−14
Pennsylvania	25	25	25, 105, 902	26, 853, 002	+7	24, 870, 343	34, 332, 649	27, 499, 786	38, 350, 998	1. 38	1. 39	+11	[2] 5, 652, 900	5, 006, 116	−11
Puerto Rico	1	1	324, 243	385, 824	+19	347, 981	571, 397	384, 242	629, 876	1. 64	1. 64	+10	1, 250	2, 832	+127
Tennessee	6	6	3, 537, 208	3, 808, 307	+8	3, 677, 116	5, 613, 477	3, 766, 807	5, 655, 635	1. 53	1. 50	+2	393, 478	434, 978	+11
Texas	10	10	7, 337, 246	7, 374, 886	+1	7, 207, 001	12, 152, 780	7, 383, 600	12, 198, 800	1. 69	1. 65	+2	[2] 910, 741	902, 027	−1
Other States [3]	44	44	31, 148, 520	30, 769, 827	−1	30, 923, 492	48, 788, 474	30, 796, 328	48, 391, 137	1. 58	1. 57	−. 4	[2] 5, 580, 884	5, 554, 383	−1
	150	152	122, 259, 154	130, 216, 511	+7	122, 651, 459	180, 893, 208	130, 349, 786	190, 078, 068	1. 47	1. 46	+6	[2] 23, 645, 583	23, 512, 308	−1
DISTRICT															
Eastern Pennsylvania, New Jersey and Maryland	22	22	23, 650, 626	24, 970, 132	+6	23, 540, 428	32, 391, 372	25, 497, 435	35, 525, 165	1. 38	1. 39	+8	[2] 4, 693, 841	4, 166, 538	−11
New York and Maine	11	12	7, 315, 716	8, 784, 509	+20	7, 271, 793	10, 587, 487	8, 613, 535	12, 305, 493	1. 46	1. 43	+18	[2] 1, 751, 787	1, 922, 761	+10
Ohio, western Pennsylvania, and West Virginia	18	18	11, 339, 742	13, 374, 846	+18	11, 541, 643	15, 709, 189	13, 641, 016	18, 425, 279	1. 36	1. 35	+18	[2] 2, 907, 114	2, 640, 944	−9
Michigan	9	9	8, 218, 760	8, 603, 188	+5	8, 327, 479	10, 891, 978	8, 519, 416	11, 389, 191	1. 31	1. 34	+2	1, 958, 993	2, 042, 765	+4
Wisconsin, Illinois, Indiana, and Kentucky	11	11	12, 276, 018	12, 663, 788	+3	12, 099, 208	18, 150, 783	12, 735, 763	19, 158, 407	1. 50	1. 50	+5	[2] 2, 285, 411	2, 213, 436	−3
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	18	18	13, 349, 464	14, 710, 971	+10	13, 506, 584	19, 753, 173	14, 852, 453	22, 473, 321	1. 46	1. 51	+10	[2] 1, 655, 336	1, 513, 854	−9
Eastern Missouri, Iowa, Minnesota, and South Dakota	11	11	10, 474, 558	10, 304, 229	−2	10, 338, 021	16, 730, 452	10, 170, 536	16, 540, 187	1. 62	1. 63	−2	[2] 2, 888, 471	3, 022, 164	+5

Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	12	12	8, 038, 885	7, 597, 759	−5	8, 017, 308	12, 128, 812	7, 614, 858	11, 527, 579	1. 51	1. 51	−5	[2] 2, 132, 775	2, 115, 676	−1
Texas	10	10	7, 337, 246	7, 374, 886	+1	7, 207, 001	12, 152, 780	7, 383, 600	12, 198, 800	1. 69	1. 65	+2	[2] 910, 741	902, 027	−1
Colorado, Montana, Utah, Wyoming, and Idaho	8	8	3, 062, 889	2, 961, 823	−3	3, 078, 540	5, 865, 025	2, 951, 094	5, 420, 245	1. 91	1. 84	−4	[2] 599, 250	609, 979	+2
California	10	11	10, 990, 079	14, 215, 745	+29	11, 293 989	15, 889, 395	13, 813, 362	17, 296, 522	1. 41	1. 25	+22	[2] 1, 208, 180	1, 610, 563	+33
Oregon and Washington	9	9	5, 880, 928	4, 268, 811	−27	6, 081, 484	10, 071, 365	4, 172, 476	7, 188, 003	1. 66	1. 72	−31	[2] 652, 434	748, 769	+15
Puerto Rico	1	1	324, 243	385, 824	+19	347, 981	571, 397	384, 242	629, 876	1. 64	1. 64	+10	1, 250	2, 832	+127
	150	152	122, 259, 154	130, 216, 511	+7	122, 651, 459	180, 893, 208	130, 349, 786	190, 078, 068	1. 47	1. 46	+6	[2] 23, 645, 583	23, 512, 308	−1

[1] Subject to revision.
[2] Revised figures.
[3] Arkansas, Colorado, Florida, Georgia, Idaho, Indiana, Kentucky, Louisiana, Maine, Maryland, Minnesota, Montana, Nebraska, New Jersey, Oklahoma, Oregon, South Dakota, Utah, Virginia, Washington, West Virginia, Wisconsin, and Wyoming.

Summary of monthly estimates of portland cement produced, shipped, and in stock at mills in the United States and Puerto Rico in 1940, 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	1, 073	805	1, 729	2, 164	2, 598	2, 220	2, 176	2, 645	2, 455	2, 570	2, 482	2, 055
New York and Maine	330	235	286	647	900	927	1, 022	1, 007	960	913	866	761
Ohio, western Pennsylvania, and West Virginia	653	603	763	872	1, 129	1, 261	1, 272	1, 471	1, 542	1, 507	1, 242	1, 071
Michigan	387	242	207	378	763	898	1, 000	956	967	1, 092	909	775
Wisconsin, Illinois, Indiana, and Kentucky	825	578	683	719	1, 181	1, 242	1, 116	1, 139	1, 358	1, 451	1, 210	1, 172
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	717	622	1, 168	1, 287	1, 288	1, 249	1, 108	1, 304	1, 449	1, 578	1, 518	1, 424
Eastern Missouri, Iowa, Minnesota, and South Dakota	355	248	634	749	991	1, 116	1, 143	1, 002	1, 034	1, 211	1, 021	809
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	235	97	335	705	871	792	853	707	684	790	802	716
Texas	445	477	589	713	758	672	523	574	631	743	648	602
Colorado, Montana, Utah, Wyoming, and Idaho	98	89	96	196	294	317	364	323	338	302	340	205
California	879	827	986	1, 091	1, 287	1, 201	1, 244	1, 143	1, 360	1, 492	1, 417	1, 307
Oregon and Washington	174	185	409	499	539	562	436	407	293	257	238	264
Puerto Rico	34	33	33	23	34	33	33	34	34	29	32	34
United States: 1940	6, 205	5, 041	7, 918	10, 043	12, 633	12, 490	12, 290	12, 712	13, 105	13, 935	12, 725	11, 195
1939	5, 301	5, 505	8, 171	9, 674	11, 185	11, 953	12, 644	12, 369	11, 937	12, 539	11, 053	9, 488
SHIPMENTS												
Eastern Pennsylvania, New Jersey, and Maryland	821	878	1, 427	2, 301	2, 786	2, 652	2, 625	2, 488	2, 645	3, 072	2, 139	1, 656
New York and Maine	202	230	336	605	820	883	995	1, 040	1, 100	1, 033	760	609
Ohio, western Pennsylvania, and West Virginia	219	330	596	1, 056	1, 615	1, 685	1, 667	1, 630	1, 600	1, 658	937	653
Michigan	161	206	242	557	805	917	1, 019	1, 138	1, 226	1, 202	673	357
Wisconsin, Illinois, Indiana, and Kentucky	246	370	560	937	1, 267	1, 415	1, 435	1, 618	1, 600	1, 692	926	669
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	555	740	1, 106	1, 223	1, 309	1, 187	1, 260	1, 413	1, 584	1, 778	1, 443	1, 253
Eastern Missouri, Iowa, Minnesota, and South Dakota	147	255	477	800	1, 110	1, 170	1, 165	1, 190	1, 480	1, 431	559	386
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	166	291	571	707	734	722	749	813	856	987	530	485
Texas	450	533	678	699	712	594	538	595	645	784	563	592
Colorado, Montana, Utah, Wyoming, and Idaho	77	102	200	273	307	310	291	333	337	356	224	138
California	684	739	963	1, 090	1, 206	1, 174	1, 214	1, 342	1, 337	1, 491	1, 375	1, 199
Oregon and Washington	131	206	522	556	504	480	451	384	295	264	211	163
Puerto Rico	34	27	38	25	31	34	33	34	36	28	32	32
United States: 1940	3, 893	4, 907	7, 716	10, 829	13, 206	13, 223	13, 442	14, 018	14, 741	15, 776	10, 372	8, 192
1939	5, 640	5, 044	8, 467	9, 654	12, 748	12, 715	11, 757	13, 401	13, 104	12, 829	10, 147	6, 785

STOCKS (END OF MONTH)												
Eastern Pennsylvania, New Jersey, and Maryland	4, 946	4, 873	5, 174	5, 029	4, 840	4, 408	3, 959	4, 115	3, 924	3, 423	3, 766	4, 166
New York and Maine	1, 880	1, 886	1, 836	1, 879	1, 960	2, 004	2, 030	1, 993	1, 852	1, 662	1, 768	1, 932
Ohio, western Pennsylvania, and West Virginia	3, 337	3, 610	3, 777	3, 599	3, 115	2, 676	2, 281	2, 123	2, 066	1, 915	2, 220	2, 641
Michigan	2, 186	2, 222	2, 188	2, 009	1, 966	1, 947	1, 929	1, 747	1, 488	1, 378	1, 615	2, 032
Wisconsin, Illinois, Indiana, and Kentucky	2, 769	2, 977	3, 100	2, 883	2, 797	2, 624	2, 305	1, 826	1, 584	1, 342	1, 626	2, 129
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	1, 818	1, 699	1, 761	1, 825	1, 804	1, 866	1, 713	1, 604	1, 468	1, 269	1, 343	1, 514
Eastern Missouri, Iowa, Minnesota, and South Dakota	3, 096	3, 088	3, 245	3, 193	3, 074	3, 020	2, 998	2, 809	2, 363	2, 143	2, 606	3, 020
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	2, 203	2, 009	1, 773	1, 771	1, 909	1, 978	2, 082	1, 976	1, 804	1, 608	1, 879	2, 116
Texas	906	850	762	775	821	898	883	862	848	807	882	903
Colorado, Montana, Utah, Wyoming, and Idaho	620	607	502	425	412	420	492	482	483	429	545	612
California	1, 349	1, 438	1, 483	1, 482	1, 565	1, 593	1, 621	1, 428	1, 459	1, 458	1, 503	1, 611
Oregon and Washington	648	628	515	478	492	574	560	582	582	573	599	700
Puerto Rico	1	7	2	0	3	2	2	2	0	1	1	3
United States: 1940	25, 759	25, 894	26, 118	25, 348	24, 758	24, 010	22, 855	21, 549	19, 921	18, 008	20, 353	23, 379
1939	23, 611	24, 092	23, 786	23, 837	22, 251	21, 489	22, 361	21, 326	20, 160	19, 870	20, 779	[1] 23, 453

[1] Revised figure.

Summary of monthly estimates of clinker (unground portland cement) produced and in stock at mills in the United States and Puerto Rico in 1940, 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	1,218	942	1,642	2,111	2,409	2,242	2,107	2,593	2,450	2,539	2,446	2,096
New York and Maine	265	271	321	699	931	930	936	950	939	914	897	774
Ohio, western Pennsylvania, and West Virginia	737	675	915	926	1,015	1,244	1,169	1,439	1,497	1,395	1,205	1,001
Michigan	434	309	357	501	757	860	977	946	886	941	929	853
Wisconsin, Illinois, Indiana, and Kentucky	853	691	769	768	1,032	1,157	1,015	1,173	1,395	1,384	1,294	1,151
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	805	634	1,111	1,299	1,343	1,318	1,077	1,203	1,369	1,570	1,498	1,460
Eastern Missouri, Iowa, Minnesota, and South Dakota	324	271	626	777	1,013	1,055	1,127	1,000	1,041	1,161	964	864
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	255	185	357	685	863	765	834	729	685	769	823	711
Texas	442	389	595	747	743	639	572	551	608	744	664	670
Colorado, Montana, Utah, Wyoming, and Idaho	114	65	67	183	270	319	358	335	331	327	344	304
California	965	978	1,001	1,103	1,197	1,215	1,208	1,011	1,275	1,538	1,440	1,326
Oregon and Washington	274	336	333	380	548	524	504	320	289	258	241	273
Puerto Rico	34	30	33	20	33	35	32	33	34	29	34	34
United States: 1940	6,720	5,776	8,127	10,199	12,154	12,303	11,916	12,283	12,799	13,569	12,779	11,517
1939	5,587	5,930	8,692	9,815	10,309	11,990	12,771	12,136	11,462	12,114	11,074	9,740
STOCKS (END OF MONTH)												
Eastern Pennsylvania, New Jersey, and Maryland	853	994	914	868	683	707	645	613	624	612	593	633
New York and Maine	229	265	299	358	396	408	333	286	275	285	327	347
Ohio, western Pennsylvania, and West Virginia	647	719	853	897	780	803	709	703	671	559	533	477
Michigan	321	385	534	651	641	594	567	549	458	301	316	394
Wisconsin, Illinois, Indiana, and Kentucky	441	545	631	668	506	415	298	327	348	273	350	324
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	460	476	423	438	483	553	522	415	335	342	344	370
Eastern Missouri, Iowa, Minnesota, and South Dakota	277	296	289	328	351	297	289	284	292	248	207	268
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	314	401	425	409	390	364	345	363	362	341	364	348
Texas	244	161	172	214	207	181	234	213	178	156	177	249
Colorado, Montana, Utah, Wyoming, and Idaho	175	151	123	110	87	89	86	99	93	119	125	225
California	1,274	1,378	1,363	1,312	1,184	1,164	1,122	980	871	904	886	904
Oregon and Washington	380	531	458	353	362	329	405	321	317	325	328	338
Puerto Rico	2	2	3	0	1	3	4	5	5	5	8	9
United States: 1940	5,617	6,304	6,487	6,606	6,071	5,907	5,559	5,158	4,829	4,470	4,558	4,886
1939	5,563	5,986	6,447	6,568	5,728	5,797	5,928	5,727	5,254	4,854	4,824	5,165

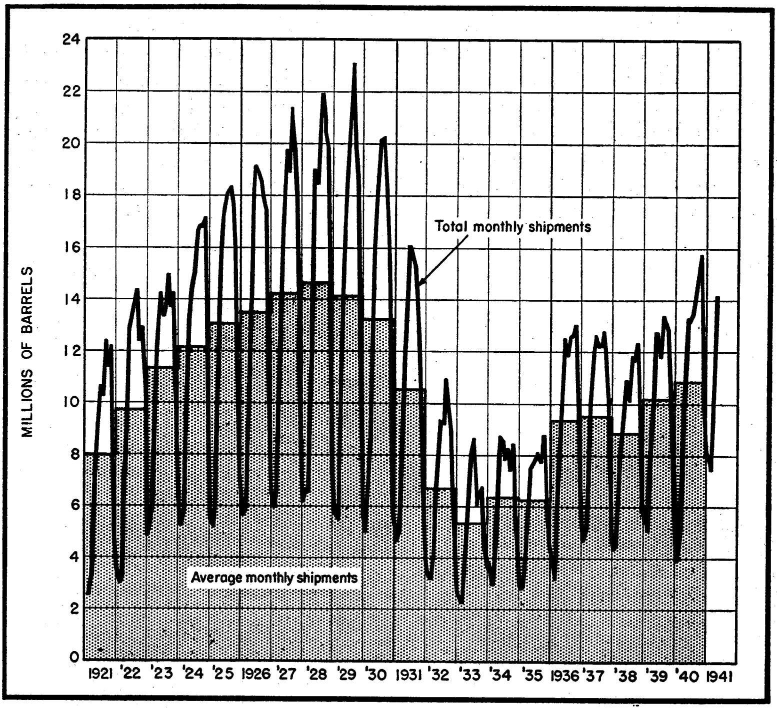

FIGURE 1.—Total monthly and average monthly shipments of portland cement in the United States, 1921–40.

Producers' stocks of portland cement on hand at the mills were 0.6 percent lower at the end of 1940 than at the end of 1939. The following table gives stocks on December 31 and the seasonal fluctuations in stocks from 1936 to 1940.

Producers' stocks of finished portland cement and clinker (unground cement) on hand at mills in the United States on Dec. 31 and monthly range, 1936–40

		Dec. 31 (barrels)	Monthly range			
			Low		High	
			Month	Barrels	Month	Barrels
1936	Cement	22,568,685	October	18,079,000	February	22,971,000
	Clinker	5,564,000	September	4,838,000	March	5,625,000
1937	Cement	24,913,245	do	21,388,000	April	25,747,000
	Clinker	6,342,000	October	5,859,000	March	7,554,000
1938	Cement	[1] 23,992,939	do	20,569,000	January	25,023,000
	Clinker	5,286,000	do	4,927,000	February	6,732,000
1939	Cement	[1 2] 23,645,583	do	19,870,000	do	24,092,000
	Clinker	5,165,000	November	4,824,000	April	6,568,000
1940	Cement	[1] 23,512,308	October	18,008,000	March	26,118,000
	Clinker	[1] 4,886,000	do	4,470,000	April	6,606,000

[1] Includes Puerto Rico.
[2] Revised figure.

DOMESTIC CONSUMPTION

Apparent consumption (shipments plus imports minus exports) for a series of years is indicated in the salient statistics presented as the first table in this chapter. The only available gage of consumption by States is the record of shipments into States by manufacturers; it is therefore merely approximate. Cement shipped to destinations within a State in which it is manufactured is, of course, added to that shipped from other States. Shipments into a State during any year may not equal the consumption during that year but over a series of years should afford a fair index of consumption. The following table shows shipments into States in 1939 and 1940 and per capita consumption in each State.

Shipments of domestic portland cement from mills into States and per capita, 1939–40, in barrels [1]

State	1939		1940	
	Total	Per capita [1]	Total	Per capita [1]
Alabama	1,368,138	0.47	1,458,811	0.51
Arizona [2]	639,754	1.55	558,629	1.12
Arkansas	841,229	.41	812,931	.42
California	9,595,856	1.56	11,619,397	1.68
Colorado	1,170,566	1.09	1,028,753	.92
Connecticut [2]	1,787,229	1.03	1,893,733	1.11
Delaware [2]	356,843	1.37	416,056	1.56
District of Columbia [2]	1,423,195	2.27	1,605,768	2.42
Florida	1,505,807	.90	2,442,623	1.29
Georgia	1,484,770	.48	1,901,663	.61
Idaho	411,488	.83	334,360	.64
Illinois	7,664,172	.97	8,584,009	1.09
Indiana	3,576,555	1.03	3,628,891	1.06
Iowa	2,994,325	1.17	2,933,570	1.16
Kansas	1,689,635	.91	1,627,535	.90
Kentucky	1,908,566	.65	2,006,097	.70
Louisiana	1,978,083	.93	2,168,927	.92
Maine	416,027	.49	331,685	.39
Maryland	1,904,453	1.13	2,141,788	1.18
Massachusetts [2]	2,606,866	.59	2,707,242	.63
Michigan	5,338,118	1.11	5,760,481	1.10
Minnesota	2,649,925	1.00	2,562,578	.92
Mississippi [2]	1,582,099	.78	1,330,367	.61
Missouri	3,225,022	.81	3,150,489	.83
Montana	469,511	.87	419,796	.75
Nebraska	1,223,654	.90	1,122,140	.85
Nevada [2]	153,351	1.52	172,710	1.57
New Hampshire [2]	374,609	.73	428,752	.87
New Jersey	4,008,134	.92	4,165,289	1.00
New Mexico [2]	674,335	1.60	514,490	.97
New York	12,224,290	.94	13,119,568	.97
North Carolina [2]	2,095,636	.60	1,770,738	.50
North Dakota [2]	284,346	.40	290,711	.45
Ohio	6,308,706	.94	6,538,166	.95
Oklahoma	2,165,556	.85	1,886,668	.81
Oregon	795,363	.77	906,358	.83
Pennsylvania	7,052,453	.69	10,008,425	1.01
Puerto Rico	690,306	---------	984,817	.53
Rhode Island [2]	567,057	.83	649,373	.91
South Carolina [2]	934,253	.50	1,118,340	.59
South Dakota	461,999	.67	427,254	.66
Tennessee	2,212,597	.76	2,455,317	.84
Texas	6,541,321	1.06	6,478,976	1.01
Utah	551,629	1.06	679,370	1.23
Vermont [2]	263,515	.69	246,820	.69
Virginia	2,162,937	.80	2,381,902	.89
Washington	5,974,458	3.60	3,540,956	2.04
West Virginia	1,394,698	.75	1,318,364	.69
Wisconsin	3,222,499	1.10	2,604,168	.83
Wyoming	264,887	1.13	250,901	1.00
Unspecified	148,737	---------	213,811	---------
	121,339,558	.94	127,700,563	.96
Exports reported by manufacturers but not included above [3]	1,311,901	---------	2,649,223	---------
Total shipped from cement plants	122,651,459	---------	130,349,786	---------

[1] Per capita figures based on latest available estimates of population made by the Bureau of the Census.
[2] Non-cement-producing State.
[3] Includes shipments to Alaska and Hawaii.

Portland cement shipped from mills into States in 1940, by months, in barrels

Shipped to—	January	February	March	April	May	June	July	August	September	October	November	December
Alabama	71, 102	89, 886	116, 895	119, 306	127, 382	118, 194	114, 656	159, 285	140, 485	147, 694	135, 174	127, 248
Alaska	------	------	5, 000	5, 132	------	17, 476	21, 895	27, 474	26, 519	11, 632	------	------
Arizona	66, 078	59, 612	56, 036	55, 647	46, 972	41, 551	30, 975	33, 391	38, 623	48, 814	44, 358	28, 076
Arkansas	32, 553	43, 572	73, 477	69, 522	79, 523	73, 362	71, 823	75, 546	67, 166	79, 529	72, 246	74, 822
California	564, 771	613, 683	843, 366	949, 392	1, 040, 077	979, 701	985, 726	1, 116, 005	1, 134, 382	1, 265, 200	1, 163, 052	964, 484
Colorado	31, 506	42, 385	74, 986	99, 544	109, 580	114, 887	96, 921	103, 109	105, 640	118, 315	86, 861	45, 259
Connecticut	36, 083	37, 020	62, 074	139, 684	203, 599	196, 892	246, 394	227, 871	223, 945	246, 250	162, 074	111, 707
Delaware	7, 780	11, 485	21, 749	23, 823	33, 723	42, 983	63, 686	47, 118	46, 016	53, 294	39, 086	25, 710
District of Columbia	55, 350	78, 485	120, 383	146, 641	161, 759	182, 713	161, 289	170, 764	172, 283	168, 361	134, 678	107, 569
Florida	123, 465	129, 731	155, 224	169, 349	174, 525	177, 033	193, 016	230, 335	248, 265	300, 848	292, 151	248, 635
Georgia	70, 189	103, 394	137, 791	165, 405	160, 410	153, 423	163, 999	203, 163	202, 518	210, 443	170, 976	160, 073
Hawaii	35, 843	41, 933	33, 542	43, 279	73, 398	66, 952	90, 752	64, 015	36, 012	101, 053	99, 478	120, 646
Idaho	13, 825	15, 697	27, 141	36, 008	35, 329	33, 772	30, 799	34, 615	32, 814	39, 225	23, 925	13, 074
Illinois	178, 880	268, 572	390, 979	669, 600	901, 370	997, 693	942, 517	1, 034, 744	1, 104, 187	1, 116, 623	558, 943	417, 093
Indiana	54, 255	86, 652	162, 384	266, 802	344, 927	398, 904	443, 906	489, 404	447, 427	496, 524	250, 936	182, 354
Iowa	19, 767	35, 588	78, 562	196, 355	278, 848	357, 738	367, 846	366, 383	566, 703	505, 741	115, 550	45, 013
Kansas	26, 808	56, 319	132, 634	155, 900	166, 175	151, 902	166, 709	185, 369	182, 111	199, 189	97, 784	103, 370
Kentucky	32, 709	55, 479	113, 404	137, 498	168, 590	189, 030	209, 773	233, 312	284, 583	348, 098	133, 921	99, 571
Louisiana	107, 143	123, 451	165, 122	171, 085	183, 936	134, 563	165, 712	178, 668	208, 817	286, 563	212, 023	232, 309
Maine	4, 848	7, 194	9, 680	20, 771	42, 160	37, 774	45, 349	48, 143	41, 562	42, 270	21, 711	9, 223
Maryland	50, 458	68, 002	120, 316	159, 809	189, 629	200, 875	198, 817	207, 719	253, 746	283, 672	210, 116	158, 613
Massachusetts	104, 814	97, 848	161, 401	242, 393	286, 655	263, 492	272, 939	286, 524	258, 176	392, 746	248, 887	155, 085
Michigan	105, 152	157, 478	174, 242	379, 639	547, 045	627, 604	705, 115	739, 743	793, 224	710, 834	478, 219	258, 946
Minnesota	44, 448	58, 307	78, 383	198, 828	291, 117	300, 716	315, 423	321, 995	402, 882	386, 271	113, 103	50, 706
Mississippi	40, 563	50, 568	119, 676	124, 811	147, 969	121, 948	93, 433	108, 829	136, 222	150, 406	140, 256	95, 450
Missouri	40, 863	95, 732	222, 254	299, 814	346, 499	323, 926	344, 411	327, 469	367, 021	367, 936	238, 643	174, 516
Montana	17, 050	8, 845	26, 968	39, 133	46, 572	47, 710	48, 206	45, 288	47, 185	55, 380	23, 217	14, 255
Nebraska	14, 342	23, 578	62, 539	104, 777	127, 118	115, 740	114, 832	150, 746	134, 601	151, 867	73, 149	48, 594
Nevada	6, 521	9, 972	10, 118	16, 883	21, 868	19, 658	17, 484	19, 609	18, 230	11, 152	13, 820	8, 645
New Hampshire	8, 952	12, 029	11, 030	23, 959	36, 619	41, 493	37, 097	75, 062	73, 206	68, 238	45, 259	24, 586
New Jersey	126, 197	146, 626	232, 898	342, 819	372, 140	401, 710	466, 085	413, 335	457, 925	523, 948	375, 211	278, 692
New Mexico	37, 261	36, 166	46, 557	47, 758	46, 468	53, 744	42, 340	42, 510	44, 622	52, 892	36, 493	27, 818
New York	435, 434	428, 306	692, 680	1, 129, 643	1, 332, 789	1, 312, 015	1, 403, 066	1, 494, 182	1, 518, 045	1, 571, 865	981, 058	817, 064
North Carolina	58, 510	91, 641	147, 919	169, 264	184, 569	157, 339	141, 470	157, 004	168, 515	193, 896	158, 311	137, 663
North Dakota	3, 974	4, 699	11, 115	26, 565	34, 937	44, 974	38, 367	34, 495	39, 759	40, 702	8, 273	3, 065
Ohio	98, 490	156, 839	268, 235	478, 244	638, 706	648, 138	777, 354	862, 435	854, 206	881, 724	533, 257	341, 236
Oklahoma	58, 320	112, 179	201, 391	217, 231	199, 789	185, 550	151, 806	178, 940	145, 952	205, 154	111, 182	119, 168
Oregon	36, 719	41, 347	60, 790	76, 579	103, 077	114, 252	100, 932	99, 476	84, 625	76, 980	64, 102	42, 455
Pennsylvania	179, 831	223, 366	391, 385	855, 777	1, 474, 662	1, 477, 030	1, 172, 245	973, 270	1, 106, 504	1, 129, 919	639, 695	390, 500
Puerto Rico	45, 855	45, 047	72, 439	88, 224	125, 665	66, 486	58, 186	58, 608	84, 689	113, 302	130, 529	104, 937
Rhode Island	13, 865	12, 801	21, 259	47, 394	65, 592	76, 557	81, 429	61, 024	62, 656	89, 004	60, 559	56, 466
South Carolina	47, 468	72, 757	91, 668	92, 225	81, 807	103, 650	132, 095	86, 360	119, 860	106, 782	90, 215	93, 799
South Dakota	8, 921	11, 423	20, 568	34, 829	45, 629	44, 713	46, 880	42, 747	66, 899	74, 180	20, 204	10, 390
Tennessee	47, 596	84, 469	152, 989	187, 970	238, 319	248, 610	266, 469	276, 569	228, 702	237, 501	262, 963	222, 545
Texas	397, 132	476, 739	600, 853	603, 628	590, 153	514, 740	475, 345	531, 977	584, 433	681, 803	499, 478	522, 633
Utah	12, 720	17, 802	37, 866	51, 764	58, 290	55, 242	64, 427	93, 704	89, 654	90, 171	60, 283	42, 666
Vermont	3, 885	4, 037	3, 246	15, 755	29, 090	33, 102	33, 789	29, 563	38, 974	35, 967	16, 753	3, 569

Portland cement shipped from mills into States in 1940, by months, in barrels—Continued

Shipped to—	January	February	March	April	May	June	July	August	September	October	November	December
Virginia	58, 823	80, 912	159, 306	183, 933	207, 392	216, 183	199, 278	219, 709	222, 750	287, 789	292, 465	282, 255
Washington	98, 353	173, 133	479, 085	497, 117	427, 619	406, 062	377, 987	316, 118	245, 592	210, 526	166, 557	141, 296
West Virginia	34, 160	48, 096	78, 564	106, 381	140, 674	129, 098	141, 840	157, 978	141, 893	150, 131	96, 589	82, 891
Wisconsin	52, 057	57, 194	78, 071	189, 393	249, 440	297, 991	310, 359	367, 008	387, 258	368, 867	157, 501	79, 433
Wyoming	5, 571	8, 718	16, 141	22, 115	26, 816	29, 726	27, 124	26, 846	26, 152	30, 033	14, 782	16, 878
Unspecified	4, 000	7, 087	4, 924	14, 241	965	30	29, 908	15, 799	26, 439	34, 635	9, 106	43, 736
	3, 831, 260	4, 823, 881	7, 637, 305	10, 709, 638	13, 047, 962	13, 146, 647	13, 300, 281	13, 851, 355	14, 540, 655	15, 551, 949	10, 185, 162	7, 966, 787
Foreign countries	61, 740	83, 119	78, 695	119, 362	158, 038	76, 353	141, 719	166, 645	200, 345	224, 051	186, 838	225, 213
Total shipped from cement plants	3, 893, 000	4, 907, 000	7, 716, 000	10, 829, 000	13, 206, 000	13, 223, 000	13, 442, 000	14, 018, 000	14, 741, 000	15, 776, 000	10, 372, 000	8, 192, 000

The official figures for exports of cement differ from those reported by manufacturers in the table on page 1114, because cement forwarded from mills and destined to foreign countries and to Alaska, Hawaii, and Puerto Rico is reported by shippers as exported, whether or not it leaves the country during the calendar year, whereas the export figures of the Bureau of Foreign and Domestic Commerce record the cement that actually leaves the country during the period specified. Furthermore, the exports recorded by the Bureau of Foreign and Domestic Commerce include all hydraulic cement exported, whereas the figures supplied by producers relate to portland cement only.

The per capita consumption indicated in the table falls short of the total apparent consumption by the quantity of imports, which affects to a limited extent certain States near the Canadian border and the seaboard.

The preceding table of monthly shipments from portland-cement mills into States in 1940 is based upon monthly reports of producers. Although the totals may vary slightly from figures shown in tables based upon annual reports, they show seasonal fluctuations with fair accuracy.

USES

The Bureau of Mines has no facilities for collecting statistics on the consumption of portland cement by uses. The following estimates covering the principal uses were made by engineers of the Portland Cement Association, who are in touch with the many users of cement throughout the country.

Estimated distribution of portland cement in the United States in 1939, by uses [1]

Classification	Percent	Barrels
Paving: Roads, streets, and airports	20	24,530,000
Structural: Buildings (including multiple dwellings), bridges, and railroads	30	36,796,000
Conservation: Reclamation, water supply, and sewerage	18	22,077,000
Housing (1- and 2-family dwellings) and miscellaneous uses	22	26,983,000
Farm	10	12,265,000
	100	122,651,000

[1] Compiled by the Portland Cement Association, based upon limited available data.

LOCAL SUPPLIES

The following table compares the shipments from mills within a State or group of States with the estimated consumption (State receipts of mill shipments) and indicates the surplus or deficiency in the supply of cement locally available. Consumption in the States that do not produce cement is indicated in a preceding table showing shipments into each State.

The surplus cement shown in this table was distributed as follows: In 1939—to non-cement-producing States 13,743,088 barrels, to foreign countries, Alaska, and Hawaii 1,311,901 barrels, and to unspecified destinations 148,737 barrels; in 1940—to non-cement-producing States 13,703,729 barrels, to foreign countries, Alaska, and Hawaii 2,649,223 barrels, and to unspecified destinations 213,811 barrels.

Estimated surplus or deficiency in local supply of portland cement in cement-producing States, 1939–40, in barrels

State or division	1939			1940		
	Shipments from mills	Estimated consumption	Surplus (+) or deficiency (—)	Shipments from mills	Estimated consumption	Surplus (+) or deficiency (—)
Alabama	5,042,921	1,368,138	+3,674,783	5,249,759	1,458,811	+3,790,948
California	11,293,989	9,595,856	+1,698,133	13,813,362	11,619,397	+2,193,965
Illinois	4,801,292	7,664,172	−2,862,880	4,937,127	8,584,009	−3,646,882
Iowa	4,717,295	2,994,325	+1,722,970	4,597,781	2,933,570	+1,664,211
Kansas	3,746,370	1,689,635	+2,056,735	3,441,612	1,627,535	+1,814,077
Michigan	8,327,479	5,338,118	+2,989,361	8,519,416	5,760,481	+2,758,935
Missouri	4,702,259	3,225,022	+1,477,237	4,867,799	3,150,489	+1,717,310
Ohio	6,140,125	6,308,706	−168,581	6,841,129	6,538,166	+302,963
Pennsylvania	24,870,343	7,052,453	+17,817,890	27,499,786	10,008,425	+17,491,361
Puerto Rico	347,981	690,306	−342,325	384,242	984,817	−600,575
Tennessee	3,677,116	2,212,597	+1,464,519	3,766,807	2,455,317	+1,311,490
Texas	7,207,001	6,541,321	+665,680	7,383,600	6,478,976	+904,624
Colorado, Montana, Utah, Wyoming, and Idaho	3,078,540	2,868,081	+210,459	2,951,094	2,713,180	+237,914
Oregon and Washington	6,081,484	6,769,821	−688,337	4,172,476	4,447,314	−274,838
Georgia, Kentucky, Virginia, Florida, and Louisiana	5,570,611	9,040,163	−3,469,552	6,727,762	10,901,212	−4,173,450
Indiana, Wisconsin, Minnesota, Nebraska, Oklahoma, South Dakota, and Arkansas	11,703,257	14,141,417	−2,438,160	11,784,963	13,044,630	−1,259,667
Maryland, New Jersey, and West Virginia	4,071,603	7,307,285	−3,235,682	4,797,536	7,625,441	−2,827,905
New York and Maine	7,271,793	12,640,317	−5,368,524	8,613,535	13,451,253	−4,837,718
	122,651,459	107,447,733	+15,203,726	130,349,786	113,783,023	+16,566,763

TRANSPORTATION

The following table for 1936, 1939, and 1940, showing quantities of portland cement shipped from mills by truck, railroad, and boat, in bulk and in containers, is added because charges for transportation and delivery are important items in the cost of cement to consumers. Data for mode of shipping were lacking in 1936 for 16,870,730 barrels—nearly 15 percent of total shipments; in 1939 for 5,681,405 barrels—about 5 percent of total shipments; and in 1940 for 1,726,649 barrels—about 1 percent of total shipments for the year.

The table presented herein is based upon the quantities of cement actually apportioned by the reporting companies; as it represents a very large proportion of the total quantity shipped, it may be assumed that the percentages thus obtained are approximately correct for the industry as a whole.

The earliest data obtained by the Bureau of Mines were for 1928, when 2.4 percent of the total was shipped in bulk and 97.6 percent in containers. Shipments in bulk were reported in 1936 by 130 plants, representing 33 States; in 1939 by 137 plants, representing 33 States; and in 1940 by 144 plants, representing 32 States.

Shipments of portland cement from mills in the United States in 1936, 1939, and 1940 in bulk and in containers, by types of carriers

[Unit of measure, barrels of 376 pounds]

Type of carrier	In bulk		In containers				Mode of shipping not stated	Total shipments	
			In bags		In other containers [1]	Total in containers			
			Paper	Cloth					
	Barrels	*Percent*	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Percent*
1936									
Truck	[2] 793,550	3.9	4,090,942	5,023.665	-------	9,114,607	---------	9,908,157	8.8
Railroad	17,071,517	84.3	36,728,613	30,107,645	4,006	66,840,264	725,809	84,637,590	75.0
Boat	165,820	.8	753,838	496,151	17,693	1,267,682	---------	1,433,502	1.3
Not stated	2,226,828	11.0	2,937,472	3,615,491	9,743	6,562,706	8,081,196	[3] 16,870,730	14.9
	20,257,715	100.0	44,510,865	39,242,952	31,442	83,785,259	8,807,005	112,849,979	100.0
Percent of total shipments	18.0	------	39.4	34.8	-------	74.2	7.8	100.0	------
1939 [5]									
Truck	[2] 2,078,494	8.6	7,325,535	6,913,700	140,904	14,380,139	---------	16,458,633	13.4
Railroad	21,255,557	87.9	43,327,220	33,360,063	34,220	76,721,503	---------	97,977,060	79.9
Boat	600,446	2.5	1,302,465	631,450	-------	1,933,915	---------	2,534,361	2.1
Not stated	250,594	1.0	439,221	498,273	-------	937,494	4,493,317	[3] 5,681,405	4.6
	24,185,091	100.0	52,394,441	41,403,486	175,124	93,973,051	4,493,317	122,651,459	100.0
Percent of total shipments	19.7	------	42.7	33.8	0.1	76.6	3.7	100.0	------
1940 [5]									
Truck	[2] 3,873,114	11.6	8,308,058	8,095,980	-------	16,404,038	---------	20,277,152	15.6
Railroad	27,943,536	83.8	45,314,998	32,216,407	23,527	77,554,932	---------	105,498,468	80.9
Boat	614,471	1.8	1,319,683	913,370	-------	2,233,053	---------	2,847,524	2.2
Not stated	[4] 934,281	2.8	427,323	365,045	-------	792,368	---------	1,726,649	1.3
	33,365,402	100.0	55,370,062	41,590,802	23,527	96,984,391	---------	130,349,793	100.0
Percent of total shipments	25.6	------	42.5	31.9	.01	74.4	---------	100.0	------

[1] Includes steel drums and iron and wood barrels.
[2] Includes cement used at mills by producers as follows: 1936, 103,893 barrels; 1939, 132,238 barrels; 1940, 118,710 barrels.
[3] Includes cement for which mode of shipping is not stated as follows: 1936, 8,081,196 barrels; 1939, 4,493,317 barrels.
[4] Includes shipments by pipe line.
[5] Includes shipments by truck and railroad in paper bags for Puerto Rico.

PRICES

The average selling price of portland cement, f. o. b. factories (excluding the price of containers and cash discounts), as reported to the Bureau of Mines, is stated on page 1108 in the table of shipments by States and districts during 1939 and 1940. The average factory value in some States is higher than the average for ordinary structural cement because considerable quantities of certain special cements that command relatively high prices are included. Thus, white portland cement is manufactured in California and Pennsylvania and high-early-strength portland cement in many States. The average selling price per barrel, f. o. b. factory, of white portland cement in 1940 was $3.89; in 1939 it was $3.72. The average price f. o. b. mill of high-early-strength portland cement was $1.87 a barrel in 1940 and $1.88 a barrel in 1939. The sales value of other hydraulic cements is given later in this chapter.

The following table shows the average factory value of portland cement from 1936 through 1940.

Average factory value per barrel in bulk of portland cement in the United States, 1936–40

1936	$1.51	1939 [1]	$1.47
1937	1.48	1940 [1]	1.46
1938	1.45		

[1] Includes Puerto Rico.

PLANT CAPACITY

At the end of 1940, the capacity for producing finished portland cement of the 152 plants active and shipping in 1940 and the 8 plants inactive in 1940 but producing or shipping from stock on hand within the 7 previous years is shown in the following table, with similar figures for 1939. Figures for plant capacity are based upon manufacturers' reports, supplemented by a few estimates.

Portland-cement-manufacturing capacity of the United States and Puerto Rico, 1939–40, by commercial districts

District	Estimated capacity (barrels)		Percent of capacity utilized	
	1939	1940	1939	1940
Eastern Pennsylvania, New Jersey, and Maryland	49,545,000	48,718,000	47.7	51.3
New York and Maine	17,199,000	17,408,000	42.5	50.5
Ohio, western Pennsylvania, and West Virginia	28,627,000	27,526,000	39.6	48.6
Michigan	16,605,000	15,196,000	49.5	56.6
Wisconsin, Illinois, Indiana, and Kentucky	29,046,000	29,724,000	42.3	42.6
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	25,778,000	25,786,000	51.8	57.0
Eastern Missouri, Iowa, Minnesota, and South Dakota	22,915,000	22,871,000	45.7	45.1
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	16,159,000	17,113,000	49.7	44.4
Texas	12,058,000	12,240,000	60.8	60.3
Colorado, Montana, Utah, Wyoming, and Idaho	5,765,000	5,690,000	53.1	52.1
California	25,280,000	24,040,000	43.5	59.1
Oregon and Washington	7,095,000	7,447,000	82.9	57.3
Puerto Rico	350,000	386,000	92.6	100.0
	256,422,000	254,145,000	47.7	51.2

The following estimates, based upon the monthly reports of producers, of the relationship between the production of finished portland cement and the manufacturing capacity of the industry for each month in 1939 and 1940 and for the 12 months ended with each month indicate the seasonal changes in capacity utilized.

Ratio (percent) of finished portland cement produced to manufacturing capacity of the United States and Puerto Rico, 1939–40

Month	Monthly		12 months ended—		Month	Monthly		12 months ended—	
	1939	1940	1939	1940		1939	1940	1939	1940
January	24.2	28.6	41.3	47.9	July	57.8	55.9	44.9	47.9
February	26.9	24.8	41.9	47.8	August	56.5	57.8	45.5	48.0
March	37.3	36.3	42.8	47.5	September	56.4	61.8	46.0	48.6
April	45.7	47.5	43.4	47.5	October	57.3	63.7	46.4	49.3
May	51.1	57.8	43.7	48.1	November	52.2	60.1	46.7	49.9
June	56.4	58.8	44.3	48.1	December	42.9	51.2	46.8	50.6

The following table gives statistics of capacity, 1938–40, by the two general methods—the "wet" and the "dry"—used in manufacturing portland cement at plants in the United States:

Portland-cement-manufacturing capacity of the United States, 1938–40, by processes

Process	Estimated capacity: Thousands of barrels 1938	1939 [1]	1940 [1]	Estimated capacity: Percent of total 1938	1939 [1]	1940 [1]	Percent of capacity utilized 1938	1939 [1]	1940 [1]	Percent of total finished cement produced 1938	1939 [1]	1940 [1]
Wet	119,776	121,337	122,266	46.8	47.3	48.1	46.1	51.8	55.4	52.4	51.4	52.0
Dry	135,921	135,085	131,879	53.2	52.7	51.9	36.9	43.9	47.4	47.6	48.6	48.0
	255,697	256,422	254,145	100.0	100.0	100.0	41.2	47.7	51.2	100.0	100.0	100.0

[1] Includes Puerto Rico.

RAW MATERIALS

For 1940 producers reported that approximately 42,204,488 short tons of raw materials (exclusive of fuels and explosives) entered into the manufacture of 130,216,511 barrels (24,480,704 short tons) of portland cement in the United States—an average of about 648 pounds to a barrel of finished cement (376 pounds). The totals were as follows: 33,986,327 tons of limestone and cement rock, 4,021,709 tons of clay and shale (including kaolin for making white cement), 581,873 tons of blast-furnace slag, 932,339 tons of marl, 121,544 tons or iron ore, 806,971 tons of gypsum, and 1,753,725 tons of other materials, such as oystershells, sandstone, sand, cinders, fluorspar, diatomite, diatomaceous shale, pumicite, fuller's earth, bentonite, silica, quartz, ashes, pyrite ore, pyrite cinder, roll scale, calcium chloride, and hydrated lime.

NEW DEVELOPMENTS

Plant rehabilitation.—Additions to plant equipment during 1940 are too numerous to be covered individually in a condensed review. At least 25 cement companies report important additions or replacements whose total cost is several million dollars. These changes include additional kilns, grinders, storage silos, recuperators, and dust collectors. An outstanding trend is exemplified by the introduction, at many cement plants, of unit coal pulverizers that discharge directly into kilns or driers.

In this connection, it is interesting to note that in the latest biennial census, the Census of Manufactures obtained data on expenditures made by the cement industry for plant and equipment during 1939. Such figures have not been obtained heretofore. Preliminary statistics show a total expenditure of about $7,913,000, of which approximately 60 percent was expended for new machinery, 36 percent for new buildings or other fixed structures, and the balance for land and used or second-hand equipment.

Specifications.—New specifications (C150–40T) covering five standard types of cement, promulgated after much study by Committee C–1, have been formally adopted by the American Society for Testing Materials and became effective September 2, 1940. The five types were defined in the chapter on Cement of Minerals Yearbook, 1940 (p. 1137).

Research.—Elaborate plans have been made by a committee of 12, headed by P. H. Bates of the National Bureau of Standards, to conduct a long-time experimental study of cement performance in concrete. An extensive program of tests was adopted in August 1940.

Experimental roads have been built to determine the effect of organic admixtures on the endurance of concrete in cold climates. The admixtures include resins, oils, stearates, and tallow, materials that tend to produce foaming and thus increase the air content of the concrete.

Grinding aids.—Minerals Yearbook, 1940 (p. 1137) referred to the use of grinding aids — substances that, when added in small quantities to a clinker charge, assist grinding materially. The Mellon Institute developed new data on the subject in 1940. As a result of comprehensive studies, it was found that as small a quantity as 0.32 percent of carbon black added to cement clinker increases the fineness of the cement by 30 percent when the time of grinding is constant or decreases the grinding time by 28 percent when constant fineness is maintained.

Technical progress.—Froth flotation is being applied increasingly to cement raw materials. Limestones that are inferior or actually unusable under conventional practice are now conditioned by flotation to make them suitable for the manufacture of any type of portland cement. A remarkable feature of the process is the successful use of flotation with materials as fine as 325-mesh.

The new plant of the Permanente Corporation near Los Altos, Calif., has set what is probably an all-time low cost for raw grinding. Grinding is done in two stages; the first gives a minus-48-mesh product, and the second gives a product of which 96 percent is minus-200-mesh. The power consumption is said to be 10 to 11 kw.-hr. per barrel of cement.

This company is also pioneering in byproducts, which may eventually include limestone for beet-sugar factories and concrete aggregate, lime, stone sand, carbon dioxide, and potash. The stone for beet-sugar manufacture must be virtually chert-free. The cherty limestone is similar in appearance to the pure stone, but under a fluorescent light the chert assumes such a distinctive coloration that it can be removed by hand selection on a picking belt. Quite a number of cement plants are equipped with dust collectors, but the dust can rarely be regarded as a byproduct because it is blended with the mill feed as a supplementary raw material.

FUELS AND POWER

Fuels.—According to monthly reports of producers, supplemented by a few estimates by the Bureau of Mines, the following quantities of fuel were consumed at portland-cement plants in the United States and Puerto Rico in 1940 in making 130,141,000 barrels of clinker (unground cement) and 130,216,511 barrels of finished cement: Coal, 5,633,156 short tons; oil, 2,424,976 barrels (42 gallons); and natural gas, 41,948,699,007 cubic feet. Corresponding figures for 1939 are: Clinker produced, 121,620,000 barrels, and finished cement produced, 122,259,154 barrels. Fuels consumed were: Coal, 5,274,463 short tons (revised figure); oil, 2,440,951 barrels (revised figure); and natural gas, 40,211,858,789 cubic feet (revised figure).

The accompanying table shows detailed data on fuels used in 1939 and 1940. Similar data were published in Minerals Yearbook, 1937 (p. 1156), covering 1934 and 1935.

Portland cement burned in the United States and Puerto Rico, 1939–40, by kinds of fuel

Fuel	Finished cement produced			Fuel consumed [1]		
	Number of plants	Barrels of 376 pounds	Percent of total	Coal (short tons)	Oil (barrels of 42 gallons)	Natural gas (cubic feet)
1939						
Coal [2]	99	[3] 79,350,367	64.9	4,775,859		
Oil	11	[3] 8,617,586	7.1		1,936,952	
Natural gas	15	[3] 11,775,964	9.6			18,006,059,152
Coal and oil	5	6,297,812	5.2	321,524	395,421	
Coal and natural gas	13	10,325,124	8.4	173,486		13,010,385,837
Oil and natural gas	3	5,892,301	4.8		44,046	4,714,075,000
Coal, oil, and natural gas [4]	4			3,594	64,532	4,481,338,800
	150	122,259,154	100.0	[5, 6] 5,274,463	[6] 2,440,951	[6] 40,211,858,789
1940						
Coal	99	[3] 83,864,320	64.4	5,009,265		
Oil	11	[3] 9,426,674	7.2		2,049,203	
Natural gas	15	[3] 11,758,348	9.0			18,350,001,017
Coal and oil	5	6,765,481	5.2	410,278	230,446	
Coal and natural gas [7]	15	11,384,238	8.8	211,015		14,125,049,790
Oil and natural gas	4	7,017,450	5.4		112,305	7,017,663,200
Coal, oil, and natural gas	3			2,598	33,022	2,455,985,000
	152	130,216,511	100.0	[8] 5,633,156	2,424,976	41,948,699,007

[1] Figures compiled from monthly estimates of the producers.
[2] In addition to the coal shown for this group, 1 plant reported the use of petroleum coke with coal.
[3] Average consumption of fuel per barrel of cement produced was as follows: 1939—coal, 120.4 pounds; oil, 0.2248 barrel; natural gas, 1,529 cubic feet. 1940—coal, 119.5 pounds; oil, 0.2174 barrel; natural gas, 1,561 cubic feet.
[4] In addition to the coal, oil, and natural gas included for this group, 1 plant reported the use of petroleum coke with coal, oil, and natural gas.
[5] Includes 79,839 short tons of anthracite and 5,194,624 short tons of bituminous coal.
[6] Revised figures.
[7] In addition to the coal and natural gas included for this group, 1 plant reported the use of petroleum coke with coal and natural gas.
[8] Includes 74,437 short tons of anthracite and 5,558,719 short tons of bituminous coal.

The two following tables show the quantities of natural gas and oil used at portland-cement plants in the United States in 1939 and 1940, by States.

Natural gas used at portland-cement plants in the United States, 1939–40, by States in cubic feet [1]

State	1939	1940
California	(2)	8,318,812,000
Kansas	6,245,652,772	5,750,642,479
Texas	9,802,705,474	10,037,845,725
Other States [3]	24,163,500,543	17,841,398,803
	40,211,858,789	41,948,699,007

[1] Compiled from monthly estimates of the producers.
[2] Included in "Other States."
[3] 1939: Alabama, Arkansas, California, Colorado, Iowa, Louisiana, Missouri, Nebraska, Oklahoma, South Dakota, and Utah; 1940: Alabama, Arkansas, Colorado, Georgia, Iowa, Louisiana, Missouri, Nebraska, Oklahoma, South Dakota, and Utah.

Oil used at portland-cement plants in the United States and Puerto Rico, 1939–40, by States, in barrels of 42 gallons [1]

State	1939	1940
California	1,672,141	1,866,144
Puerto Rico	62,189	74,000
Other States [2]	706,621	484,832
	2,440,951	2,424,976

[1] Compiled from monthly estimates of the producers.
[2] 1939: Florida, Idaho, Kansas, Louisiana, New York, Ohio, Oregon, Pennsylvania, Texas, and Washington; 1940: Florida, Idaho, Kansas, New York, Ohio, Oregon, Pennsylvania, Texas, and Washington.

Electric power.—The accompanying table gives the electric energy produced at portland-cement plants and that purchased from power companies during 1939 and 1940. The cement industry generated 49 percent of its electric-power requirements in 1940 compared with 50 percent in 1939 and 51 percent in 1938.

Electrical energy used at portland-cement-producing plants in the United States and Puerto Rico, 1939–40, by processes, in kilowatt-hours

Process	Electrical energy used						Finished cement produced	Average electrical energy used per barrel of cement produced
	Generated at portland-cement plants		Purchased		Total			
	Active plants	Kilowatt-hours	Active plants	Kilowatt-hours	Kilowatt-hours	Percent	Barrels	Kilowatt-hours
1939								
Wet	32	526,914,528	72	891,020,665	1,417,935,193	51.0	62,894,829	22.5
Dry	35	859,576,415	51	503,548,018	1,363,124,433	49.0	59,364,325	23.0
	67	1,386,490,943	123	1,394,568,683	2,781,059,626	100.0	122,259,154	22.7
Percent of total electrical energy used		49.9		50.1	100.0			
1940								
Wet	33	569,045,020	72	970,439,295	1,539,484,315	51.8	67,689,498	22.7
Dry	36	887,343,326	52	544,500,540	1,431,843,866	48.2	62,527,013	22.9
	69	1,456,388,346	124	1,514,939,835	2,971,328,181	100.0	130,216,511	22.8
Percent of total electrical energy used		49.0		51.0	100.0			

SPECIAL CEMENTS

Regular or standard portland cements have been greatly improved during recent years. They attain adequate strength for ordinary use in a much shorter time and have higher ultimate strength and better workability than cements made some years ago. Although these cements are well-adapted for all ordinary uses, new conditions have arisen in industry that demand cements having special qualities, such as high early strength, unusual plasticity, low or moderate heat of setting, or high resistance to chemical action. Special types of cement are discussed in the following paragraphs, and available figures for sales are tabulated at the end of this section.

White portland cement.—White cement has been manufactured for many years in Pennsylvania and since 1932 in California. It is simply a standard cement, the raw materials of which are unusually pure, with an especially low iron content. To avoid contamination and discoloration from fuel, white cement is calcined with gas. It is produced at so few plants that the Bureau is not at liberty to publish figures of output separately.

Alumina cement.—A product known as alumina or high-alumina cement was first manufactured in France under the name of "ciment fondu." Modifications of alumina cement have been made in the United States for many years under patent. The raw materials are bauxite and limestone or lime, which are ground to fine consistency and fused in a furnace. The melted product is cooled rapidly and ground to a fine powder. Production figures cannot be published separately.

High-early-strength portland cement.—For street work where traffic is so heavy that interruptions for long periods are undesirable, in building enterprises where one step must follow another rapidly, or in any type of construction where speed has primary importance, a cement that attains adequate strength in 24 hours or less is much in demand. This has led to the development of the special high-early-strength cements that are now manufactured in many States. These are simply portland cements modified by more complete calcination of raw materials relatively high in calcium carbonate and by grinding the resulting clinker to an extremely fine state of subdivision. They are more costly to manufacture than standard portland cements. Statistics of sales from 1937 to 1940 are given in the table at the end of this section.

Masonry cement.—Masonry or mortar cements must be plastic and of low shrinkage. A good masonry cement should not be harsh or gritty and should not stick to the trowel. It should spread freely and smoothly and should make a perfect bond without shrinkage cracks or air pockets. "Masonry portland" is a variety of portland cement well-suited for mortar uses. It may contain small additions of special ingredients to improve its plasticity or reduce its shrinkage, but it remains essentially a portland cement. The quantities of such cement sold from 1937 to 1940 are recorded in a table later in this section.

Producers also report certain masonry cements that are not true portlands, although they employ portland-cement clinker and finished portland cement as a base. To this base, however, considerable quantities of lime or other constituents of various kinds are added. These specially prepared masonry cements are sold under proprietary names. Production, which was reported from 49 plants in 1940, totaled 2,312,155 barrels and shipments 2,260,636 barrels valued at $3,175,088—an average of $1.40 a barrel. Corresponding data for 1939, representing the output of 33 plants (revised) are: Production 1,765,170 barrels (revised figure) and shipments 1,754,887 barrels (revised figure), valued at $2,362,885 (revised figure)—an average of $1.35 a barrel (revised figure). As the finished portland cement and clinker used in making these types of masonry cement have been reported elsewhere by producers, to avoid duplication the above figures are not included in the totals.

Low- and moderate-heat-of-hardening portland cement.—The construction of enormous dams during recent years has led to the development of cements having low heat of hydration, a desirable quality for mass concrete work. This was accomplished by decreasing the cement compounds primarily responsible for the generation of heat—namely, the tricalcium silicate and tricalcium aluminate. Such reduction necessitated an increase in the percentages of dicalcium silicate and tetracalcium aluminoferrite, which resulted in a much slower development of strength. Because of the slow gain in strength of low-heat cement a compromise product known as the moderate-heat type was developed. It reverted to standard portland cement in its content of tricalcium and dicalcium silicates but retained the low percentage of tricalcium aluminate used in low-heat cement. With very fine grinding this moderate-heat type develops strength at about the same rate as standard portland cement, attains higher ultimate strength in mass concrete work, and generates 10 percent less heat than standard cement, whereas the low-heat type develops 27 percent less heat. The moderate-heat type has proved most satisfactory and has been used in the Grand Coulee Dam and similar large projects. Quantities of low- and moderate-heat cements produced and shipped in recent years are indicated in the following table. Both the quantities used and the number of plants manufacturing these types of cement have increased greatly in recent years.

Portland-puzzolan cement.—Portland-puzzolan cements, including those reported as "high-silica" cements, are made by adding to portland cement small quantities of pumicite, slag, burned clay, or other materials that react with the calcium content of the cement. The so-called "active lime" is thus fixed by the puzzolanic materials, and the concrete made from such cements resists chemical attack as, for instance, the reaction with salts contained in alkali soil or in sea water.

Oil-well portland cement.—Cement is important to the oil industry particularly when employed to shut off water-bearing strata. The cement slurry sometimes is used at great depth and may be forced into the crevices of the water-bearing rock surrounding the well. Several types of cement are made to suit the varying conditions of use. By employing retarders or accelerators, the time of set is regulated accurately so that the cement will not set until it reaches its destination but will set immediately thereafter. Oil-well cements are also modified to satisfy conditions of high or low temperature and to make them resistant to chemical action. These special cements are prepared in the oil-producing States, particularly California, Texas, and Wyoming.

Miscellaneous.—Other special portland cements include those suitable for resisting high temperatures.

The following table presents statistical data for recent years in so far as they are available. All figures given in this table except those for masonry cement (hydraulic but not portland) and "masonry natural" are included in the general tables earlier in this chapter.

Special portland cements produced and shipped in the United States, 1937–40, by kinds

Kind and year	Active plants	Production (barrels)	Shipments		
			Barrels	Value	
				Total	Average
High-early-strength:					
1937	64	4,192,959	3,845,314	$7,134,468	$1.86
1938	72	3,340,582	3,385,523	6,247,699	1.85
1939	79	[2] 3,780,716	[2] 3,693,460	[2] 6,964,608	[2] 1.89
1940	88	4,471,297	4,401,274	8,241,879	1.87
Masonry or mortar:					
1937	10	257,385	273,144	362,807	1.33
1938	5	84,875	88,905	124,239	1.40
1939	[2] 5	173,737	155,781	211,711	1.36
1940	5	219,480	214,303	308,333	1.44
Low- and moderate-heat:					
1937	[2] 27	[2] 3,158,165	[2] 3,499,340	[2] 4,989,425	1.43
1938	[2] 38	[2] 4,181,568	[2] 3,808,927	[2] 5,710,698	1.50
1939	[2] 43	[2] 5,564,921	[2] 5,761,840	[2] 8,237,440	1.43
1940	55	8,422,707	7,584,047	10,136,101	1.34
Portland-puzzolan:					
1937	[2] 8	[2] 263,877	[2] 298,067	[2] 423,297	1.42
1938	[2] 9	[2] 198,268	[2] 185,664	[2] 285,088	1.54
1939	[2] 9	[2] 337,187	[2] 321,217	[2] 434,281	[2] 1.35
1940	10	413,870	412,143	552,830	1.34
Oil-well:					
1937	10	342,316	313,064	652,960	2.09
1938	[2] 8	[2] 238,966	[2] 232,319	[2] 481,401	[2] 2.07
1939	12	[2] 375,866	[2] 375,027	[2] 710,032	[2] 1.89
1940	22	711,348	719,022	1,365,840	1.90
Sulfate-resisting:					
1937	2	(1)	(1)	(1)	(1)
1938	3	(1)	(1)	(1)	(1)
1939	4	38,279	27,362	57,867	2.11
1940	11	193,348	200,090	316,280	1.58
Miscellaneous:					
1937	[2] 14	[2] 641,960	[2] 648,973	[2] 1,014,058	[2] 1.56
1938	[2] 15	[2] 642,854	[2] 625,860	[2] 1,004,393	[2] 1.60
1939	[2] 15	[2] 755,833	[2] 775,179	[2] 1,067,699	[2] 1.38
1940	14	580,502	577,579	755,764	1.31

[1] Bureau of Mines not at liberty to publish these figures separately.
[2] Revised figures.

NATURAL, MASONRY (NATURAL), AND PUZZOLAN CEMENTS

Natural cement is made by calcining argillaceous limestone at comparatively low temperature and grinding the calcined material to fine powder. Some of these cements have special properties that adapt them peculiarly for laying brick and stone, and they are classed as masonry (natural) cements. Masonry cements are therefore of three distinct types—masonry portland and special masonry cements having a portland-cement base, both of which have been discussed, and masonry of the natural-cement class, which is included in the following table.

Hydraulic lime differs from natural cement chiefly in its content of free lime, which is so high that the clinker will slake when water is added to it. The materials are, however, so closely related to natural cement that hydraulic lime is included in this chapter. Two companies (with one plant each, located respectively at Riverton, Va., and Highcliff, Wis.) reported production in 1940.

In addition to portland-puzzolan cement, discussed previously, another type, known as slag-lime cement, is made at Birmingham and Graystone, Ala., by mixing granulated blast-furnace slag with hydrated lime and grinding them to fine consistency. The mixture is not subsequently calcined.

Producers of these special nonportland cements reported that 42,873 short tons of coal were consumed in their manufacture in 1940. They also reported the use of a small quantity of gas having a total fuel value equivalent to about 68 short tons of coal. The fuel consumed in 1939 consisted of 55,193 short tons of coal together with gas having a total fuel value equivalent to about 97 short tons of coal.

Production and shipments of these special types of cement combined are indicated in the following table.

Natural, masonry (natural), and puzzolan (slag-lime) cements produced, shipped, and in stock at mills in the United States, 1936–40

Year	Production		Shipments		Stock (Dec. 31)
	Active plants	Barrels (376 pounds)	Barrels (376 pounds)	Value	Barrels (376 pounds)
1936	13	1,819,488	1,760,993	$2,362,396	230,788
1937	12	1,900,643	1,873,400	2,578,885	253,518
1938	12	1,820,795	1,867,949	2,725,776	373,816
1939	12	2,439,110	2,405,135	3,361,724	[1] 239,938
1940	12	2,534,566	2,514,597	3,386,801	259,907

[1] Revised figure.

CEMENT CONSUMPTION IN RELATION TO CONSTRUCTION CONTRACTS

[Prepared by Shirley F. Colby]

Cement is an important construction material, therefore it is of interest to determine the quantity used in relation to the value of contracts in various sections of the country and to trace trends in the relative quantities used over a series of years. In presenting these relationships in figure 2 the scales for plotting the curves have been so chosen that a coincidence of the cement-consumption curve with the construction curve would indicate that 2½ barrels of cement were used for each $100 of construction contracts awarded; that is, the number of dollars shown on the right margin is 40 times the number of barrels shown at the left. Identical scales have been used for each chart.

The curves begin in 1928, when construction activity had dropped only slightly from the high points of the preceding few years; consequently the patterns presented show the decline from prosperity levels and the subsequent partial recovery.

Total for 37 Eastern States.—As no comparable construction data are available for the 11 Western States, the comparisons in figure 2 concern only the 37 Eastern States covered by the F. W. Dodge Corporation's statistics of construction contracts awarded. However, as indicated in the lower right chart, cement consumption in the 48 States displays a pattern very similar to consumption in the 37 Eastern States. Indications are, however, that the number of barrels of cement used per $100 of construction contracts awarded was considerably above the average for the entire country because a large part of the construction in these States consists of dams, highways, and other concrete structures.

Considering the 37 Eastern States as a whole, it may be observed that in 1928 and 1929 the ratio of cement used to contracts awarded was comparatively small, but by 1930 it had increased considerably. This was caused, no doubt, by the growth of the public works program and the curtailment of industrial and residential building, where relatively smaller proportions of cement are generally used. Since 1938, however, the proportion of cement to contracts awarded has been falling, and in 1940 the ratio stood at 2⅗ barrels of cement to each $100 of construction contracts awarded. This figure is somewhat exaggerated because some cement was used in work for which no contracts were let and in small jobs not included in the statistics of construction contracts awarded. However, as such quantities are relatively small and are fairly constant from year to year, they do not materially affect the general relationships.

Eastern Pennsylvania, New Jersey, Maryland, Delaware, and the District of Columbia.—Considerably more cement is produced than used in this district. In 1940, there were 22 active plants, including 2 in Maryland, 1 in New Jersey, and the remaining 19 in Eastern Pennsylvania—an area that furnishes large quantities of the cement used in New York and the New England States. The quantity of cement used per $100 of contracts awarded ranged from 2.3 barrels in 1928 to 3.8 in 1932 and 3.1 in 1940.

New York and New England.—Two relationships displayed by these curves distinguish this district from the others—less cement was used per value of contracts awarded, and more cement was imported from other States than was produced. There were 12 active plants in 1940—1 in Maine and the remaining 11 scattered throughout New York State. The balance of the cement used comes chiefly from Eastern Pennsylvania. The sharp drop in value of construction contracts awarded (from 2,017 million dollars in 1928 to 328 million dollars in 1932—a fall of 84 percent) was reflected in only a 56-percent decline in cement consumption. Large cities are important centers of construction activity, and the adverse effect of the depression on residen-

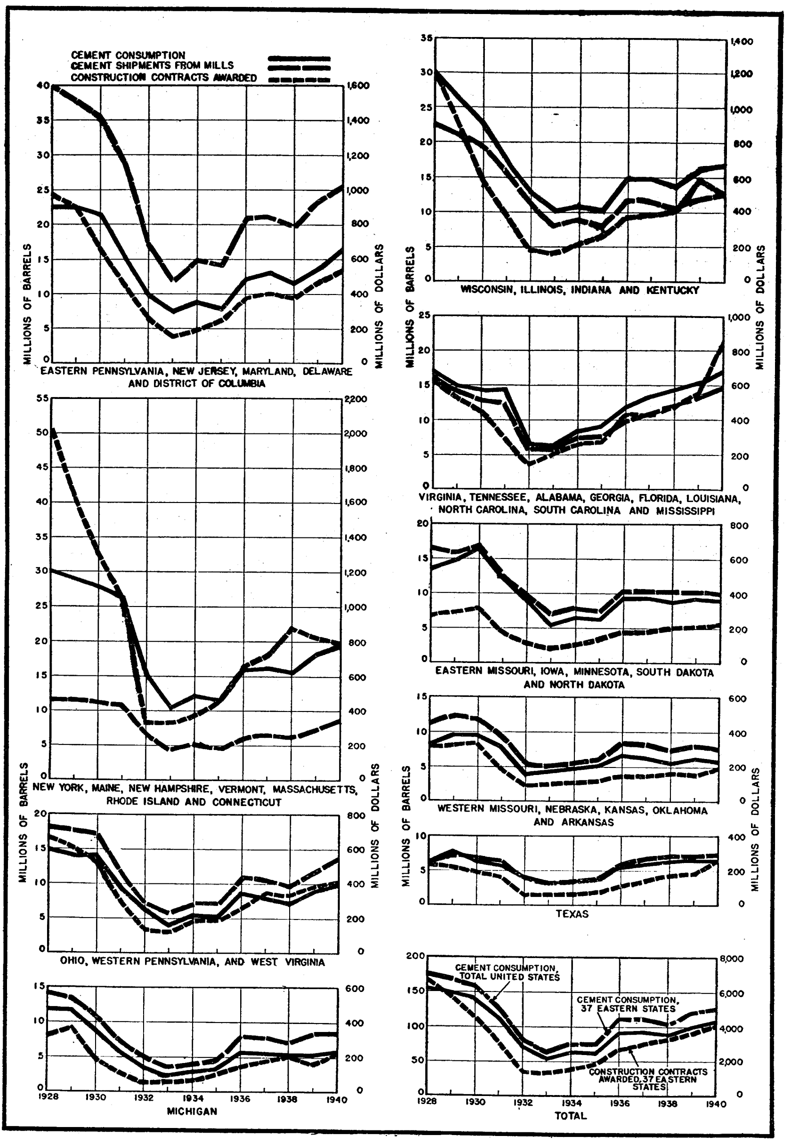

FIGURE 2.—Portlant cement consumption and shipments from mills compared with construction contracts awarded by districts, 1928–40. Data on consumption and shipments of cement from sections of this chapter on Production, Shipments and Stocks, and Domestic Consumption and from corresponding sections of earlier reports. Data on construction contracts awarded from F. W. Dodge Corporation.

tial, commercial, and industrial construction was more serious than on cement consumption, where the decline was cushioned by large expenditures for highways and their maintenance and for other forms of public works. Cement consumption in this area was 1.5 barrels per $100 of contracts awarded in 1928, 4.6 in 1932, 1.8 in 1938, and 2.4 in 1940.

Ohio, western Pennsylvania, and West Virginia.—Eighteen active plants in this district furnished more portland cement than was used; Ohio had 9 plants, western Pennsylvania 6, and West Virginia 3. The average amount of cement used per $100 was similar to that used in New York and New England, rising from 2.2 barrels in 1928 to 4.8 in 1932 and dropping to 2.4 barrels by 1940.

Michigan.—This State had nine active plants in 1940, which supplied almost 50 percent more cement than was used in the State that year. More cement in relation to construction was used in Michigan than in any of the districts already considered. In 1928, 3.6 barrels of cement were used per $100 of construction contracts awarded, 7.6 barrels in 1932, and 2.7 barrels in 1940.

Wisconsin, Illinois, Indiana, and Kentucky.—This district produces less cement than it consumes. Of the 11 active plants, 1 was in Wisconsin, 4 in Illinois, 5 in Indiana, and 1 in Kentucky. The steep 85-percent drop in contracts awarded between 1928 and 1932 and the 56-percent drop in cement consumption in these years parallel closely the condition that existed in New York and the New England States, already discussed. Consumption of cement rose from 2.5 barrels per $100 of construction contracts awarded in 1928 to 7.1 in 1932 and by 1940 had declined to 3.2 barrels.

Virginia, Tennessee, Alabama, Georgia, Florida, Louisiana, North Carolina, South Carolina, and Mississippi.—Production of cement during the 13 years covered was somewhat below consumption. Of the 18 plants active in 1940, 2 were in Virginia, 6 in Tennessee, 6 in Alabama, 2 in Georgia, 1 in Florida, and 1 in Louisiana. Construction activity in this district in 1940 surpassed the 1928 level by over $100,000,000. Virginia and Florida accounted for over half of the rise—nearly $300,000,000—from 1939 to 1940, and most of the increase in these States was in residential and nonresidential construction. For this reason, the rate of increase in cement consumption was less than the rate of increase in construction contracts awarded.

T. V. A. construction has been directed by the Authority itself, no contracts having been let. Therefore, the Dodge construction data do not cover the value of this activity. The number of barrels of cement shipped to the T. V. A. each fiscal year was as follows: 1935, 1,280,520; 1936, 1,073,610; 1937, 820,050; 1938, 579,580; 1939, 895,100; 1940, 702,580; and 1941 (through April) 1,249,990—a total of 6,601,430 barrels since this program was initiated. Considering the fact that the value of T. V. A. construction is not included in the statistics of contracts awarded, the consumption of cement in this district has been very low indeed. Only 2 barrels per $100 of awards were used in 1940, 2.7 barrels in 1928, and 4.5 barrels in 1932.

Eastern Missouri, Iowa, Minnesota, South Dakota, and North Dakota—This district produced a little more cement than was used. Iowa had 5 of the 11 active plants in 1940, eastern Missouri 4, Minnesota 1, and South Dakota 1. The outstanding characteristics of this district are the large proportionate use of cement and the smooth trend displayed by the curve of contracts awarded. Even in 1928, 5.0 barrels of portland cement were used per $100 of awards. In 1932 the ratio had grown to 8.1 barrels, but by 1940 it dropped to 3.9 barrels.

Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas.—This district also had a net surplus of cement in each of the 13 years. Of 12 active plants in 1940, Kansas had 6, Oklahoma 2, Arkansas 1, western Missouri 1, and Nebraska 2. Cement consumption here was fairly typical of the country as a whole, with 2.6 barrels per $100 of construction used in 1928, 4.4 barrels in 1932, and 3.0 barrels in 1940.

Texas.—This State shares the distinction with the Southeastern States of having surpassed the 1928 levels of both cement consumption and contracts awarded. The 10 plants active in 1940 supplied a little more cement than was required. This extra amount probably went to States west of Texas. Cement consumption was 7.0 barrels per $100 of contracts awarded in 1932 compared to 2.7 barrels in 1928 and 2.6 barrels in 1940.

FOREIGN TRADE[1]

Imports.—The figures in the following table cover imports of hydraulic cements of all kinds. The values assigned are supposed to represent those in the foreign countries from which the materials are exported, including the cost of containers or coverings.

Hydraulic cement imported for consumption in the United States, 1936–40

Year	Barrels	Value	Year	Barrels	Value
1936	1,658,902	$1,421,620	1939	1,913,853	$1,860,543
1937	1,803,932	1,392,633	1940	538,060	506,191
1938	1,727,411	1,436,730			

The following table of imports, by countries of origin and import districts, includes all hydraulic cements except "white, nonstaining portland cement," which was reported "imported for consumption" as follows: 1940—2,441 barrels valued at $8,353, of which 496 barrels valued at $1,874 came from Belgium, 202 barrels valued at $763 from Denmark, 384 barrels valued at $624 from France, and 1,359 barrels valued at $5,092 from the United Kingdom; 1939—22,883 barrels valued at $75,983, of which 2,323 barrels valued at $7,405 came from Belgium, 11,029 barrels valued at $42,864 from Denmark, 4,279 barrels valued at $7,686 from France, and 1,278 barrels valued at $4,413 from the United Kingdom.

Exports.—Although the United States is the major cement-producing country of the world, its export trade is small. Shipments to North and Central America increased substantially in 1940, but exports to South America decreased—a condition that indicates the growing self-sufficiency of that area. The value of exports is the actual cost at United States ports, as indicated by the shippers on the export declarations.

[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.

Roman, portland, and other hydraulic cements imported for consumption in the United States, 1939–40, by countries and customs districts [1]

Country and district	1939		1940	
	Barrels	Value	Barrels	Value
COUNTRY				
Belgium	1,041,292	$895,170	325,937	$285,193
Canada	263	549	2,058	4,755
Denmark	466,553	484,044	81,848	81,635
France	13,334	12,431		
Germany	126,354	170,598		
Italy	2,088	8,874	581	2,561
Japan	52,528	44,121	23,364	25,241
Mexico	2,130	2,425	296	308
Netherlands	23,705	33,331	9,000	7,070
Norway	25,392	18,492	3,000	3,744
Poland and Danzig	78,919	53,490		
United Kingdom	8,405	17,756	71,596	72,431
Yugoslavia	50,007	43,279	17,939	14,900
	1,890,970	1,784,560	535,619	497,838
CUSTOMS DISTRICT				
Connecticut	1,863	1,641		
El Paso	615	882	252	256
Florida	365,071	373,214	132,677	125,926
Galveston	18,686	13,837	11,313	9,336
Georgia	30,891	28,445	3,676	3,736
Hawaii	52,378	44,029	23,364	25,241
Laredo	57,120	64,525	43	52
Los Angeles	325	997		
Maine and New Hampshire	228	464	1,818	4,194
Maryland	88,170	53,150	30,806	21,920
Massachusetts	72,171	80,461	36,253	35,513
Mobile	53,475	56,395	12,939	11,795
Montana and Idaho	5	21		
New Orleans	11,491	8,421	3,415	2,627
New York	647,857	637,190	162,201	155,355
North Carolina	1,917	1,467		
Oregon	12,575	8,974		
Philadelphia	116,676	67,412	25,441	18,460
Puerto Rico	295,036	275,648	78,312	71,379
Rhode Island	27,891	38,518	9,000	7,070
Sabine	2,013	1,489		
St. Lawrence	30	64	233	545
San Francisco	150	92		
South Carolina	10,915	9,837	3,868	4,417
Vermont			8	16
Virgin Islands	4,321	4,267		
Washington	19,100	13,120		
	1,890,970	1,784,560	535,619	497,838

[1] Excludes "white, nonstaining, and other special cements."

Hydraulic cement exported from the United States, 1936–40

Year	Barrels	Value	Percent of total shipments from mills
1936	334,673	$886,560	0.3
1937	378,554	1,044,161	.3
1938	558,226	1,294,883	.5
1939	1,146,339	2,352,693	.9
1940	1,667,595	3,294,118	1.3

The following table shows exports in 1939 and 1940, by country of destination.

Hydraulic cement exported from the United States, 1939–40, by countries

Country	1939		1940	
	Barrels	Value	Barrels	Value
North America:				
Bermuda	10	$58	8,149	$15,024
Canada	7,365	40,269	9 560	48,448
Central America:				
British Honduras	4,520	6,714	2,442	4,246
Costa Rica	26,195	45,585	147,388	232,903
El Salvador	3,830	8,073	27,040	36,589
Guatemala	3,630	7,220	3,168	7,445
Honduras	18,323	31,309	24,698	42,080
Nicaragua	3,470	6,261	56,929	85,226
Panama:				
Canal Zone	199,431	433,363	482,849	910,798
Republic of	66,763	121,814	141,938	236,003
Mexico	29,444	65,666	46,788	101,947
Newfoundland and Labrador	4,148	6,917	3,044	6,011
West Indies:				
British:				
Trinidad and Tobago	539	1,379	13,148	19,759
Other British	6,052	12,347	6,923	16,620
Cuba	17,579	76,385	21,460	97,463
Dominican Republic	37,274	67,407	117,920	217,634
French			1,474	4,039
Haiti	51,204	84,350	51,414	88,342
Netherlands (Curaçao)	19,629	34,076	45,584	82,945
Other North America			993	2,200
	499,406	1,049,193	1,212,909	2,255,722
South America:				
Argentina	22,756	96,047	13,802	61,432
Bolivia	280	1,261	867	3,527
Brazil	24,410	93,516	20,218	97,323
Chile	3,216	16,306	4,804	21,754
Colombia	23,046	68,456	30,722	79,506
Ecuador	11,372	25,665	2,108	7,480
Paraguay	212	914	176	856
Peru	7,238	27,559	4,973	17.368
Surinam	3,000	5,795	11,088	19,647
Uruguay	1,155	4,925	8,312	35,958
Venezuela	498,609	832,762	334,145	631,104
Other South America	500	760	689	1,322
	595.794	1,173,966	431.904	977,277
Europe:				
United Kingdom	4,230	15,246	165	619
Other Europe	1,023	5,790	287	1,060
	5,253	21,036	452	1,679
Asia:				
British Malaya	165	676	1,515	2,588
Iraq	532	2,415		
Netherlands Indies	480	2,011	1,073	5,266
Philippine Islands	30,213	52,722	974	5,649
Saudi Arabia	3,664	12,810	3,260	10,981
Other Asia	5,712	18,584	988	6,155
	40,766	89,218	7.810	30,639
Africa:				
Liberia	2,754	6,989	12,500	22,148
Union of South Africa	1,818	9,264	803	3,609
Other Africa	24	114	805	2,016
	4,596	16,367	14,108	27,773
Oceania	524	2,913	412	1,028
	1,146,339	2,352,693	1,667,595	3,294,118

The following table shows shipments to outlying Territories of the United States in 1939 and 1940.

Domestic hydraulic cement shipped to noncontiguous Territories of the United States, 1939–40

Territory	1939		1940	
	Barrels	Value	Barrels	Value
Alaska	43,506	$115,056	81,233	$190,278
American Samoa	7	31	50	169
Canton and Enderbury Islands	2,200	6,094	303	730
Guam			265	760
Hawaii	328,381	725,301	689,727	1,268,928
Midway Island			44	123
Puerto Rico	352,763	511,674	676,396	1,143,236
Virgin Islands	20,354	38,905	13,744	23,734
Wake Island			178	444
	747,211	1,397,061	1,461,940	2,628,402

WORLD PRODUCTION

The following table of world production has been compiled by the Bureau of Mines from consular reports, official statistics, and trade literature. The figures are in metric tons (1 metric ton equals 2,204.622 pounds). The table shows the latest reported plant capacity and the production from 1936 to 1940, inclusive. Although figures for certain countries are still lacking the table presents a reasonably complete picture of the cement industry throughout the world. Figures on capacity are the best estimates that can be made from available data.

World production of cement, 1936–40, and latest reported plant capacity, by countries, in metric tons [1]

[Compiled by L. P. Lounsbery]

Country	Latest reported plant capacity [2]	Production				
		1936	1937	1938	1939	1940
North America:						
Canada	2,390,000	784,103	975,231	876,193	909,875	1,200,143
Cuba	(3)	(3)	(3)	(3)	(4)	(4)
Guatemala	25,000	(3)	(3)	(3)	(4)	(4)
Mexico	529,000	285,978	344,693	373,712	(4)	(4)
United States:						
Continental	43,279,000	19,522,716	20,137,732	18,279,156	21,211,969	22,574,873
Puerto Rico	66,000				55,300	65,802
South America:						
Argentina	1,856,000	833,631	1,035,495	1,160,706	1,127,608	(4)
Bolivia	25,000	10,547	11,100	18,600	(4)	(4)
Brazil	830,000	485,064	571,462	617,896	697,793	(4)
Chile	(3)	248,424	313,110	363,987	447,992	(4)
Colombia	(3)	104,465	123,175	141,809	167,000	(4)
Ecuador	20,000	(3)	(3)	(3)	15,445	16,490
Peru	120,000	75,115	83,048	101,380	119,986	(4)
Uruguay	240,000	111,073	147,773	158,359	173,500	167,880
Venezuela	50,000	37,583	44,626	39,863	39,130	(4)

See footnotes at end of table.

World production of cement, 1936–40, and latest reported plant capacity, by countries, in metric tons —Continued

Country	Latest reported plant capacity [2]	Production				
		1936	1937	1938	1939	1940
Europe:						
Albania	22,000	8,000	14,000	(3)	(4)	(4)
Belgium	4,000,000	2,350,000	3,008,016	3.054,144	2,551,756	(4)
Bulgaria	245,000	113,000	135,000	180,000	(4)	(4)
Czechoslovakia	2,300,000	1,050,000	1,360,000	(3)	(4)	(4)
Denmark	938,000	792,369	676,125	639,957	(4)	(4)
Estonia	(3)	50,611	65,931	79,740	(4)	(4)
Finland	640,000	332,557	410,371	475,152	(4)	(4)
France	10,578,000	4,638,400	4,254,800	(3)	(4)	(4)
Germany	17,000,000	11,689,000	12,605,000	15,600,000	(4)	(4)
Austria	1,000,000	369,000	430,000	650,000	(4)	(4)
Greece	450,000	276,850	290,000	308,000	(4)	(4)
Hungary	876,000	215,000	392,000	395,000	(4)	(4)
Italy	6,689,000	3,826,548	4,359,112	4,607,454	4,800,000	(4)
Latvia	170,000	100,213	117,591	154,621	164,601	(4)
Netherlands	(3)	401,000	441,000	456,000	541,000	(4)
Norway	358,000	300,658	320,481	331,600	390,000	(4)
Poland	1,850,000	1,048,270	1,289,108	1,719,452	(4)	(4)
Portugal	(3)	245,343	254,000	268,000	297,000	(4)
Rumania	1,200,000	376,000	456,311	448,402	(4)	(4)
Spain	2,600,000	[5] 600,000	[5] 650,000	[5] 570,000	1,000,000	(4)
Sweden	(3)	795,181	875,541	992,932	1,184,991	(4)
Switzerland	1,300,000	509,000	(3)	[5] 650,000	(4)	(4)
U. S. S. R	6,000,000	5,845,000	5,459,000	5,696,000	5,700,000	(4)
United Kingdom	10,000,000	6,700,000	7,300,000	7,900,000	(4)	(4)
Yugoslavia	1,680,000	643,072	618,635	712,302	663,000	(4)
Asia:						
China	1,170,000	[6] 450,000	(3)	(3)	(4)	(4)
Manchuria	1,010,000	580,000	[6] 800,000	(3)	(4)	(4)
Chosen	1,600,000	567,000	665,000	(3)	(4)	(4)
Hong Kong	115,000	(3)	(3)	110,036	(4)	(4)
India, British	1,465,000	977,000	1,142,000	(3)	(4)	(4)
Indochina	300,000	149,230	234,638	266,366	305,800	278,500
Iran	125,000	(3)	(3)	(3)	(4)	(4)
Japan	13,100,000	6,232,206	6,703,328	5,519,000	5,074,000	(4)
Levant	(3)	120,000	180,459	162,245	169,285	(4)
Netherlands Indies	235,000	136,000	(3)	(3)	170,000	(4)
Palestine	(3)	154,000	161,000	98,445	112,350	(4)
Philippine Islands	336,000	133,102	150,374	167,448	(4)	(4)
Syria	90,000	58,000	74,000	80,000	58,000	(4)
Thailand (Siam)	120,000	62,000	77,000	82,000	92,000	(4)
Turkey	350,000	137,086	214,794	267,568	274,742	(4)
Africa:						
Algeria	(3)	66,800	65,000	(3)	(4)	(4)
Belgian Congo	40,000	7,520	10,723	16,500	(4)	(4)
Egypt	700,000	335,000	330,000	375,763	371,941	(4)
Morocco, French	(3)	161,780	156,000	165,000	(4)	(4)
Mozambique	30,000	11,826	14,957	24,297	27,618	(4)
Tunisia	(3)	48,600	56,400	68,700	(4)	(4)
Union of South Africa	1,000,000	760,047	839,526	878,206	948,664	831,018
Oceania:						
Australia [7]	1,323,000	655,590	731,650	862,539	881,778	(4)
New Zealand [8]	(3)	153,705	176,000	220,000	(4)	(4)
	146,645,000	78,004,000	83,759,000	85,959,000	(4)	(4)

[1] Table includes all kinds of cement.
[2] Figures are approximate only and are subject to revision.
[3] Data not available; estimate included in total.
[4] Data not yet available.
[5] Shipments.
[6] Approximate production.
[7] 12 months ended June 30 of the year indicated.
[8] 12 months ended March 31 of the year indicated.

STONE

By Oliver Bowles and M. S. Jensen

SUMMARY OUTLINE

Sales of crushed and dimension stone combined, totaling nearly 154,000,000 tons, attained an all-time record in 1940 and exceeded by 4 percent the sales in 1939, which had also been a record-breaking year. The value of sales was the highest since 1930 and was 1 percent greater than in 1939. Sales of dimension stone (exclusive of slate) were 8 percent lower in quantity and 16 percent lower in value. The relatively large decrease in value indicates a trend toward lower unit prices. The crushed-stone industry gained 4 percent in both quantity and value of output in 1940.

The present chapter follows the general plan inaugurated in 1938, whereby the data on dimension stone are separated from those on crushed stone, except in the introductory general tables.

The tables of 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 producers is considered as sold and is included in the statistics of sales. The data, however, do not include stone made into abrasives (such as grindstones) or that used in making lime and cement. These materials are reported in terms of finished products in the Abrasive Materials, Lime, and Cement chapters of this volume. The following tables show the total sales of stone by kinds, uses, and States.

Stone sold or used by producers in the United States, 1936–40, 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
1936	15,442,150	$22,893,289	14,014,440	$13,386,933	165,760	$5,761,554	87,735,740	$81,559,984
1937	9,265,830	20,192,882	13,581,460	12,508,276	207,760	5,456,191	94,577,270	90,901,877
1938	10,432,980	20,915,609	13,908,790	12,280,016	219,390	5,248,290	81,679,690	82,286,555
1939	12,041,360	22,495,983	16,091,250	14,164,016	228,080	6,688,662	100,846,090	94,817,481
1940	10,880,580	21,621,943	15,715,890	15,185,652	239,730	5,196,124	112,658,060	103,007,305

Year	Sandstone		Other stone [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1936	6,254,290	$9,717,105	7,804,040	$8,207,114	131,416,420	$141,525,979
1937	5,072,660	7,516,136	10,438,260	9,637,766	133,143,240	146,213,128
1938	6,314,430	8,066,200	12,283,660	10,458,376	124,838,940	139,255,046
1939	8,853,680	11,745,631	9,386,670	8,549,742	147,447,130	158,461,515
1940	6,498,960	8,513,654	7,739,820	6,519,437	153,733,040	160,044,115

[1] Includes mica schist, conglomerate, argillite, various light-color volcanic rocks, serpentine not used as marble, soapstone sold as dimension stone, and such other stone as cannot properly be classed in any main group.

Stone sold or used by producers in the United States, 1939–40, by uses

Use	1939		1940	
	Quantity	Value	Quantity	Value
Dimension stone:				
Building stone:				
Rough construction ---- short tons	652,500	$1,694,526	299,090	$1,272,588
Cut stone, slabs, and mill blocks ---- cubic feet	9,300,300	14,313,759	7,012,610	10,228,111
Approximate equivalent in short tons	700,510		536,700	
Rubble ---- short tons	549,240	525,173	916,290	976,872
Monumental stone ---- cubic feet	2,571,840	7,265,575	2,378,820	7,378,016
Approximate equivalent in short tons	211,400		196,250	
Paving blocks ---- number	[1] 2,797,560	[1] 246,084	1,868,790	240,070
Approximate equivalent in short tons	[1] 25,580		18,650	
Curbing ---- cubic feet	[2] 1,175,260	[2] 1,080,861	888,740	908,204
Approximate equivalent in short tons	[2] 94,290		71,450	
Flagging ---- cubic feet	789,410	427,048	884,400	413,049
Approximate equivalent in short tons	64,840		68,300	
Total dimension stone (quantities approximate, in short tons)	2,298,360	25,553,026	2,106,730	21,416,910
Crushed and broken stone:				
Riprap ---- short tons	5,811,740	5,851,732	5,264,100	5,414,038
Crushed stone ---- do	103,891,020	93,958,275	100,268,390	91,563,088
Furnace flux (limestone and marble) ---- do	17,287,790	12,632,243	22,872,050	15,754,692
Refractory stone [3] ---- do	1,492,310	2,044,054	1,740,420	2,329,200
Agricultural (limestone) ---- do	5,459,260	6,592,827	8,724,160	9,910,373
Other uses [4] ---- do	11,206,650	11,829,358	12,757,190	13,655,814
Total crushed and broken stone ---- do	145,148,770	132,908,489	151,626,310	138,627,205
Grand total (quantities approximate, in short tons)	147,447,130	158,461,515	153,733,040	160,044,115

[1] To avoid disclosing confidential information, sandstone paving blocks in 1939 are included under "Curbing."
[2] Includes sandstone paving blocks.
[3] Ganister (sandstone), mica schist, soapstone, and dolomite.
[4] Includes roofing granules as follows: 1939, 158,924 tons, $743,034; 1940, 187,086 tons, $753,818. Slate granules used for roofing were also produced, as follows: 1939, 351,780 tons valued at $2,581,089; 1940, 319,000 tons, $2,301,901.

Stone sold or used by noncommercial producers in the United States in 1940, by uses

[Included in total production]

Use	Short tons	Value	Use	Short tons	Value
Dimension stone:			Crushed and broken stone—Continued.		
Building stone	29,800	$31,117	Agricultural (limestone)	$485,750	$494,246
Rubble	83,450	78,991	Other uses	1,774,690	1,604,447
Curbing and flagging	1,940	11,816	Total crushed and broken	41,132,570	41,490,065
Total dimension stone	115,190	121,924	Grand total	41,247,760	41,611,989
Crushed and broken stone:					
Riprap	1,806,980	1,686,111			
Crushed stone	37,065,150	37,705,261			

Stone sold or used by producers in the United States, 1939–40, by States

State	1939		1940	
	Short tons (approximate)	Value	Short tons (approximate)	Value
Alabama	1,855,990	$2,516,584	2,496,480	$3,048,043
Alaska	(1)	(1)	(1)	(1)
Arizona	665,290	626,281	1,149,000	1,043,101
Arkansas	641,460	640,330	1,222,690	1,152,328
California	5,734,100	4,673,751	6,340,080	5,048,242
Colorado	900,460	1,040,579	1,089,650	1,067,788
Connecticut	1,816,650	2,077,366	1,915,990	1,918,132
Delaware	(1)	(1)	114,690	152,313
District of Columbia			(1)	(1)
Florida	[2] 1,444,100	[2] 1,462,730	[2] 2,880,540	[2] 2,750,017
Georgia	1,988,530	4,838,623	2,507,600	5,034,288
Hawaii	373,040	573,812	[2] 705,470	[2] 1,140,769
Idaho	1,863,350	1,238,735	967,900	809,797
Illinois	8,420,120	7,820,589	[2] 9,209,170	[2] 7,556,497
Indiana	[2] 4,338,690	[2] 7,469,659	[2] 4,498,490	[2] 5,822,006
Iowa	6,400,590	4,385,234	4,013,740	3,832,070
Kansas	3,406,640	4,550,560	2,880,930	3,672,644
Kentucky	4,802,280	4,480,098	4,620,750	4,207,875
Louisiana	(1)	(1)	(1)	(1)
Maine	[2] 205,280	[2] 1,228,930	[2] 245,580	[2] 1,876,198
Maryland	1,024,130	1,327,830	1,109,960	1,395,373
Massachusetts	2,543,730	4,459,797	2,176,340	3,819,708
Michigan	11,138,280	5,890,728	13,527,170	6,891,433
Minnesota	1,405,740	2,339,774	1,119,230	1,987,822
Mississippi	(1)	(1)	[2] 210	[2] 410
Missouri	[2] 3,958,470	[2] 4,589,986	6,085,790	6,176,867
Montana	1,266,220	1,714,718	829,600	813,286
Nebraska	427,580	660,732	832,890	906,563
Nevada	[2] 34,260	[2] 40,207	171,670	189,143
New Hampshire	105,390	437,342	[2] 51,250	[2] 409,616
New Jersey	2,806,020	3,036,516	2,705,170	2,888,339
New Mexico	[2] 287,190	[2] 164,924	362,020	223,680
New York	10,703,690	10,111,032	9,782,120	10,398,401
North Carolina	[2] 6,037,000	[2] 6,979,426	3,031,300	4,850,277
North Dakota	(1)	(1)	(1)	(1)
Ohio	[2] 11,133,560	[2] 10,140,272	[2] 11,915,520	[2] 10,234,221
Oklahoma	1,992,660	1,820,409	1,311,640	1,217,525
Oregon	2,225,610	1,682,175	[2] 2,757,820	[2] 2,234,928
Pennsylvania	[2] 15,743,790	[2] 16,906,854	[2] 19,277,690	[2] 19,855,478
Puerto Rico	849,610	531,867	406,160	271,022
Rhode Island	320,780	558,944	[2] 201,380	[2] 511,620
South Carolina	[2] 1,339,030	[2] 1,732,795	[2] 1,233,610	[2] 1,570,689
South Dakota	408,730	998,444	255,600	878,866
Tennessee	[2] 5,626,210	[2] 8,312,977	5,604,170	6,674,710
Texas	3,771,750	3,320,508	2,737,690	2,581,358
Utah	[2] 700,610	[2] 444,856	1,024,660	693,127
Vermont	232,770	3,412,005	[2] 135,680	[2] 3,681,752
Virginia	5,813,630	5,879,447	6,800,640	6,959,136
Washington	2,329,020	2,020,445	2,347,190	1,941,820
West Virginia	[2] 3,808,140	[2] 4,477,828	[2] 3,719,950	[2] 3,818,788
Wisconsin	3,182,780	3,564,045	4,330,360	5,030,263
Wyoming	690,860	668,069	405,140	375,463
Undistributed	683,320	612,702	624,670	430,323
	147,447,130	158,461,515	153,733,040	160,044,115

1 Included under "Undistributed."
2 To avoid disclosing confidential information, certain State totals are incomplete, the figures not included being combined under "Undistributed."

DIMENSION STONE

The term "dimension stone" is applied to blocks or slabs of natural stone, most of which are cut to definite shapes and sizes. These products are quite distinct from crushed, broken, and pulverized stone, which comprises irregular fragments or grains sized chiefly by mechanical screening or air separation. Crushed and broken stone is covered in a later section of this chapter.

Dimension-stone producers may be divided into three main groups upon the basis of plant operation. The first group includes operators who quarry stone and sell it as rough blocks or slabs; the second group quarries stone and also manufactures it into finished products; and the third buys sawed slabs or rough blocks of stone and manufactures them into finished products but does not operate quarries. The Bureau of Mines statistical canvass covers the first and second groups, but as the third group comprises manufacturers rather than quarrymen it is canvassed by the Bureau of the Census. Bureau of Mines statistics are compiled from reports of quantities and values of original sales; hence they include some material sold as rough blocks and some sold as finished products.

Total sales of dimension stone in 1940 declined 9 percent in quantity and 16 percent in value compared with 1939. These figures include slate, but details of the slate industry are given in a separate chapter. Marble, sandstone, and basalt suffered the most serious declines.

The following table of salient statistics includes figures for 1939 and 1940 and the percentage of change from 1939, for each type of stone, by principal products.

Dimension stone sold or used by producers in the United States, 1939–40, by kinds and uses

Kind and use	1939	1940	
		Total	Percent of change
Granite:			
Building stone:			
Rough construction ... short tons	204,490	89,040	−56.5
Value	$410,395	$245,385	−40.2
Average per ton	$2.01	$2.76	+37.3
Cut stone, slabs, and mill blocks ... cubic feet	865,130	1,104,590	+27.7
Value	$2,665,205	$2,847,082	+6.8
Average per cubic foot	$3.08	$2.58	−16.2
Rubble ... short tons	197,050	239,560	+21.6
Value	$226,675	$288,636	+27.3
Monumental stone ... cubic feet	2,160,480	2,108,950	−2.4
Value	$5,664,543	$5,906,942	+4.3
Average per cubic foot	$2.62	$2.80	+6.9
Paving blocks ... number	2,797,560	1,813,130	−35.2
Value	$246,084	$236,330	−4.0
Curbing ... cubic feet	725,590	569,290	−21.5
Value	$624,651	$563,849	−9.7
Total:			
Quantity ... approximate short tons	733,610	658,250	−10.3
Value	$9,837,553	$10,088,224	+2.5
Basalt and related rocks (trap rock):			
Building stone:			
Rough construction ... short tons	10,960	15,680	+43.1
Value	$14,619	$17,548	+20.0
Average per ton	$1.33	$1.12	−15.8
Rubble ... short tons	90,360	6,120	−93.2
Value	$38,405	$3,089	−92.0
Total:			
Quantity ... short tons	101,320	21,800	−78.5
Value	$53,024	$20,637	−61.1

Dimension stone sold or used by producers in the United States, 1939–40, by kinds and uses—Continued

Kind and use	1939	1940 Total	1940 Percent of change
Marble:			
Building stone (cut stone, slabs, and mill blocks)..cubic feet..	1,046,830	782,600	−25.2
Value	$4,704,047	$3,324,029	−29.3
Average per cubic foot	$4.49	$4.25	−5.3
Monumental stone..cubic feet..	411,360	269,870	−34.4
Value	$1,601,032	$1,471,074	−8.1
Average per cubic foot	$3.89	$5.45	+40.1
Total:			
Quantity..approximate short tons..	123,740	89,040	−28.0
Value	$6,305,079	$4,795,103	−23.9
Limestone:			
Building stone:			
Rough construction..short tons..	320,640	103,470	−67.7
Value	$424,230	$174,148	−58.9
Average per ton	$1.32	$1.68	+27.3
Cut stone, slabs, and mill blocks..cubic feet..	6,857,380	4,636,950	−32.4
Value	$5,978,450	$3,425,411	−42.7
Average per cubic foot	$0.87	$0.74	−14.9
Rubble..short tons..	221,060	616,250	+178.8
Value	$189,597	$582,257	+207.1
Flagging..cubic feet..	168,480	236,530	+40.4
Value	$85,565	$78,149	−8.7
Total:			
Quantity..approximate short tons..	1,060,670	1,082,130	+2.0
Value	$6,677,842	$4,259,965	−36.2
Sandstone:			
Building stone:			
Rough construction..short tons..	65,610	33,470	−49.0
Value	$190,940	$80,750	−57.7
Average per ton	$2.91	$2.41	−17.2
Cut stone, slabs, and mill blocks..cubic feet..	530,960	488,470	−8.0
Value	$966,057	$631,589	−34.6
Average per cubic foot	$1.82	$1.29	−29.1
Rubble..short tons..	10,380	31,130	+199.9
Value	$15,245	$47,201	+209.6
Paving blocks..number..	(1)	55,660	
Value	(1)	$3,740	
Curbing..cubic feet..	[2] 449,670	319,450	
Value	[2] $456,210	$344,355	
Flagging..cubic feet..	593,180	614,260	+3.6
Value	$327,743	$318,569	−2.8
Total:			
Quantity..approximate short tons..	195,560	172,130	−12.0
Value	$1,956,195	$1,426,204	−27.1
Miscellaneous stone: [3]			
Building stone..cubic feet..	601,880	680,690	+13.1
Value	$654,342	$754,757	+15.3
Average per cubic foot	$1.09	$1.11	+1.8
Rubble..short tons..	30,390	23,230	−23.6
Value	$55,251	$55,689	+0.8
Flagging..cubic feet..	27,750	33,610	+21.1
Value	$13,740	$16,331	+18.9
Total:			
Quantity..approximate short tons..	83,460	83,380	−0.1
Value	$723,333	$826,777	+14.3
Total, exclusive of slate:			
Quantity..approximate short tons..	2,298,360	2,106,730	−8.3
Value	$25,553,026	$21,416,910	−16.2
Slate as dimension stone [4]..approximate short tons..	179,600	154,450	−14.0
Value	$4,101,125	$3,436,368	−16.2
Total, including slate:			
Quantity..approximate short tons..	2,477,960	2,261,180	−8.7
Value	$29,654,151	$24,853,278	−16.2

[1] To avoid disclosing confidential information, paving blocks in 1939 are included under "Curbing."
[2] Includes paving blocks.
[3] Includes soapstone, mica schist, volcanic rocks, argillite, and other varieties that cannot be classified in the principal groups.
[4] Details of production, by uses, are given in the chapter on Slate in this volume.

BUILDING STONE

The largest use of dimension stone is for building. The following table gives the quantity and value of each kind of stone used for construction in 1940.

Building stone sold or used by producers in the United States in 1940, by kinds

Kind	Rough			
	Construction		Architectural	
	Cubic feet	Value	Cubic feet	Value
Granite	1,074,620	$245,385	563,270	$515,442
Basalt	184,520	17,548		
Marble			176,680	430,052
Limestone	1,265,060	174,148	2,344,440	982,842
Sandstone	425,190	80,750	252,410	199,607
Miscellaneous	680,690	754,757		

Kind	Finished				Total	
	Sawed [1]		Cut [1]			
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
Granite	155,470	$522,343	385,850	$1,809,297	2,179,210	$3,092,467
Basalt					184,520	17,548
Marble	232,500	563,508	373,420	2,330,469	782,600	3,324,029
Limestone	1,148,080	673,948	1,144,430	1,768,621	5,902,010	3,599,559
Sandstone	176,280	247,268	59,780	184,714	913,660	712,339
Miscellaneous					680,690	754,757

[1] For granite, sawed stone corresponds to dressed stone for construction work (walls, foundations, bridges) and cut stone to architectural stone for high-class buildings.

GRANITE

Sales of granite as dimension stone fell 10 percent in quantity but increased 2½ percent in value in 1940 compared with 1939. Cut stone and rubble made substantial gains, and monumental stone declined 2 percent in quantity and gained 4 percent in value, but granite for rough construction, paving blocks, and curbing dropped far below the 1939 totals. The paving-block and curbing industries are dwindling rapidly toward almost total extinction. More than 37 million granite paving blocks were made in 1925, whereas in 1940 the number had slumped to only about 1,800,000.

Granite (dimension stone) sold or used by producers in the United States in 1940, by States and uses

State	Active plants	Building								Monumental				Paving blocks		Curbing		Total	
		Rough				Dressed		Rubble		Rough		Dressed							
		Construction		Architectural															
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Cubic feet	Value	Cubic feet	Value	Number	Value	Cubic feet	value	Short tons (approximate)	Value
California	16	[1]	[1]	[1]	[1]	[1]	[1]	4,120	$12,453	11,910	$23,660	10,380	$76,082			1,960	$2,980	6,850	$134,457
Colorado	7	[1]	[1]							[1]	[1]	[1]	[1]					380	9,735
Connecticut	7	3,090	$3,538	[1]	[1]	[1]	[1]	5,340	9,459	1,960	6,250	3,390	15,256			12,290	15,511	10,650	77,163
Delaware	1							4,020	4,883									4,020	4,883
Georgia	18			7,010	$35,239	[1]	[1]	23,240	18,253	518,690	603,698	115,630	399,396	[1]	[1]	37,380	89,488	80,750	1,211,597
Maine	15	5,470	25,263	173,600	88,531	289,670	$1,233,460	12,210	18,324	17,620	16,392	360	1,705	1,412,170	$196,736	7,880	10,306	72,680	1,590,717
Maryland	6	[1]	[1]	[1]	[1]			[1]	[1]							[1]	[1]	92,910	187,471
Massachusetts	22	5,400	16,734	154,220	175,662	118,040	430,226	14,330	22,236	26,950	63,866	17,760	124,572	81,020	6,127	351,600	292,558	75,510	1,131,981
Minnesota	25	[1]	[1]	106,230	92,031	20,860	96,481	[1]	[1]	208,680	224,985	47,480	259,857					35,490	677,436
Missouri	3	1,850	5,240							8,430	18,304	300	1,924	4,950	595			2,630	26,063
Montana	8			490	514					1,910	2,261	350	3,200					220	5,975
New Hampshire	10	350	986	29,030	34,284	38,520	263,620	550	794	3,710	6,465	6,420	33,595	2,400	150	6,430	7,542	7,760	347,436
New Jersey	1	[1]	[1]					[1]	[1]									[1]	[1]
New York	3	[1]	[1]	2,000	4,000	2,000	8,000	9,930	11,274					[1]	[1]			13,300	45,330
North Carolina	10	3,620	10,022	6,800	5,135	[1]	[1]	1,860	3,634	18,520	27,401	[1]	[1]	13,250	1,426	[1]	[1]	15,760	289,499
Oklahoma	9	[1]	[1]					[1]	[1]	17,610	36,886	20,320	139,819			[1]	[1]	3,250	177,085
Oregon	2					300	1,875			200	600	400	4,066					90	6,541
Pennsylvania	13	20,220	45,461	[1]	[1]			100,270	110,785	[1]	[1]	28,860	126,218	2,590	132	6,700	4,474	124,310	301,403
Rhode Island	3							3,230	3,208	48,880	164,340	7,200	48,277					7,800	215,825
South Carolina	4	[1]	[1]	[1]	[1]			[1]	[1]	[1]	[1]					[1]	[1]	12,020	214,986
South Dakota	6			[1]	[1]	[1]	[1]			46,320	40,199	79,990	564,569					11,930	632,353
Texas	8	[1]	[1]	36,950	26,728	5,340	44,099			16,670	29,008	[1]	[1]					5,940	111,935
Vermont	8					[1]	[1]			604,190	2,044,585	[1]	[1]					49,440	2,076,285
Virginia	2	[1]	[1]	[1]	[1]			[1]	[1]	[1]	[1]			[1]	[1]			[1]	[1]
Washington	5			[1]	[1]			[1]	[1]	[1]	[1]	440	5,881					12,170	14,333
Wisconsin	14			[1]	[1]	2,050	8,208	[1]	[1]	17,420	32,212	37,860	480,050	125,400	20,291	[1]	[1]	7,100	559,085
Undistributed		49,040	138,141	46,940	53,318	64,540	245,671	60,460	73,333	153,770	237,846	8,370	43,517	171,350	10,873	145,050	140,990	5,290	38,650
	226	89,040	245,385	563,270	515,442	541,320	2,331,640	239,560	288,636	1,723,440	3,578,958	385,510	2,327,984	1,813,130	236,330	569,290	563,849	658,250	10,088,224
Short tons (approximate)		[2]		46,450		44,770				141,530		31,810		18,140		46,950			

[1] Included under "Undistributed."

[2] 1,074,620 cubic feet (approximate).

The following tables show sales of monumental granite in the Quincy (Mass.) and Barre (Vt.) centers.

Monumental granite sold by quarrymen at Quincy, Mass. 1936–40 [1]

Year	Active plants	Cubic feet	Value	Year	Active plants	Cubic feet	Value
1936	3	46,570	$85,013	1939	3	25,620	$61,955
1937	3	36,020	80,248	1940	3	24,540	60,139
1938	3	33,360	73,832				

[1] Quincy granite is sold also for construction, curbing, rubble, riprap, and crushed stone.

Monumental granite sold by quarrymen in the Barre district, Vermont, 1936–40 [1]

Year	Cubic feet	Value	Year	Cubic feet	Value
1936	771,230	$2,109,526	1939	684,310	$2,029,801
1937	847,740	2,390,377	1940	601,190	2,039,960
1938	605,660	1,849,607			

[1] Barre granite is sold also for construction and crushed stone.

Estimated output of monumental granite in the Barre district, Vermont, 1938–40 [1]

	1938	1939	1940
Total quarry output, rough stock .... cubic feet	589,440	614,256	548,412
Shipped out of Barre district in rough .... do	117,888	122,852	109,682
Manufactured in Barre district .... do	471,552	491,404	438,730
Light stock consumed in district .... do	294,720	307,128	274,206
Dark stock consumed in district .... do	176,832	184,276	164,524
Number of cutters in district	1,550	1,550	1,295
Average daily wage	$8.00	$8.50	$8.50
Average number of days worked	220	220	220
Total pay roll for year	$2,813,250	$2,898,500	$2,421,650
Estimated overhead	1,406,625	1,449,250	1,210,825
Estimated value of light stock	1,176,987	1,247,714	1,199,651
Estimated value of dark stock	934,347	990,494	874,033
Estimated polishing cost	372,938	388,639	346,980
Output from saws	124,312	129,546	115,660
Total value of granite	6,828,459	7,104,143	6,168,799

[1] Through the kindness of the Granite Manufacturers' Association, Barre, figures covering the entire granite industry of the Barre district are given in this table to supplement figures of sales reported by quarrymen.

BASALT AND RELATED ROCKS (TRAP ROCK)

Because of its dark color, basalt is not used extensively for building. In 1939 considerable quantities were used for rubble, but this use declined greatly in 1940. The tonnage sold in 1940 was only about one-fifth and the value two-fifths as great as in 1939. Some of these dark rocks are used for memorials; but such stones are classed commercially as black granites, and are therefore included with the figures for monumental granite.

Basalt and related rocks (trap rock) (dimension stone) sold or used by producers in the United States in 1940, by States and uses

State	Active plants	Building stone: Rough construction: Short tons	Building stone: Rough construction: Value	Building stone: Rubble: Short tons	Building stone: Rubble: Value	Total: Short tons	Total: Value
California	1			2,620	$1,293	2,620	$1,293
Connecticut	2	(1)	(1)			(1)	(1)
Idaho	1			(1)	(1)	(1)	(1)
Massachusetts	1	(1)	(1)			(1)	(1)
Montana	1			(1)	(1)	(1)	(1)
New Jersey	1	(1)	(1)			(1)	(1)
Oregon	2	1,420	$4,812			1,420	4,812
Pennsylvania	2	(1)	(1)			(1)	(1)
Rhode Island	1	(1)	(1)			(1)	(1)
Washington	3	2,360	2,443	1,110	945	3,470	3,388
Undistributed		11,900	10,293	2,390	851	14,290	11,144
	15	[2] 15,680	17,548	6,120	3,089	21,800	20,637

[1] Included under "Undistributed."

[2] 184,520 cubic feet, approximate.

MARBLE

Sales of marble in 1940 declined 28 percent in quantity and 24 percent in value compared with 1939. The recession was shared by all types of products sold, but interior finished building stone and finished monuments suffered the least. There were drastic declines in sales in Georgia, Tennessee, and Missouri, but sales of building marble made large gains in Vermont. Sales in Massachusetts were a little higher in 1940 than in 1939.

Marble (dimension stone) sold by producers in the United States, 1939–40, by uses

Use	1939: Cubic feet	1939: Value	1940: Cubic feet	1940: Value
Building stone:				
Rough:				
Exterior	179,520	$358,053	65,070	$159,337
Interior	[1] 133,750	[1] 306,945	[1] 111,610	[1] 270,715
Finished:				
Exterior	412,130	1,945,441	313,300	1,214,887
Interior	321,430	2,093,608	292,620	1,679,090
Total exterior	591,650	2,303,494	378,370	1,374,224
Total interior	455,180	2,400,553	404,230	1,949,805
Total building stone	1,046,830	4,704,047	782,600	3,324,029
Monumental stone:				
Rough	192,110	241,828	56,190	64,122
Finished	219,250	1,359,204	213,680	1,406,952
Total monumental stone	411,360	1,601,032	269,870	1,471,074
Total building and monumental	1,458,190	6,305,079	1,052,470	4,795,103
Approximate short tons	123,740		89,040	

[1] Includes onyx for the manufacture of mantels, lamp bases, desk sets, clock cases, and novelties.

Marble (dimension stone) sold by producers in the United States in 1940, by States and uses

State	Active plants	Building [1]		Monumental		Total		
		Cubic feet	Value	Cubic feet	Value	Quantity: Cubic feet	Quantity: Short tons (approximate)	Value
Alabama	2	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Arizona [3]	1	1,560	$4,415			1,560	130	$4,415
Arkansas	4	20,950	28,654	500	$1,200	21,450	1,830	29,854
California	2	(2)	(2)			(2)	(2)	(2)
Colorado	1	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Georgia	1	67,380	480,238	127,050	627,979	194,430	16,530	1,108,217
Maryland	1	(2)	(2)			(2)	(2)	(2)
Massachusetts	2	15,260	29,964	6,110	46,980	21,370	1,800	76,944
Minnesota	1	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Missouri	4	162,030	356,365	8,420	18,844	170,450	14,180	375,209
New York	1	(2)	(2)	(2)	(2)	(2)	(2)	(2)
North Carolina	1	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Tennessee	8	212,260	1,241,625	6,760	30,959	219,020	18,620	1,272,584
Utah [3]	1	320	3,156			320	30	3,156
Vermont	6	210,790	752,302	97,960	578,722	308,750	26,210	1,331,024
Virginia	1	(2)	(2)			(2)	(2)	(2)
Undistributed		92,050	427,310	23,070	166,390	115,120	9,710	593,700
Short tons (approximate)	37	782,600	3,324,029	269,870	1,471,074	1,052,470	89,040	4,795,103

[1] Includes 11,880 cubic feet of serpentine marble (verde antique) valued at $70,738, which was sold as building and ornamental stone.
[2] Included under "Undistributed."
[3] Onyx rough blocks for the manufacture of mantels, lamp bases, desk sets, clock cases, and novelties.

LIMESTONE

Limestone is used in the United States more extensively than any other type of building stone, and Indiana supplied about 70 percent of the rough architectural and finished (cut and sawed) limestone sold in 1940. All the better grades of building stone (those classed above rubble) suffered serious declines in 1940. Only about one-third as much rough construction stone was sold in 1940 as in 1939. The quantity of rough architectural and finished building stone sold in 1940 was 68 percent and the value 57 percent of the corresponding figures for 1939. On the other hand, rubble sold in 1940 was about three times as great both in quantity and value as in 1939. Flagging also made decisive gains. The total quantity of dimension limestone sold in 1940 was a little higher than in 1939, but as the gains were confined to the lower-priced products the total amount realized from sales was only about two-thirds as great as in 1939.

Limestone (dimension stone) sold or used by producers in the United States in 1940, by States and uses

State	Active plants	Building: Rough: Construction: Short tons	Building: Rough: Construction: Value	Building: Rough: Architectural: Cubic feet	Building: Rough: Architectural: Value	Building: Finished (cut and sawed): Cubic feet	Building: Finished (cut and sawed): Value	Building: Rubble: Short tons	Building: Rubble: Value	Flagging: Cubic feet	Flagging: Value	Total: Short tons (approximate)	Total: Value
Alabama	2	-----	-----	(1)	(1)	(1)	(1)	(1)	(1)	-----	-----	(1)	(1)
California	6	(1)	(1)	-----	-----	-----	-----	3,370	$2,961	(1)	(1)	7,550	$9,890
Colorado	2	-----	-----	(1)	(1)	-----	-----	(1)	(1)	-----	-----	(1)	(1)
Florida	4	-----	-----	-----	-----	25,500	$76,750	640	1,350	5,450	$9,500	2,940	87,600
Georgia	1	2,500	$2,000	-----	-----	-----	-----	-----	-----	-----	-----	2,500	2,000
Illinois	15	2,530	14,957	-----	-----	-----	-----	20,930	33,105	16,700	4,129	24,900	52,191
Indiana	24	(1)	(1)	1,395,910	$425,990	1,826,270	1,699,193	(1)	(1)	(1)	(1)	248,420	2,132,108
Iowa	5	(1)	(1)	-----	-----	-----	-----	(1)	(1)	(1)	(1)	1,830	2,499
Kansas	13	32,030	23,529	65,200	12,080	(1)	(1)	64,860	35,755	(1)	(1)	106,800	114,157
Kentucky	10	3,240	3,094	1,600	1,040	-----	-----	11,200	6,784	4,560	676	14,950	11,594
Maryland	3	(1)	(1)	(1)	(1)	-----	-----	(1)	(1)	-----	-----	5,000	15,615
Michigan	1	(1)	(1)	-----	-----	-----	-----	(1)	(1)	-----	-----	(1)	(1)
Minnesota	9	(1)	(1)	55,130	34,356	(1)	(1)	6,640	6,806	49,810	13,263	19,610	197,937
Missouri	15	(1)	(1)	(1)	(1)	(1)	(1)	62,840	91,744	8,810	2,590	65,260	99,448
Montana	1	-----	-----	(1)	(1)	-----	-----	-----	-----	-----	-----	(1)	(1)
New Mexico	1	(1)	(1)	-----	-----	-----	-----	-----	-----	-----	-----	(1)	(1)
New York	5	(1)	(1)	-----	-----	-----	-----	8,880	9,529	(1)	(1)	10,380	12,739
Ohio	12	10,770	21,152	-----	-----	-----	-----	(1)	(1)	(1)	(1)	14,150	26,602
Oklahoma	1	1,930	2,310	-----	-----	-----	-----	-----	-----	-----	-----	1,930	2,310
Pennsylvania	14	6,650	8,565	-----	-----	-----	-----	13,230	11,193	7,600	1,352	20,490	21,110
Puerto Rico	7	(1)	(1)	(1)	(1)	-----	-----	(1)	(1)	-----	-----	5,730	11,740
South Dakota	1	-----	-----	-----	-----	-----	-----	-----	-----	(1)	(1)	(1)	(1)
Tennessee	2	(1)	(1)	-----	-----	-----	-----	(1)	(1)	-----	-----	(1)	(1)
Texas	5	8,200	43,443	223,950	56,310	197,960	259,629	(1)	(1)	(1)	(1)	394,210	677,320
Utah	1	-----	-----	(1)	(1)	-----	-----	-----	-----	-----	-----	(1)	(1)
Virginia	1	-----	-----	-----	-----	-----	-----	(1)	(1)	-----	-----	(1)	(1)
West Virginia	1	-----	-----	-----	-----	-----	-----	(1)	(1)	-----	-----	(1)	(1)
Wisconsin	18	3,890	14,445	514,010	368,584	77,900	62,549	6,840	9,628	100,350	30,021	66,090	485,227
Wyoming	1	-----	-----	(1)	(1)	-----	-----	-----	-----	-----	-----	(1)	(1)
Undistributed	-----	31,730	40,653	88,640	84,482	164,880	344,448	416,820	373,402	43,250	16,618	69,390	297,878
	181	103,470	174,148	2,344,440	982,842	2,292,510	2,442,569	616,250	582,257	236,530	78,149	1,082,130	4,259,965
Short tons (approximate)	-----	(2)	-----	175,570	-----	167,770	-----	-----	-----	19,070	-----	-----	-----

1 Included under "Undistributed."

2 1,265,060 cubic feet, approximate.

The following tables show detailed figures, by uses, for limestone produced near Bedford and Bloomington, Ind.; Carthage, Mo.; and Mankato and Kasota, Minn. The value of sales of Indiana limestone was only about one-half as great in 1940 as in 1939.

Limestone sold by producers in the Indiana oolitic-limestone district, 1936-40, by classes

Year	Construction					
	Rough block		Sawed and semifinished		Cut	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
1936	2,346,380	$698,231	1,028,740	$577,368	1,456,190	$1,861,947
1937	2,152,560	727,425	957,240	633,350	1,332,330	2,168,229
1938	2,090,110	619,602	914,180	561,767	1,147,620	2,044,216
1939	2,462,860	845,252	1,277,730	784,247	1,534,530	2,470,724
1940	1,395,910	425,990	994,370	573,368	831,900	1,125,825

Year	Construction—Continued			Other uses		Total	
	Total						
	Cubic feet	Short tons (approximate)	Value	Short tons	Value	Short tons (approximate)	Value
1936	4,831,310	350,270	$3,137,546	178,150	$132,898	528,420	$3,270,444
1937	4,442,130	322,050	3,529,004	139,250	68,253	461,300	3,597,257
1938	4,151,910	310,000	3,225,585	41,610	26,595	351,610	3,252,180
1939	5,275,120	383,000	4,100,223	247,680	117,200	630,680	4,217,423
1940	3,222,180	233,600	2,125,183	79,730	40,676	313,330	2,165,859

Indiana limestone sold by mills in the district not operated by quarry companies and by mills of quarry companies from stock obtained at quarries other than their own, 1936-40, by classes

Year	Sawed and semifinished		Cut		Total	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
1936	461,560	$328,015	1,392,150	$1,956,641	1,853,710	$2,284,656
1937	168,340	93,815	1,142,249	1,931,488	1,310,589	2,025,303
1938	110,670	69,896	1,136,410	1,703,254	1,247,080	1,773,150
1939	108,360	50,338	1,839,520	2,966,530	1,947,880	3,016,868
1940:						
Mills not operated by quarry companies	80,520	38,452	489,260	750,554	569,780	789,006
Mills of quarry companies from stock obtained at quarries other than their own	191,990	143,787	544,840	878,719	736,830	1,022,506
	272,510	182,239	1,034,100	1,629,273	1,306,610	1,811,512

Limestone and marble sold by producers in the Carthage district, Jasper County, Mo., 1936–40, by classes

Year	Dimension stone (rough and dressed)							Other uses		Total	
	Building		Monumental		Total						
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Short tons (approximate)	Value	Short tons	Value	Short tons (approximate)	Value
1936	116, 970	$296, 653	5, 500	$10, 998	122, 470	10, 220	$307, 651	69, 370	$109, 028	79, 590	$416, 679
1937	128, 570	338, 040	7, 530	14, 912	136, 100	11, 380	352, 952	95, 840	128, 617	107, 220	481, 569
1938	113, 940	300, 936	8, 450	18, 831	122, 390	10, 220	319, 767	65, 560	118, 349	75, 780	438, 116
1939	180, 040	448, 966	8, 400	18, 603	188, 440	15, 730	467, 569	60, 580	94, 215	76, 310	561, 784
1940	94, 180	248, 498	8, 430	18, 844	102, 610	8, 570	267, 342	90, 390	128, 627	98, 960	395, 969

Limestone and marble sold by producers at Mankato and Kasota, Minn., 1936–40

Year	Building stone (rough and dressed)		Other uses		Total	
	Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
1936	157, 130	$332, 699	51, 090	$54, 163	68, 570	$386, 862
1937	143, 580	251, 164	36, 860	40, 106	47, 750	291, 270
1938	123, 780	199, 997	(1)	(1)	[2] 9, 990	[2] 199, 997
1939	122, 030	175, 772	14, 720	15, 830	24, 480	191, 602
1940	[3] 116, 930	[3] 177, 456	20, 880	19, 000	30, 200	196, 456

[1] Bureau of Mines not at liberty to publish figures.
[2] Exclusive of "Other uses."
[3] Includes stone for mausoleums and curbing.

SANDSTONE

Sales of sandstone declined 12 percent in quantity and 27 percent in value in 1940 compared with 1939. Stone for rough construction declined about 50 percent. The quantity of rough architectural and dressed stone sold in 1940 decreased 8 percent and the value 35 percent, compared with 1939. Sales of curbing also slumped greatly. The only principal classifications to gain were rubble and flagging, but the value of the flagging sold was lower than in 1939.

The second table presents a 20-year history of the bluestone industry. This type of sandstone is used for building stone and for curbing and flagging. As "sidewalk stone" it has been replaced generally by concrete, but this loss of market has been compensated to some extent by enlarged demands for ornamental flagging. Sales in 1940 were 1 percent higher in quantity and 15 percent lower in value than in 1939.

Sandstone (dimension stone) sold or used by producers in the United States in 1940, by States and uses

State	Number of plants	Building										Paving blocks		Curbing		Flagging		Total	
		Rough construction		Rough architectural		Dressed				Rubble									
						Sawed		Cut											
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Number	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value
Arizona	3	4,260	$2,198							550	$923					18,100	$6,692	6,210	$9,813
California	5	2,000	8,065							1,340	2,242					29,920	14,983	4,890	25,290
Colorado	2	(1)	(1)							(1)	(1)					(1)	(1)	(1)	(1)
Connecticut	2	(1)	(1)	(1)	(1)			(1)	(1)									(1)	(1)
Indiana	1	600	6,324							10	44					200	131	630	6,499
Kansas	1									50	30					660	908	100	938
Maryland	5	6,680	14,578							14,950	13,455					38,770	13,260	24,730	41,293
Massachusetts	1			(1)	(1)	(1)	(1)	(1)	(1)									(1)	(1)
Michigan	1	1,330	5,240							200	600					130	50	1,540	5,890
Minnesota	1	(1)	(1)															(1)	(1)
Mississippi	1	210	410															210	410
New Jersey	2	(1)	(1)					(1)	(1)	(1)	(1)							(1)	(1)
New Mexico	1	(1)	(1)															(1)	(1)
New York [2]	21	1,200	3,848	1,100	$1,399	(1)	(1)	(1)	(1)	(1)	(1)	55,660	$3,740	144,470	$149,221	77,680	57,200	23,580	279,207
North Carolina	1	(1)	(1)													(1)	(1)	(1)	(1)
Ohio	9	1,180	2,894	209,390	158,406	164,550	$215,691	38,560	$110,861	680	2,533			173,380	193,645	307,950	108,568	66,670	792,598
Pennsylvania [3]	22	10,350	24,891							4,380	7,035			1,600	1,489	96,890	69,636	22,920	103,051
South Dakota	1			(1)	(1)													(1)	(1)
Tennessee	3	(1)	(1)	34,670	28,564					(1)	(1)					23,970	35,721	5,720	68,864
Vermont	1									1,570	1,569							1,570	1,569
Virginia	8	970	1,656							770	2,405					8,710	3,717	2,440	7,778
Washington	1	(1)	(1)	(1)	(1)			(1)	(1)							(1)	(1)	(1)	(1)
Wisconsin	2	(1)	(1)					(1)	(1)	(1)	(1)							(1)	(1)
Undistributed		4,690	10,646	7,250	11,238	11,730	31,577	21,220	73,853	6,630	16,365					11,280	7,703	10,920	83,004
	95	33,470	80,750	252,410	199,607	176,280	247,268	59,780	184,714	31,130	47,201	55,660	3,740	319,450	344,355	614,260	318 569	172,130	1,426,204
Short tons, approximate		(4)		18,550		12,930		4,530				510		24,500		46,510			

[1] Included under "Undistributed."
[2] Includes 175,140 cubic feet of bluestone (approximately 14,800 short tons) valued at $206,575 sold for construction, curbing, and flagging.
[3] Includes 81,760 cubic feet of bluestone (approximately 8,400 short tons) valued at $65,926 sold for construction, curbing, and flagging.
[4] 425,190 cubic feet, approximate.

Bluestone (dimension stone) sold or used in the United States,[1] 1921–40

Year	Cubic feet	Value	Year	Cubic feet	Value
1921	630,700	$657,658	1931	356,210	$427,801
1922	722,830	697,341	1932	185,960	185,643
1923	618,360	747,422	1933	116,246	123,867
1924	769,240	875,734	1934	181,960	168,720
1925	987,900	910,585	1935	215,150	203,537
1926	692,640	885,597	1936	343,040	332,749
1927	815,730	1,000,217	1937	308,740	346,349
1928	891,190	1,014,843	1938	329,670	369,857
1929	670,020	773,532	1939	254,440	319,405
1930	611,240	749,703	1940	256,900	272,501

[1] New York and Pennsylvania are the only States that produce bluestone.

MISCELLANEOUS STONE

The following table gives data on certain types of dimension stone not included in the major groups already discussed. The principal varieties are mica schist, argillite, various light-color volcanic rocks, soapstone, and greenstone. The quantity sold was almost the same in 1940 as in 1939, but the value was much higher.

Miscellaneous varieties of stone (dimension stone) sold or used by producers in the United States in 1940, by States and uses

State	Active plants	Building: Rough and dressed		Building: Rubble		Flagging		Total	
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Arizona	1	(1)	(1)	(1)	(1)			(1)	(1)
California	3			(1)	(1)	(1)	(1)	1,430	$4,797
Florida	1			(1)	(1)			(1)	(1)
Georgia	3					1,630	$8,804	1,630	8,804
Maryland	5	6,370	$17,555	(1)	(1)	(1)	(1)	9,490	25,718
New Jersey	2	(1)	(1)	(1)	(1)			(1)	(1)
New York	2	(1)	(1)					(1)	(1)
Ohio	1	(1)	(1)					(1)	(1)
Pennsylvania	6	(1)	(1)	(1)	(1)			44,870	62,303
Virginia	2	(1)	(1)			(1)	(1)	(1)	(1)
Undistributed		51,060	737,202	23,230	$55,689	1,090	7,527	25,960	725,155
	26	[2] 57,430	754,757	23,230	55,689	[2] 2,720	16,331	83,380	826,777

[1] Included under "Undistributed."
[2] Building stone, approximately 680,690 cubic feet; flagging, approximately 33,610 cubic feet.

TRENDS IN USE OF DIMENSION STONE

Figure 1 shows graphically the history of production of dimension stone, by kinds, for a 25-year period. Dimension stone includes all classes of building stone, as well as memorial stone, paving blocks, curbing, and flagging. Wars and depressions evidently affect the output of these products adversely. Although the output of certain mineral products, particularly the metals, is stimulated greatly by a program of national defense, this group does not include dimension stone. An environment of peace and general prosperity is requisite for active growth and development of the dimension-stone industries.

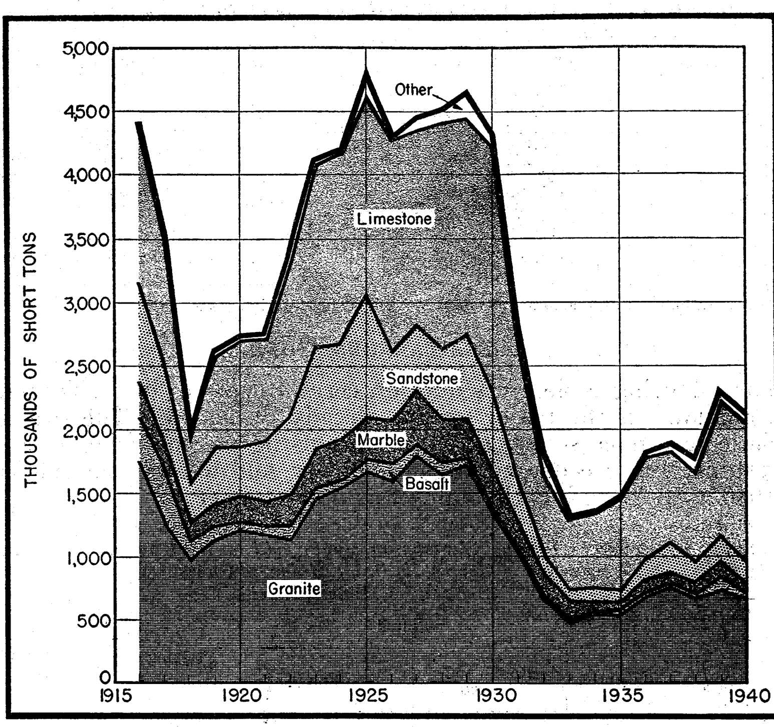

FIGURE 1.—Sales of dimension stone in the United States, by kinds, 1916-40.

Figure 2 traces the history of production of all building stone and of the principal variety, limestone, in their relation to nonresidential building, which is the class of construction in which stone is used most

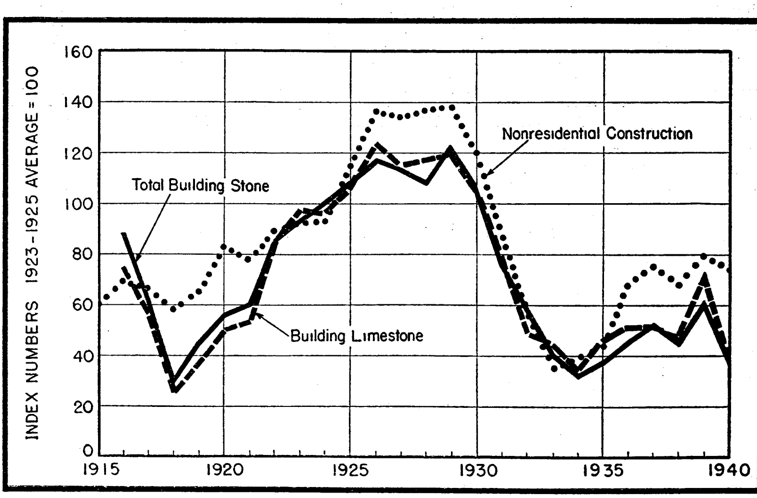

FIGURE 2.—Sales of all building stone and building limestone compared with physical volume of new nonresidential building activity, 1916-40. Data on nonresidential building construction from Bureau of Foreign and Domestic Commerce.

extensively. Building-stone production was at a low ebb in 1918 at the close of the World War of 1914–18, but recovered rapidly. However, it failed to reach the high level attained by building construction during the prosperous years 1926–29. Sales of stone followed the rapid decline in nonresidential building during the depression years that followed. The substantial recovery in building since 1935 has, however, failed to stimulate corresponding activity in stone output, although there was a promising upward trend in 1939, which was reversed, however, in 1940 when building-stone sales fell almost as low as during the depression period.

NEW DEVELOPMENTS

The results of exhaustive studies of 116 commercial granites produced for dimension stone uses in the United States are included in a recent report of the National Bureau of Standards.[1] This report is obtainable as a separate pamphlet under the designation Research Paper 1320 from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Onyx marble and travertine are used moderately in the United States for novelties and decorative building, but most of our supplies are obtained from foreign sources—onyx from Mexico and Argentina and travertine from Italy. A recent report[2] describes both foreign and domestic deposits of these materials and outlines their characteristics and uses.

CRUSHED AND BROKEN STONE

Nearly 152,000,000 tons of crushed and broken stone were sold in 1940, exclusive of that used for making cement and lime. Sales increased 4 percent in both quantity and value compared with 1939. The largest proportional gains were in metallurgical, refractory, and agricultural stone and for limestone used in calcium carbide manufacture. Sales of concrete aggregate, road stone, and riprap declined.

The following table of salient statistics shows the quantity and value of crushed and broken stone sold during 1939 and 1940, by uses. Detailed data on asphaltic stone and slate granules and flour are given in the chapters on Asphalt and Slate.

[1] Kessler, D. W., Insley, Herbert, and Sligh, William H., Physical, Mineralogical, and Durability Studies on the Building and Monumental Granites of the United States: Nat. Bureau of Standards Jour. Research, vol. 25, 1940, pp. 161–206.

[2] Bowles, Oliver, Onyx Marble and Travertine: Bureau of Mines Inf. Circ. 6751R, 1940, 11 pp.

Crushed and broken stone sold or used by producers in the United States, 1939–40, by principal uses

Use	1939			1940		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Concrete and road metal	96,894,220	$88,988,217	$0.92	92,814,090	$86,331,273	$0.93
Railroad ballast	6,996,800	4,970,058	.71	7,454,300	5,231,815	.70
Metallurgical	17,287,790	12,632,243	.73	22,872,050	15,754,692	.69
Alkali works	4,655,960	2,100,535	.45	4,848,490	2,017,804	.42
Riprap	5,811,740	5,851,732	1.01	5,264,100	5,414,038	1.03
Agricultural	5,459,260	6,592,827	1.21	8,724,160	9,910,373	1.14
Refractory (ganister, mica schist, dolomite, soapstone)	1,492,310	2,044,054	1.37	1,740,420	2,329,200	1.34
Asphalt filler	265,710	676,978	2.55	320,220	759,399	2.37
Calcium carbide works	274,890	233,085	.85	482,950	389,246	.81
Sugar factories	621,730	853,235	1.37	558,560	868,786	1.56
Glass factories	240,840	394,727	1.64	300,720	475,273	1.58
Paper mills	302,620	488,079	1.61	333,800	575,814	1.73
Other uses	4,844,900	7,082,719	1.46	5,912,450	8,569,492	1.45
	145,148,770	132,908,489	.92	151,626,310	138,627,205	.91
Portland cement (including "cement rock") [1] Natural cement ("cement rock") [1]	30,463,000	(2)		33,986,000	(2)	
Lime [3]	8,509,000	(2)		9,774,000	(2)	
Total stone	184,121,000	(2)		195,386,000	(2)	
Asphaltic stone	422,484	2,007,810	4.75	458,665	1,949,166	4.25
Slate granules and flour	351,780	2,581,089	7.34	319,000	2,301,901	7.22

[1] Value reported as cement in chapter on Cement.
[2] No value available for stone used in manufacture of cement and lime.
[3] Value reported as lime in chapter on Lime.

The following tables show the tonnage and value of stone used for concrete aggregate, road construction, and railroad ballast for a series of years and by States for 1940.

Concrete and road metal and railroad ballast sold or used by producers in the United States, 1936–40

Year	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1936	79,336,740	$76,095,094	7,934,080	$6,022,693	87,270,820	$82,117,787
1937	80,271,900	76,972,465	8,160,670	5,852,143	88,432,570	82,824,608
1938	88,787,080	84,212,446	5,975,970	4,554,775	94,763,050	88,767,221
1939	96,894,220	88,988,217	6,996,800	4,970,058	103,891,020	93,958,275
1940	92,814,090	86,331,273	7,454,300	5,231,815	100,268,390	91,563,088

Concrete and road metal and railroad ballast sold or used by producers in the United States in 1940, by States

State	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	786,820	$753,919	(1)	(1)	[2] 786,820	[2] $753,919
Alaska	(1)	(1)			(1)	(1)
Arizona	882,270	822,255	(1)	(1)	[2] 882,270	[2] 822,255
Arkansas	[2] 690,430	[2] 634,412	209,690	$142,491	[2] 900,120	[2] 776,903
California	4,893,580	3,131,143	185,950	99,656	5,079,530	3,230,799
Colorado	509,840	541,090	(1)	(1)	[2] 509,840	[2] 541,090
Connecticut	[2] 1,538,290	[2] 1,355,118	90,040	76,219	[2] 1,628,330	[2] 1,431,337
Delaware	110,500	147,212			110,500	147,212
District of Columbia	(1)	(1)			(1)	(1)
Florida	1,902,830	1,604,841	(1)	(1)	[2] 1,902,830	[2] 1,604,841
Georgia	[2] 1,793,210	[2] 1,744,539	35,000	25,000	[2] 1,828,210	[2] 1,769,539
Hawaii	683,990	1,129,013	(1)	(1)	[2] 683,990	[2] 1,129,013
Idaho	908,820	744,489			908,820	744,489
Illinois	5,920,070	4,442,070	359,540	234,056	6,279,610	4,676,126
Indiana	[2] 3,189,890	[2] 2,767,152	182,460	140,320	[2] 3,372,350	[2] 2,907,472
Iowa	3,330,850	3,136,167	40,160	27,980	3,371,010	3,164,147
Kansas	[2] 1,907,380	[2] 2,642,688	185,000	149,828	[2] 2,092,380	[2] 2,792,516
Kentucky	3,389,570	3,222,063	439,690	233,569	3,829,260	3,455,632
Louisiana	133,880	77,211			133,880	77,211
Maine	[2] 74,970	[2] 90,593			[2] 74,970	[2] 90,593
Maryland	783,450	816,354	[2] 90,440	[2] 90,440	[2] 873,890	[2] 906,794
Massachusetts	1,411,060	1,434,099	132,440	119,599	1,543,500	1,553,698
Michigan	2,176,280	1,394,211	196,310	117,058	2,372,590	1,511,269
Minnesota	950,260	959,993	(1)	(1)	[2] 950,260	[2] 959,993
Mississippi	(1)	(1)			(1)	(1)
Missouri	[2] 4,101,510	[2] 3,923,765	[2] 5,800	[2] 6,699	[2] 4,107,310	[2] 3,930,464
Montana	654,890	631,453	4,280	3,181	659,170	634,634
Nebraska	703,620	637,154			703,620	637,154
Nevada	66,440	73,792			66,440	73,792
New Hampshire	43,850	49,802			43,850	49,802
New Jersey	2,358,030	2,408,881	[2] 86,150	[2] 86,345	[2] 2,444,180	[2] 2,495,226
New Mexico	164,290	126,761	(1)	(1)	[2] 164,290	[2] 126,761
New York	7,112,870	7,400,467	645,180	465,399	7,758,050	7,865,866
North Carolina	2,691,230	4,150,924	(1)	(1)	[2] 2,691,230	[2] 4,150,924
North Dakota	20,750	31,040			20,750	31,040
Ohio	[2] 6,272,700	[2] 4,988,692	836,830	561,434	[2] 7,109,530	[2] 5,550,126
Oklahoma	901,440	800,707	(1)	(1)	[2] 901,440	[2] 800,707
Oregon	[2] 2,734,620	[2] 2,192,830			[2] 2,734,620	[2] 2,192,830
Pennsylvania	7,420,810	7,411,858	[2] 525,990	[2] 505,648	[2] 7,946,800	[2] 7,917,506
Puerto Rico	[2] 108,040	[2] 107,477	7,120	7,382	[2] 115,160	[2] 114,859
Rhode Island	[2] 175,830	[2] 249,601			[2] 175,830	[2] 249,601
South Carolina	834,580	994,760	275,360	249,058	1,109,940	1,243,818
South Dakota	165,950	161,507	(1)	(1)	[2] 165,950	[2] 161,507
Tennessee	4,123,960	4,090,543	529,260	374,335	4,653,220	4,464,878
Texas	1,478,910	1,171,138	522,140	279,063	2,001,050	1,450,201
Utah	[2] 625,850	[2] 395,943			[2] 625,850	[2] 395,943
Vermont	29,660	42,840			29,660	42,840
Virginia	4,172,980	3,793,996	602,270	425,499	4,775,250	4,219,495
Washington	1,882,590	1,378,633			1,882,590	1,378,633
West Virginia	[2] 857,680	[2] 996,901	(1)	(1)	1,530,660	2,026,180
Wisconsin	3,454,050	2,723,047	(1)	(1)	[2] 3,454,050	[2] 2,723,047
Wyoming	[2] 207,880	[2] 175,180	(1)	(1)	324,190	251,631
Undistributed	1,480,840	1,630,949	1,267,200	811,556	1,958,750	1,336,775
	92,814,090	86,331,273	7,454,300	5,231,815	100,268,390	91,563,088

[1] Included under "Undistributed."
[2] To avoid disclosing confidential information certain totals are somewhat incomplete, the figures not included being combined under "Undistributed."

Commercial and noncommercial operations.—The following table shows the production of crushed stone for concrete and road metal and railroad ballast during recent years by Government agencies of various kinds contrasted with that by commercial enterprises. Production by commercial companies increased 6 percent in 1940 compared with 1939, whereas production by Government agencies declined 16½ percent. Sixty-three percent of the total production was made by commercial companies.

Concrete and road metal and railroad ballast sold or used by commercial and noncommercial operators in the United States, 1936–40

[Figures for "noncommercial operations" represent tonnages reported by States, counties, municipalities, and other Government agencies, produced either by themselves or by contractors expressly for their consumption, often with publicly owned equipment; they do not include purchases from commercial producers. Figures for "commercial operations" represent tonnages reported by all other producers]

Year	Commercial operations				Noncommercial operations				Total	
	Short tons	Average value per ton	Percent of change in quantity from preceding year	Percent of total quantity	Short tons	Average value per ton	Percent of change in quantity from preceding year	Percent of total quantity	Short tons	Percent of change in quantity from preceding year
1936	57,494,430	$.93	+50.9	65.9	29,776,390	$.95	+78.7	34.1	87,270,820	+59.4
1937	62,315,350	.88	+8.4	70.5	26,117,220	1.06	−12.3	29.5	88,432,570	+1.3
1938	60,254,170	.88	−3.3	63.6	34,508,880	1.04	+32.1	36.4	94,763,050	+7.2
1939	59,516,270	.86	−1.2	57.3	44,374,750	.97	+28.6	42.7	103,891,020	+9.6
1940	63,203,240	.87	+6.2	63.0	37,065,150	1.02	−16.5	37.0	100,268,390	−3.5

Methods of transportation.—The following table shows the quantities of concrete and road metal conveyed during 1939 and 1940 by each of the principal methods of transportation.

Concrete and road metal sold or used by commercial producers in the United States, 1939–40, by methods of transportation [1]

Method of transportation	1939		1940	
	Short tons	Percent of total	Short tons	Percent of total
Truck	33,495,870	63.8	36,069,110	64.7
Rail	11,712,330	22.3	10,911,260	19.5
Waterway	4,886,820	9.3	6,072,270	11.0
Unspecified	2,424,450	4.6	2,696,300	4.8
	52,519,470	100.0	55,748,940	100.0

[1] For practical purposes the entire output of noncommercial operations commonly is moved by truck. Including noncommercial production, crushed stone for concrete and road metal moved as follows: 1939: Truck 80 percent, rail 12 percent, waterway 5 percent, and unspecified 3 percent; 1940: Truck 79 percent, rail 12 percent, waterway 6 percent, and unspecified 3 percent.

GRANITE

Sales of crushed and broken granite declined 10 percent in quantity and 9 percent in value in 1940 compared with 1939. Riprap declined to about one-half the tonnage sold in 1939, but sales of stone for miscellaneous uses were about 2½ times as great as in 1939.

Noncommercial production, which is a substantial part of the total, is reported by city, county, and State governments, highway commissions, or other Government agencies. From the reports submitted it is impossible to determine the number of plants that supply materials. Because the number of individual operations supplying noncommercial crushed stone cannot be determined with any degree of accuracy, the columns indicating the number of active plants (which have appeared in the granite and other tables covering the crushed-stone industry for many years prior to 1939) have been omitted in this report.

Granite (crushed and broken stone) sold or used by producers in the United States in 1940, by States and uses

State	Riprap		Crushed stone: Concrete and road metal		Crushed stone: Railroad ballast		Other uses [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			(2)	(2)					(2)	(2)
Arizona	(2)	(2)	(2)	(2)					22,980	$15,986
Arkansas	59,480	$53,881							59,480	53,881
California	251,740	201,113	920,980	$651,712	(2)	(2)	(2)	(2)	1,254,530	901,678
Colorado			107,550	104,789			590	$1,966	108,140	106,755
Connecticut	(2)	(2)					(2)	(2)	24,400	26,905
Delaware	170	218	110,500	147,212					110,670	147,430
Georgia	56,420	67,116	1,478,470	1,348,054	35,000	$25,000	293,570	482,401	1,863,460	1,922,571
Idaho			(2)	(2)					(2)	(2)
Maine	(2)	(2)	64,920	79,012			(2)	(2)	71,010	83,716
Maryland	(2)	(2)	(2)	(2)					75,590	90,234
Massachusetts	38,320	49,991	332,640	374,246	20,000	20,046	63,290	213,873	454,250	658,156
Minnesota	5,940	3,917	(2)	(2)			(2)	(2)	26,900	36,752
Missouri	700	584							700	584
Montana	(2)	(2)	(2)	(2)	(2)	(2)			(2)	(2)
New Hampshire	(2)	(2)	32,250	37,446			(2)	(2)	35,360	44,061
New Jersey			(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
New York	(2)	(2)	625,260	573,044	(2)	(2)	(2)	(2)	704,180	639,228
North Carolina	1,230	1,018	2,081,350	3,485,208	(2)	(2)	(2)	(2)	2,387,130	3,836,019
North Dakota			(2)	(2)					(2)	(2)
Oklahoma	(2)	(2)	(2)	(2)					(2)	(2)
Pennsylvania	(2)	(2)	293,830	313,393			(2)	(2)	294,480	314,317
Rhode Island	(2)	(2)	(2)	(2)					7,730	7,289
South Carolina	5,700	7,434	723,430	847,987	275,360	249,058	46,240	21,206	1,050,730	1,125,685
South Dakota			(2)	(2)			(2)	(2)	9,930	14,205
Tennessee			(2)	(2)					(2)	(2)
Texas	13,060	15,750							13,060	15,750
Utah			225,390	90,826					225,390	90,826
Vermont	(2)	(2)	(2)	(2)					8,060	10,322
Virginia	(2)	(2)	947,650	950,012	(2)	(2)	(2)	(2)	1,112,400	1,069,283
Washington	(2)	(2)	29,140	19,085			(2)	(2)	38,800	47,439
Wisconsin	(2)	(2)	(2)	(2)					4,880	6,176
Undistributed	148,380	139,036	332,690	370,083	490,210	435,702	110,880	152,300	258,090	268,471
	581,140	540,058	8,306,050	9,392,109	820,570	729,806	514,570	871,746	10,222,330	11,533,719

[1] Includes stone used for artificial stone, asphalt filler, chips, fill material, poultry grit, spalls, stone sand, and terrazzo.
[2] Included under "Undistributed."

BASALT AND RELATED ROCKS (TRAP ROCK)

Basalt, gabbro, diorite, and other dark igneous rocks (known commercially as trap rock), are used widely for highway construction and concrete aggregate. Sales of crushed and broken trap rock declined 2 percent in quantity but gained 7 percent in value in 1940 compared with 1939. Sales of riprap declined greatly and railroad ballast moderately. Stone used as concrete aggregate and for road construction made modest gains, and that sold for miscellaneous uses increased nearly elevenfold. Sales of riprap in the major producing States fluctuate greatly, as they depend chiefly on special reclamation and other projects. Prices per ton of trap rock at the quarry for all forms of trap rock increased from an average of 88 cents in 1939 to an average of 97 cents in 1940.

Basalt and related rocks (trap rock) (crushed and broken stone) sold or used by producers in the United States, 1940, by States and uses

State	Riprap		Crushed stone				Other uses[1]		Total	
			Concrete and road metal		Railroad ballast					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Arizona	------	------	(2)	(2)	------	------	------	------	(2)	(2)
California	190,710	$298,195	498,220	$414,262	3,050	$2,413	------	------	691,980	$714,870
Colorado	(2)	(2)	(2)	(2)	------	------	------	------	(2)	(2)
Connecticut	187,020	164,711	1,538,290	1,355,118	90,040	76,219	------	------	1,815,350	1,596,048
Hawaii	(2)	(2)	683,990	1,129,013	(2)	(2)	6,730	$1,974	705,470	1,140,769
Idaho	(2)	(2)	(2)	(2)	------	------	------	------	899,570	760,462
Maine	------	------	8,690	9,198	------	------	------	------	8,690	9,198
Maryland	12,840	9,556	198,780	245,483	90,440	90,440	------	------	302,060	345,479
Massachusetts	71,160	69,600	811,240	815,990	112,440	99,553	39,150	66,889	1,033,990	1,052,032
Michigan	------	------	24,890	25,170	------	------	------	------	24,890	25,170
Minnesota	------	------	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Montana	(2)	(2)	(2)	(2)	------	------	------	------	92,370	71,114
New Hampshire	------	------	(2)	(2)	------	------	------	------	(2)	(2)
New Jersey	(2)	(2)	2,128,480	2,214,900	86,150	86,345	(2)	(2)	2,286,220	2,364,206
New York	------	------	(2)	(2)	(2)	(2)	------	------	873,860	1,030,725
North Carolina	------	------	240,000	272,000	------	------	------	------	240,000	272,000
Oregon	12,350	9,860	2,699,550	2,158,564	------	------	------	------	2,711,900	2,168,424
Pennsylvania	------	------	772,400	677,543	200,270	198,273	2,600	5,800	975,270	881,616
Rhode Island	------	------	123,570	191,136	------	------	------	------	123,570	191,136
Texas	------	------	(2)	(2)	(2)	(2)	------	------	(2)	(2)
Utah	(2)	(2)	------	------	------	------	------	------	(2)	(2)
Virginia	------	------	314,670	321,044	------	------	------	------	314,670	321,044
Washington	280,270	177,520	1,823,340	1,339,396	------	------	------	------	2,103,610	1,516,916
Wisconsin	(2)	(2)	(2)	(2)	------	------	(2)	(2)	(2)	(2)
Wyoming	------	------	67,340	41,619	------	------	------	------	67,340	41,619
Undistributed	122,230	132,788	2,037,640	2,146,779	140,370	128,272	75,180	189,392	423,280	662,187
	876,580	862,230	13,971,090	13,357,215	722,760	681,515	123,660	264,055	15,694,090	15,165,015

[1] Includes stone sold for concrete blocks, fill material, roofing granules, stone sand, and tennis courts.
[2] Included under "Undistributed."

MARBLE

Marble producers accumulate large quantities of waste material, consisting either of defective blocks or of cuttings and spalls that result from marble dressing, and they are constantly seeking profitable outlets for this waste. As the following table indicates, the price per ton realized varies greatly, because some States produce relatively high priced products, such as terrazzo, stucco, and marble flour, that may be worth several dollars a ton, whereas other States find outlets only in the form of riprap, road stone, and concrete aggregate that may command prices of only $1 or less a ton.

Marble (crushed and broken stone) sold by producers in the United States in 1940, by States [1]

State	Active plants	Short tons	Value	State	Active plants	Short tons	Value
Georgia	1	17,000	$17,829	Texas	2	9,690	$63,875
Massachusetts	1	3,510	4,256	Utah	1	4,400	21,727
Missouri	2	12,860	17,553	Other States [2]	10	30,620	135,814
New York	3	16,520	74,265				
Tennessee	5	56,090	65,702		25	150,690	401,021

[1] Includes stone used for agriculture, artificial stone, crushed stone, flux, magnesite floors, mineral food, poultry grit, riprap, spalls, stucco, terrazzo, tile, and whiting (excluding marble whiting made by companies that purchase their marble).
[2] Alabama, Arkansas, California, Maryland, New Jersey, Virginia, and Washington

LIMESTONE

Limestone is the most widely used type of rock employed in crushed and broken form. It is used more extensively than other rocks because it can be quarried and crushed at moderate cost, is available to a multitude of markets, and is essential to many chemical and manufacturing industries. In 1940 limestone comprised 74 percent of all crushed and broken stone sold (excluding that used for making cement and lime). Sales in 1940 were 12 percent higher in both quantity and value than in 1939. Sales of riprap increased 45 percent in quantity and 73 percent in value. The high level of iron and steel production in 1940 was reflected in a 32-percent increase in sales of fluxing stone. Sales of stone for concrete aggregate and road building declined slightly, but average prices were higher than in 1939. Railroad ballast gained 16 percent, and stone for agriculture made a remarkable 60-percent advance over 1939. An 18-percent advance in sales of stone for miscellaneous uses (chiefly in the chemical and processing industries) reflects the increased tempo of industrial activity. The following tables show production by States and uses in 1940 and sales for miscellaneous industrial uses in 1939 and 1940.

Limestone (crushed and broken stone) sold or used by producers in the United States in 1940, by States and uses

State	Riprap		Fluxing stone		Crushed stone: Concrete and road metal		Crushed stone: Railroad ballast		Agriculture		Other uses		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	49, 840	$52, 766	1, 388, 310	$1, 191, 818	693, 190	$691, 047	(1)	(1)	155, 750	$144, 312	(1)	(1)	2, 347, 880	$2, 309, 855
Arizona			(1)	(1)	(1)	(1)							251, 810	306, 814
Arkansas	35, 870	40, 436			611, 760	570, 149	(1)	(1)	32, 940	40, 041	(1)	(1)	727, 030	718, 117
California	163, 220	213, 078	25, 440	49, 093	196, 600	247, 646			280	813	253, 820	$579, 678	639, 360	1, 090, 308
Colorado	(1)	(1)	(1)	(1)	56, 340	29, 837					149, 100	146, 688	511, 080	341, 953
Connecticut			(1)	(1)	(1)	(1)			47, 230	144, 038	(1)	(1)	60, 800	191, 565
Florida	(1)	(1)			1, 840, 940	1, 474, 331	(1)	(1)	51, 050	111, 044	577, 380	480, 893	2, 815, 710	2, 531, 907
Georgia	1, 250	1, 000	3, 350	6, 701	314, 740	396, 485			54, 310	89, 433	150, 780	268, 052	524, 430	761, 671
Hawaii									(1)	(1)			(1)	(1)
Idaho			(1)	(1)	(1)	(1)					(1)	(1)	21, 570	26, 684
Illinois	366, 210	354, 600	567, 350	572, 515	5, 660, 360	4, 229, 303	359, 540	$234, 056	1, 842, 550	1, 562, 682	224, 480	377, 114	9, 020, 490	7, 330, 270
Indiana	49, 650	31, 272	44, 040	24, 967	3, 189, 890	2, 767, 152	182, 460	140, 320	601, 580	541, 374	181, 820	178, 314	4, 249, 440	3, 683, 399
Iowa	204, 090	197, 594	(1)	(1)	3, 330, 850	3, 136, 167	40, 160	27, 980	391, 820	350, 282	(1)	(1)	4, 011, 910	3, 829, 571
Kansas	288, 390	402, 707			1, 907, 380	2, 642, 688	185, 000	149, 828	37, 700	35, 898	219, 930	132, 602	2, 638, 400	3, 363, 723
Kentucky	82, 190	83, 696	(1)	(1)	3, 334, 600	3, 158, 124	439, 690	233, 569	678, 540	625, 924	(1)	(1)	4, 548, 380	4, 128, 263
Louisiana					(1)	(1)					(1)	(1)	(1)	(1)
Maine	28, 500	41, 130			1, 360	2, 383			28, 910	91, 382	34, 430	57, 672	93, 200	192, 567
Maryland			(1)	(1)	528, 700	495, 448	(1)	(1)	(1)	(1)	21, 840	35, 061	565, 360	565, 885
Massachusetts	(1)	(1)	15, 740	23, 000	(1)	(1)			134, 810	389, 346	46, 950	106, 614	223, 420	544, 857
Michigan	68, 850	27, 156	7, 119, 940	3, 296, 766	2, 151, 390	1, 369, 041	196, 310	117, 058	118, 550	83, 604	3, 751, 730	1, 873, 849	13, 406, 770	6, 767, 474
Minnesota	33, 090	26, 900	(1)	(1)	931, 340	932, 109			23, 520	25, 354	(1)	(1)	998, 610	1, 020, 165
Mississippi					(1)	(1)					(1)	(1)	(1)	(1)
Missouri	864, 710	815, 566	10, 860	13, 833	4, 101, 510	3, 923, 765	5, 800	6, 699	599, 130	577, 922	131, 370	230, 258	5, 713, 380	5, 568, 043
Montana			(1)	(1)	(1)	(1)	(1)	(1)			51, 730	74, 824	244, 730	239, 396
Nebraska	91, 280	122, 664			703, 620	637, 154					37, 990	146, 745	832, 890	906, 563
Nevada			(1)	(1)	(1)	(1)					(1)	(1)	(1)	(1)
New Jersey					(1)	(1)			(1)	(1)	(1)	(1)	218, 670	305, 620
New Mexico					(1)	(1)	(1)	(1)					321, 810	193, 545
New York	218, 300	410, 787	22, 510	20, 571	5, 257, 200	5, 463, 869	512, 080	349, 094	295, 130	600, 175	1, 351, 850	1, 017, 332	7, 657, 070	7, 861, 828
North Carolina					155, 580	168, 536			15, 860	10, 972			171, 440	179, 508
Ohio	31, 310	24, 765	3, 448, 320	2, 289, 828	6, 272, 700	4, 988, 692	836, 830	561, 434	811, 290	726, 764	331, 070	468, 235	11, 731, 520	9, 059, 718
Oklahoma	236, 370	125, 270			802, 390	744, 253	(1)	(1)	9, 660	9, 758	(1)	(1)	1, 201, 690	976, 976
Oregon									(1)	(1)	(1)	(1)	9, 340	20, 885
Pennsylvania	800	800	7, 200, 210	5, 962, 932	5, 102, 890	5, 132, 647	160, 920	150, 406	635, 690	1, 414, 574	1, 203, 060	1, 783, 891	14, 303, 570	14, 445, 250
Puerto Rico					108, 040	107, 477	(1)	(1)	(1)	(1)	(1)	(1)	110, 140	109, 103
Rhode Island			660	1, 470					9, 350	37, 412	10	23	10, 020	38, 905

South Carolina	----------	----------	----------	----------	(1)	(1)	----------
South Dakota	(1)	(1)	----------	----------	46,030	30,358	(1)
Tennessee	38,790	36,382	13,210	12,103	4,078,010	4,039,043	529,260
Texas	(1)	(1)	(1)	(1)	1,306,910	1,035,122	436,180
Utah	----------	----------	161,650	99,571	400,460	305,117	----------
Vermont	----------	----------	----------	----------	(1)	(1)	----------
Virginia	31,240	19,977	532,010	512,159	2,723,310	2,346,876	449,830
Washington	----------	----------	(1)	(1)	----------	----------	----------
West Virginia	(1)	(1)	1,726,850	1,273,371	857,680	996,901	(1)
Wisconsin	95,750	92,867	(1)	(1)	3,328,820	2,587,028	(1)
Wyoming	(1)	(1)	(1)	(1)	119,970	118,124	(1)
Undistributed	263,660	414,912	576,460	388,189	819,540	818,709	751,350
	3,243,360	3,536,325	22,856,910	15,738,887	60,934,100	55,585,581	5,085,410

South Carolina	----------	(1)	(1)	----------	----------	170,860	230,018
South Dakota	(1)	----------	----------	(1)	(1)	51,470	35,857
Tennessee	374,335	772,800	647,848	34,910	88,901	5,466,980	5,198,612
Texas	218,124	----------	----------	229,790	198,504	2,056,220	1,514,975
Utah	----------	----------	----------	49,980	94,301	612,090	498,989
Vermont	----------	(1)	(1)	(1)	(1)	29,090	241,644
Virginia	315,733	751,340	764,919	626,130	571,205	5,113,860	4,530,869
Washington	----------	(1)	(1)	127,620	276,218	157,040	327,902
West Virginia	(1)	83,310	140,442	322,390	305,604	3,239,440	2,893,640
Wisconsin	(1)	306,950	341,744	16,790	29,157	3,779,750	3,080,582
Wyoming	(1)	----------	----------	(1)	(1)	201,790	231,972
Undistributed	467,978	234,110	402,316	605,040	1,107,825	515,420	351,892
	3,346,614	8,724,160	9,910,373	10,731,990	10,629,560	111,575,930	98,747,340

[1] Included under "Undistributed."

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Limestone (crushed and broken) sold or used by producers in the United States for miscellaneous uses, 1939–40

Use	1939		1940	
	Short tons	Value	Short tons	Value
Alkali works	4,655,960	$2,100,535	4,848,490	$2,017,804
Calcium carbide works	274,890	233,085	482,950	389,246
Coal-mine dusting	68,260	180,123	99,300	281,320
Filler (not whiting substitute):				
Asphalt	265,710	676,978	320,220	759,399
Fertilizer	116,080	185,844	233,990	402,191
Other	84,910	330,359	93,670	413,311
Filter beds	105,850	81,277	61,290	37,972
Glass factories	240,840	394,727	300,720	475,273
Limestone sand	270,430	183,035	407,310	311,722
Limestone whiting [1]	175,460	948,528	207,910	1,242,448
Magnesia works (dolomite)	89,390	147,129	80,210	105,028
Mineral food	68,580	267,269	93,160	350,964
Mineral (rock) wool	123,720	102,670	123,700	86,488
Paper mills	302,620	488,079	333,800	575,814
Poultry grit	39,010	180,529	38,910	149,050
Refractory (dead-burned dolomite)	824,930	713,991	857,950	632,582
Road base	524,240	445,040	1,129,690	843,531
Stucco, terrazzo, and artificial stone	33,820	179,321	27,320	167,368
Sugar factories	621,730	853,235	558,560	868,786
Other uses [2]	183,400	225,636	364,690	406,596
Use unspecified	52,990	80,403	68,150	112,667
	9,122,820	8,997,793	10,731,990	10,629,560

[1] Includes stone for filler for artificial leather, asbestos cement, calcimine, explosives, linoleum, paint, parting compounds, pottery, putty, regrinding, rubber, sealing wax, tanning, and toothpaste.
[2] Includes stone for asphaltic concrete, acid neutralization, chemicals (unspecified), chips, concrete blocks and pipes, foundry facings, fill, motion-picture snow, oil wells, rayon, rice milling, spalls, and waste rock.

Sales of dolomite (calcium-magnesium carbonate) and its primary product of calcination—dolomitic lime—for certain special uses are covered in the following table:

Dolomite and dolomitic lime sold or used by producers in the United States for specified purposes, 1939–40

	1939	1940
Dolomite for—		
Basic magnesium carbonate:		
Short tons	89,390	80,210
Value	$147,129	$105,028
Dead-burned dolomite or refractory stone:		
Short tons	824,930	857,950
Value	$713,991	$632,582
Dolomitic lime for—		
Refractory (dead-burned dolomite):		
Short tons	671,561	867,909
Value	$5,447,554	$6,925,328
Paper mills:		
Short tons	41,000	59,000
Value	$267,000	$390,000
Total (calculated as raw stone) short tons	2,339,000	2,792,000

Limestone is quarried not only for use raw but also for manufacture into cement and lime. The large and important industries manufacturing these products are covered in separate chapters. It is of interest, however, to show in one table the total tonnage of limestone consumed for all purposes.

Limestone sold or used for all purposes in the United States, 1938–40, in short tons

Use	1938	1939	1940
Limestone (as given in this report) (approximate)	81,680,000	100,846,000	112,658,000
Portland cement (including "cement rock") [1]; Natural cement ("cement rock") [1]	26,193,000	30,463,000	33,986,000
Lime [2]	6,694,000	8,509,000	9,774,000
	114,567,000	139,818,000	156,418,000

[1] Value reported as cement in chapter on Cement.
[2] Value reported as lime in chapter on Lime.

SANDSTONE

The crushed-sandstone industry, which made substantial gains in 1938 and 1939, receded in 1940. In that year sales were 27 percent lower in quantity and 28 percent lower in value than in 1939. Refractory stone, however, continued the marked upward trend of 1939, because steel plants experienced unusual activity. Sales of refractory stone were 32 percent higher in quantity and 29 percent higher in value than in 1939. Sales of riprap made small gains, but the output of concrete aggregate and stone for road construction declined 41 percent in quantity and 45 in value. Railroad ballast declined 16 percent in tonnage and 19 in value. Stone applied to various miscellaneous uses dropped 12 percent in quantity and 8 in value. The average sales value at the mill or quarry for all crushed sandstone was $1.12 a ton in 1940, whereas it was $1.13 in 1939.

Sandstone (crushed and broken stone) sold or used by producers in the United States in 1940, by States and uses

State	Refractory stone (ganister)		Riprap		Crushed stone				Other uses [1]		Total	
					Concrete and road metal		Railroad ballast					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	([2])	([2])	([2])	([2])	([2])	([2])					98,860	$77,430
Arizona			([2])	([2])	([2])	([2])					([2])	([2])
Arkansas					78,670	$64,263					78,670	64,263
California	([2])	([2])	12,840	$14,530	395,920	363,636	([2])	([2])	235,000	$119,372	652,120	526,811
Colorado	17,050	$24,153	5,730	7,937	118,620	97,096					141,400	129,186
Georgia					([2])	([2])					([2])	([2])
Illinois	([2])	([2])	([2])	([2])	([2])	([2])					163,780	174,036
Kansas			([2])	([2])	([2])	([2])					135,630	193,826
Kentucky	([2])	([2])	([2])	([2])	54,970	63,939					57,420	68,018
Maryland					([2])	([2])			([2])	([2])	15,740	33,309
Massachusetts					([2])	([2])					([2])	([2])
Michigan									([2])	([2])	([2])	([2])
Minnesota			([2])	([2])							([2])	([2])
Missouri	([2])	([2])									([2])	([2])
Montana			6,820	2,454	49,760	33,008					56,580	35,462
New Jersey					([2])	([2])					([2])	([2])
New York	6,300	7,875	1,270	2,852	308,390	330,530					315,960	341,257
North Carolina					([2])	([2])					([2])	([2])
Ohio	([2])	([2])	15,820	21,200	([2])	([2])			([2])	([2])	103,180	355,303
Oklahoma			([2])	([2])	([2])	([2])					79,760	47,579
Oregon			([2])	([2])	([2])	([2])					([2])	([2])
Pennsylvania	497,610	806,519	2,380	2,229	811,110	813,315	164,800	$156,969	1,183,160	949,696	2,659,060	2,728,728
South Dakota	31,270	42,274	([2])	([2])	53,390	57,095			([2])	([2])	124,760	131,031
Tennessee	([2])	([2])	([2])	([2])	([2])	([2])					([2])	([2])
Texas			([2])	([2])	([2])	([2])					([2])	([2])
Utah	5,970	11,936	([2])	([2])	([2])	([2])					181,600	76,279
Vermont					([2])	([2])					([2])	([2])
Virginia			([2])	([2])	123,630	130,437	([2])	([2])	([2])	([2])	173,440	162,977
Washington			([2])	([2])							([2])	([2])
West Virginia	([2])	([2])			([2])	([2])					480,510	925,148
Wisconsin	([2])	([2])	([2])	([2])	([2])	([2])			([2])	([2])	323,470	614,384
Wyoming	([2])	([2])			([2])	([2])					([2])	([2])
Undistributed	294,270	643,693	296,100	233,643	1,342,570	1,630,006	34,460	21,499	178,950	435,294	484,890	402,423
	852,470	1,536,450	340,960	284,845	3,337,030	3,583,325	199,260	178,468	1,597,110	1,504,362	6,326,830	7,087,450

[1] Includes sandstone used for fill material, manufacture of spun glass, poultry grit, rock dust, rock wool, roofing granules, spalls, stone sand, and terrazzo.
[2] Included under "Undistributed."

MISCELLANEOUS STONE

Stone other than the five principal varieties already discussed includes light-color volcanic rocks, schists, boulders from river beds, serpentine, and flint. The following table shows sales of stone of these types by uses in 1940. Total sales declined 18 percent in quantity and 27 percent in value compared with 1939.

Miscellaneous varieties of stone (crushed and broken stone) sold or used by producers in the United States in 1940, by States and uses

State	Riprap		Crushed stone				Other uses [1]		Total	
			Concrete and road metal		Railroad ballast					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			(2)	(2)					(2)	(2)
Alaska			(2)	(2)					(2)	(2)
Arizona			(2)	(2)	(2)	(2)			619,320	$514,687
Arkansas	(2)	(2)	(2)	(2)	(2)	(2)			(2)	(2)
California	52,230	$51,519	2,881,860	$1,453,887	128,060	$64,097	14,300	$35,445	3,076,450	1,604,948
Colorado			(2)	(2)	(2)	(2)			62,280	20,309
District of Columbia			(2)	(2)					(2)	(2)
Florida			61,890	130,510					61,890	130,510
Georgia							(2)	(2)	(2)	(2)
Idaho			(2)	(2)					(2)	(2)
Illinois			(2)	(2)					(2)	(2)
Indiana			(2)	(2)					(2)	(2)
Louisiana			(2)	(2)					(2)	(2)
Maine			(2)	(2)					(2)	(2)
Maryland	(2)	(2)	(2)	(2)			(2)	(2)	(2)	(2)
Massachusetts	(2)	(2)	(2)	(2)					(2)	(2)
Michigan							(2)	(2)	(2)	(2)
Missouri			(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Montana			(2)	(2)			(2)	(2)	337,870	349,512
Nevada			(2)	(2)					(2)	(2)
New Hampshire			(2)	(2)			(2)	(2)	8,130	18,119
New Jersey			119,240	103,892			7,720	10,232	126,960	114,124
New Mexico			(2)	(2)					(2)	(2)
New York			(2)	(2)	(2)	(2)			166,940	107,147
North Carolina	(2)	(2)	(2)	(2)					201,200	209,316
North Dakota			(2)	(2)					(2)	(2)
Oklahoma			(2)	(2)					(2)	(2)
Oregon			35,070	34,266					35,070	34,266

See footnotes at end of table.

Miscellaneous varieties of stone (crushed and broken stone) sold or used by producers in the United States in 1940, by States and uses—Continued

State	Riprap		Crushed stone				Other uses [1]		Total	
			Concrete and road metal		Railroad ballast					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Pennsylvania	(2)	(2)	440,580	$474,960	(2)	(2)	389,440	520,560	832,720	$997,700
Puerto Rico			(2)	(2)	(2)	(2)			290,290	150,179
Rhode Island			52,260	58,465					52,260	58,465
South Carolina			(2)	(2)					(2)	(2)
South Dakota			(2)	(2)					(2)	(2)
Tennessee			(2)	(2)					(2)	(2)
Texas			(2)	(2)	(2)	(2)			147,660	97,160
Utah							(2)	(2)	(2)	(2)
Vermont	(2)	(2)	(2)	(2)			(2)	(2)	21,310	20,908
Virginia	(2)	(2)	63,720	45,627			(2)	(2)	(2)	(2)
Washington			30,110	20,152					30,110	20,152
Wisconsin			(2)	(2)					(2)	(2)
Wyoming			20,570	15,437					20,570	15,437
Undistributed	169,830	$139,061	2,560,520	2,075,847	498,240	231,315	130,800	$227,388	1,565,410	1,229,721
	222,060	190,580	6,265,820	4,413,043	626,300	295,412	542,260	793,625	7,656,440	5,692,660

[1] Includes stone used for linoleum filler, filler (unspecified), poultry grit, refractory, road base, roofing granules, spalls, and terrazzo.
[2] Included under "Undistributed."

MARKETS

As indicated in figure 3, sales of crushed stone have since 1936 followed closely the trend of highway construction and maintenance. Sales of aggregates, however, failed in 1940 to pace the physical volume of total construction activity or the shipments of portland cement. Commercial operations fared better than the chart would indicate because they gained 6 percent in 1940 over 1939, whereas the noncommercial output dropped 17 percent. The trend toward an increase in the proportion of total aggregates produced by commercial operators will be welcomed by the industry.

Sales of limestone for use as a flux in blast furnaces producing pig iron, which rose phenomenally in 1939, continued their upward trend in 1940 in consonance with increasing activity at furnaces. As indicated in figure 4, sales of fluxing stone follow closely the output of pig iron.

Sales of dolomite and ganister for use as refractories in steel furnaces, which made a much greater proportional gain than the output of steel ingots in 1939, continued upward in 1940. With steel mills running at virtually 100 percent of capacity, sales of refractories apparently have nearly reached their peak. Figure 4 shows that the abnormal upward trend of refractories was checked to some extent in 1940.

NEW DEVELOPMENTS

The deepest limestone mine in the United States is that now being developed by the Columbia Chemical Division of the Pittsburgh Plate Glass Co. at Barberton, Ohio, where a 40- to 50-foot bed of high-grade limestone will be tapped by a shaft 2,250 feet deep. The new mine will have two shafts—one for service and one for production. The room-and-pillar mining method will be used; and the crusher, which will be situated below the haulage level, will discharge to a skip-loading compartment at a still lower level on the production shaft. The mine will attain full operation in about 2 years and will be capable of furnishing 300 tons of high-grade chemical limestone an hour.

As limestone is extremely important to many industrial processes connected directly or indirectly with the national defense program, the Bureau of Mines has prepared a report [3] covering the numerous applications of limestone in industry.

FOREIGN TRADE [4]

Exports.—The export trade in stone is relatively small, but it increased somewhat in 1940 compared with 1939, probably on account of the fact that stone from most European sources was not available.

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[3] Bowles, Oliver and Jensen, M. S., Limestone and Dolomite in the Chemical and Processing Industries: Bureau of Mines Inf. Circ. 7169, 1941, 15 pp.

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

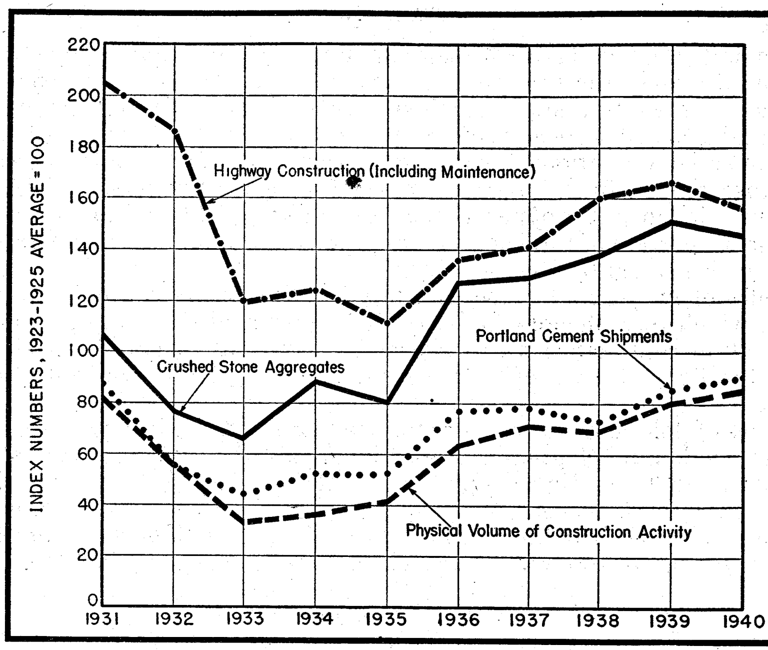

FIGURE 3.—Crushed-stone aggregates (concrete and road metal and railroad ballast) sold or used in the United States compared with shipments of portland cement, physical volume of total construction, and highway construction, 1931–40. Data on physical volume of construction activity and highway construction from Bureau of Foreign and Domestic Commerce.

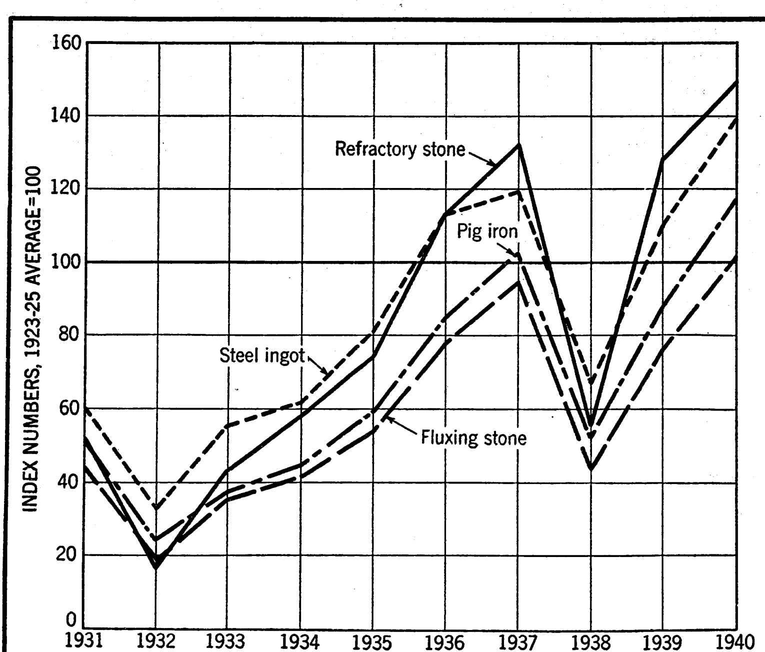

FIGURE 4.—Sales of fluxing stone and refractory stone (tons) compared with production of steel ingot and pig iron, 1931–40. Statistics of steel-ingot and pig-iron production compiled by American Iron and Steel Institute.

Stone exported from the United States in 1940, by countries

Country	Marble and other building and monumental stone: Cubic feet	Marble and other building and monumental stone: Value	Other manufactures of stone (value)
Canada	68,216	$108,666	$171,137
Chile			1,642
Colombia	322	3,255	1,862
Cuba	5,830	22,010	11,601
Mexico	151	2,726	10,869
Netherlands Indies			5,075
Newfoundland and Labrador	1,013	5,053	1,359
Panama	1,172	$3,591	$10,430
Philippine Islands	621	10,094	1,498
Union of South Africa			7,067
United Kingdom			7,428
Venezuela			14,490
Other countries	571	2,613	20,491
	77,896	158,008	264,949

Imports.—As might be expected from the disturbed conditions throughout the world, imports of stone declined greatly in 1940. The value of marble imports was about two-thirds as great as in 1939. Imports of granite, of which a large part normally originates in the Scandinavian countries, decreased to less than one-fourth of the 1939 figure, in quantity and even more in value. Imports of the other categories were maintained at a higher rate.

Stone [1] imported for consumption in the United States in 1940, by classes

Class	Quantity	Value
Marble, breccia, and onyx:		
In blocks, rough, etc. cubic feet	38,316	$159,498
Sawed do	91	300
Slabs or paving tiles superficial feet	84,377	28,414
All other manufactures		21,209
Mosaic cubes of marble or onyx: Loose pounds	12,320	254
		209,675
Granite:		
Dressed cubic feet	4,169	18,600
Rough do	8,223	11,160
	12,392	29,760
Quartzite short tons	106,527	$190,599
Travertine stone: Rough cubic feet	21,657	23,468
Stone (other):		
Dressed		1,104
Rough (monumental or building stone) cubic feet	1,198	1,286
Rough (other) short tons	69,790	56,358
Marble chip or granite short tons	2,448	11,588
		70,336
Grand total		523,838

[1] In addition, 3,231 pounds valued at $162 of "Lithographic stones, not engraved," were imported.

Stone [1] imported for consumption in the United States in 1940, 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	3	$3	$80	6,173	$8,700	$622	$56,278	106,527	$190,599			$256,282
Cuba	48	50	625									675
Mexico	15,506	58,210	970			12						59,192
Total North America	15,557	58,263	1,675	6,173	8,700	634	56,278	106,527	190,599			316,149
South America:												
Argentina	6,416	57,180								486	$1,021	58,201
Brazil	582	3,061	15	538	1,894							4,970
Total South America	6,998	60,241	15	538	1,894					486	1,021	63,171
Europe:												
Belgium	4,117	11,538	6,176				2,019			58	396	20,129
Finland				4,176	16,532							16,532
France	189	329	4,507									4,836
Italy	7,405	19,665	28,086	3	66	1,281	9,541			21,113	22,051	80,690
Portugal	2,241	5,060										5,060
Spain	1,659	3,172	57									3,229
Sweden				1,445	2,248							2,248
United Kingdom			1,950	38	221	3	76					2,250
Other Europe			97									97
Total Europe	15,611	39,764	40,873	5,662	19,067	1,284	11,636			21,171	22,447	135,071
Asia			7,614	19	99	432	32					8,177
Africa	150	1,230										1,230
Oceania						40						40
Grand total	38,316	159,498	50,177	12,392	29,760	2,390	67,946	106,527	190,599	21,657	23,468	523,838

[1] In addition, 3,231 pounds valued at $162 of "Lithographic stones, not engraved," were imported, all coming from Canada.

SLATE

By Oliver Bowles and M. S. Jensen

SUMMARY OUTLINE

Sales of slate as dimension stone decreased 14 percent in quantity and 16 percent in value in 1940 compared with 1939, but the totals are still substantially higher than in 1938. In general, unit prices were lower than in 1939.

Roofing-slate sales were considerably lower, both in quantity and value, than in 1939; they were, in fact, very little higher than the 1935–39 average. The average value a square in 1940 was $7.02, whereas in 1939 it was $7.18. Sales in the Pennsylvania slate area were 9 percent lower in quantity and 10 percent lower in value than in 1939. In the New York-Vermont area sales dropped 18 percent in quantity and value. Although Virginia sales, in 1940, dropped 22 percent in quantity and 26 percent in value compared with the preceding year, they were the highest of any year in the history of the Virginia industry except 1939.

Mill-stock sales declined 23 percent in quantity and 20 percent in value. The total physical volume of building construction advanced from 80 percent of the 1923–25 average in 1939 to 85 percent in 1940, yet sales of structural and sanitary slate dropped 27 percent in both quantity and value, indicating that other products are displacing slate in the construction field. Electrical slate, which enjoyed a decided recovery in 1939, continued its gains in 1940; the quantity sold advanced 36 percent and the value 35 percent compared with 1939. Sales of blackboards and bulletin boards, which made large gains in 1939, declined 51 percent in quantity and 54 percent in value in 1940. This drastic reduction in sales is not, however, inconsistent with expected demands because the erection of new school buildings also declined more than 50 percent. The output of vaults and covers declined slightly, but sales of billiard table tops—a relatively small item—were nearly two and one-half times as great in 1940 as in 1939. Sales of school slates, which were very low in 1939, increased 50 percent in both quantity and value in 1940. Sales of slate for flagging, cross walks, and stepping stones increased moderately, but average unit prices declined for the third consecutive year.

Statistics on slate granules and flour are included in this chapter, although these products have little connection with the dimension-slate industry except that granules compete in the roofing-slate market. For the most part, slate used for the manufacture of granules is unsuited for other slate products. In 1940 sales of granules declined whereas sales of flour increased, a condition just the reverse of that in 1939. The average sales value of granules f. o. b. mill was $8.72 and flour $3.31 per short ton in 1940 compared with $8.70 and $3.13, respectively, in 1939. Figures for sales of granules made of rock other than slate are given in the Stone chapter of this volume.

The following table, giving the principal statistical data for the slate industry during 1939 and 1940, is arranged to permit ready comparison for the 2 years.

Salient statistics of the slate industry in the United States, 1939–40

	1939			1940				
	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* 399,320	149,410	$2,868,961	*Squares* 347,130	127,600	$2,436,123	−13.1	−15.1
Mill stock:	*Sq. ft.*			*Sq. ft.*				
Electrical slate	324,590	2,710	237,001	440,080	3,710	319,163	+35.6	+34.7
Structural and sanitary slate	1,022,510	8,020	327,882	748,160	6,010	240,355	−26.8	−26.7
Grave vaults and covers	255,080	2,390	60,813	251,070	2,390	57,604	−1.6	−5.3
Blackboards and bulletin boards	2,065,830	7,470	500,809	1,023,250	2,620	229,687	−50.5	−54.1
Billiard-table tops	100,310	740	36,397	243,700	1,890	80,364	+142.9	+120.8
School slates	[1] 276,210	380	5,769	[1] 413,860	450	8,637	+49.8	+49.7
Total mill stock	4,044,530	21,710	1,168,671	3,120,120	17,070	935,810	−22.9	−19.9
Flagstones, etc.[2]	1,194,320	8,480	63,493	1,380,040	9,780	64,435	+15.6	+1.5
Total slate as dimension stone		179,600	4,101,125		154,450	3,436,368	−14.0	−16.2
Granules and flour		351,780	2,581,089		319,000	2,301,901	−9.3	−10.8
Grand total domestic production		531,380	6,682,214		473,450	5,738,269	−10.9	−14.1
Foreign trade:								
Imports for consumption			1,017			520		−48.9
Exports:[3]	*Squares*			*Squares*				
Roofing	569		5,244	475		5,547	−16.5	+5.8
Other dimension slate			51,815			[4] 70,109		
Granules and flour		13,316	120,731			(5)		

[1] Number of pieces: 1939, 516,280; 1940, 773,690; square feet approximate.
[2] Includes walkways, stepping stones, and miscellaneous slate.
[3] Figures obtained by the Bureau of Mines from shippers.
[4] Exclusive of structural slate; Bureau of Mines not at liberty to publish figures.
[5] Bureau of Mines not at liberty to publish figures.

SALES

Dimension slate.—All slate products except granules and flour are classed as dimension slate because they consist of blocks or slabs cut to specified sizes and shapes. The following table shows sales of these products for a 5-year period.

Slate (other than granules and flour) sold by producers in the United States, 1936–40

Year	Roofing			Mill stock		Other [1]		Total	
	Squares	Approximate equivalent short tons	Value	Approximate short tons	Value	Approximate short tons	Value	Approximate short tons	Value
1936	336,130	138,190	$2,607,402	20,100	$1,175,668	6,820	$55,358	165,110	$3,838,428
1937	365,800	137,400	2,728,109	21,480	1,225,645	8,670	73,554	167,550	4,027,308
1938	322,040	119,590	2,247,910	16,310	853,602	7,790	63,839	143,690	3,165,351
1939	399,320	149,410	2,868,961	21,710	1,168,671	8,480	63,493	179,600	4,101,125
1940	347,130	127,600	2,436,123	17,070	935,810	9,780	64,435	154,450	3,436,368

[1] Includes flagstones, walkways, stepping stones, and miscellaneous slate.

Figure 1 compares sales of roofing slate, as well as all slate except granules and flour, with the physical volume of construction activity and the number of new residential dwelling units from 1915 to 1940. Sales of slate products experienced a drastic decline from 1915 to 1918, from which they have never recovered. Since 1929 slate has followed closely the trend of total building construction.

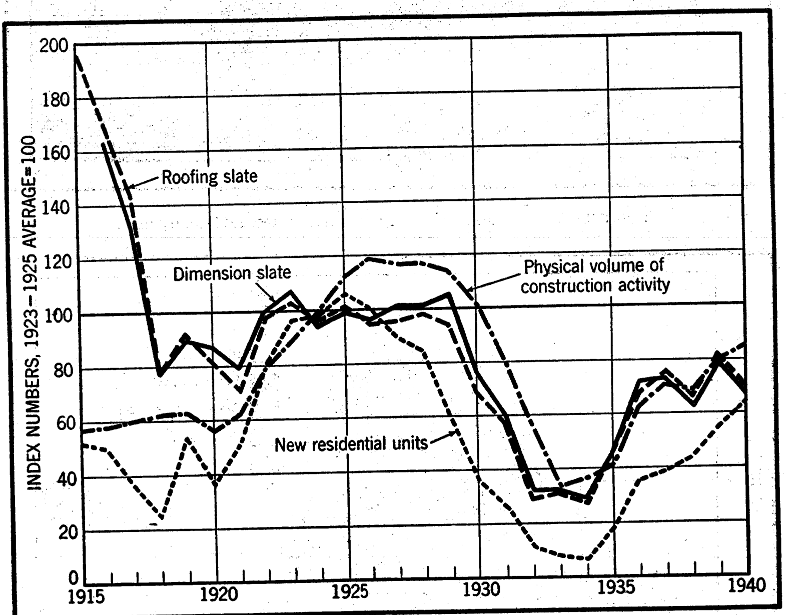

FIGURE 1.—Sales of dimension slate and roofing slate compared with total building and residential building, 1915–40. Data on construction activity from the Bureau of Foreign and Domestic Commerce and on residential building from the Bureau of Foreign and Domestic Commerce and the Bureau of Labor Statistics.

Figure 2 presents graphically a statistical history of all slate products except school slates over a 26-year period. The industry reached its peak of productive activity in 1925 and had already experienced a moderate decline at the beginning of the depression that culminated in 1933 in the smallest sales of any year since the period when slate production was an infant industry. Subsequent recovery was strong at first but has not been sustained.

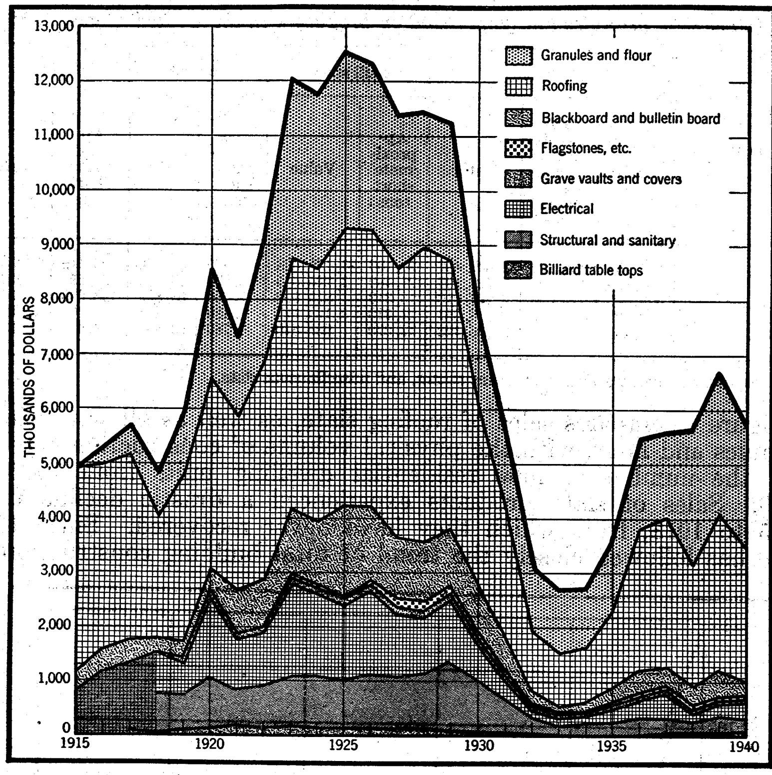

FIGURE 2.—Value of slate sold in the United States, 1915–40, by uses.

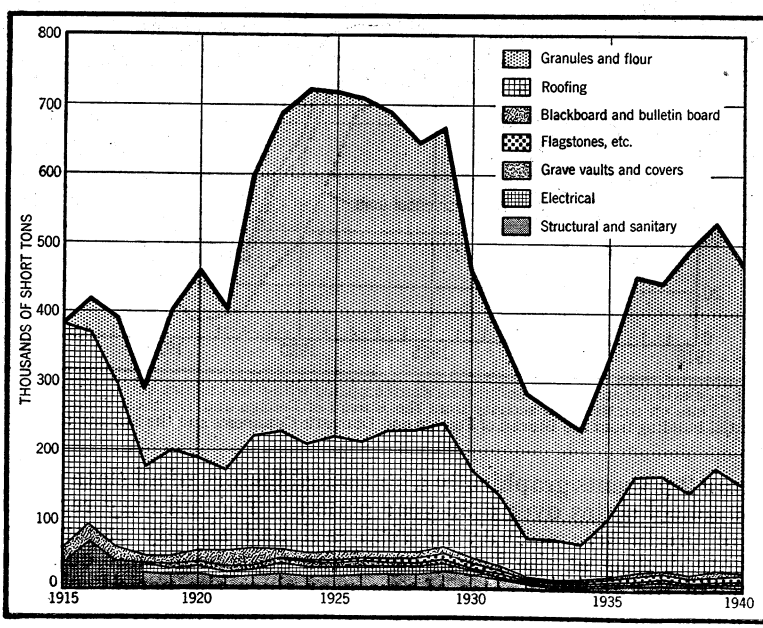

FIGURE 3.—Quantity of slate sold in the United States, 1915–40, by uses.

Figure 3 presents the same data as figure 2, except that quantities rather than values are used. Roofing granules and flour are most important on a tonnage basis. Mill stock has a relatively high unit value, and the quantities involved are not great. It is noteworthy that for the year of peak production the value of mill stock was considerably greater than that of granules and flour, but on a quantity basis mill-stock sales amounted to scarcely one-tenth of the tonnage of granules and flour.

Granules and flour.—Slate granules are used extensively in surfacing prepared roofing, and slate flour is employed as a filler in paints, road asphalt-surface mixtures, roofing mastic, oilcloth, linoleum, and various other products. The following table shows sales of granules and flour by producers from 1936 to 1940.

Crushed slate (granules and flour) sold by producers in the United States, 1936–40

Year	Granules		Flour		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1936	202, 730	$1, 372, 095	86, 920	$274, 685	289, 650	$1, 646, 780
1937	193, 950	1, 309, 549	83, 060	268, 465	277, 010	1, 578, 014
1938	258, 930	2, 220, 306	90, 070	269, 656	349, 000	2, 489, 962
1939	265, 830	2, 312, 177	85, 950	268, 912	351, 780	2, 581, 089
1940	230, 440	2, 009, 151	88, 560	292, 750	319, 000	2, 301, 901

PRICES

The average price of roofing slate f. o. b. quarry or mill, as reported to the Bureau of Mines, declined 16 cents a square in 1940 compared with 1939. In Pennsylvania it declined 10 cents, in the Vermont-New York area 5 cents, and in Virginia 47 cents a square.

The price of mill stock increased from 29 cents in 1939 to an average of 30 cents a square foot in 1940. Average values of electrical, structural and sanitary, and school slates remained virtually unchanged; those for vaults and covers declined 1 cent; and those for blackboards and bulletin boards dropped 2 cents.

Price history.—Figure 4 shows the trend of slate prices over a 26-year

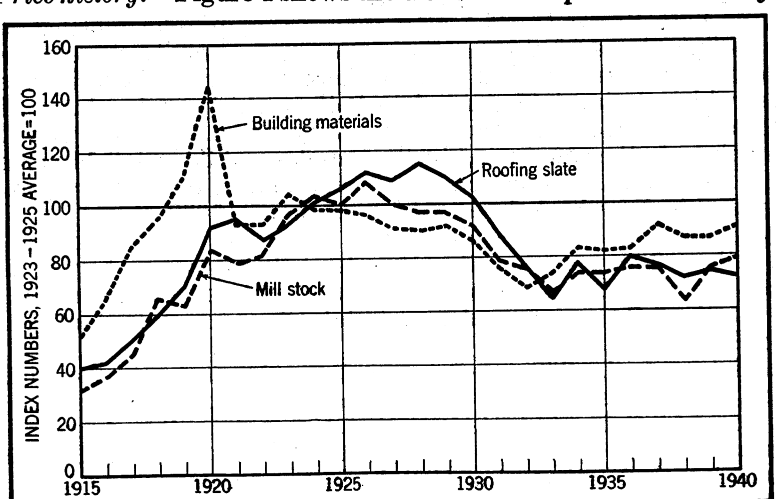

FIGURE 4.—Prices of slate compared with wholesale prices of building materials in general, 1915–40. Wholesale prices are from the Bureau of Labor Statistics.

period compared with prices of building materials in general. Slate responded only moderately to the skyrocket prices of other building materials that culminated in an unprecedented peak in 1920, but from 1924 to 1932 prices of both roofing and mill stock were well above the average of all building materials. Since 1932, however, slate prices have remained considerably below that average.

REVIEW BY STATES AND DISTRICTS

The following table gives sales of slate in 1940 by States and uses.

Slate sold by producers in the United States in 1940, by States and uses

State	Operators	Roofing		Mill stock		Other uses [1] (value)	Total value
		Squares (100 square feet)	Value	Square feet	Value		
Arkansas	1					(2)	(2)
California	2					(2)	(2)
Georgia	1					(2)	(2)
Maine	3	2,950	$25,877	305,140	$253,836	$6,947	$286,660
Maryland	1					(2)	(2)
New York	13	2,900	24,972			454,081	479,053
Pennsylvania [3]	27	216,020	1,444,696	2,658,260	603,118	561,987	2,609,801
Vermont	44	86,270	610,691	[4] 156,720	[4] 78,856	[4] 865,683	1,555,230
Virginia	6	38,990	329,887			(2)	(2)
Undistributed [5]						477,638	807,525
	98	347,130	2,436,123	[4] 3,120,120	[4] 935,810	2,366,336	5,738,269

[1] Flagging and similar products, granules, and flour.
[2] Included under "Undistributed."
[3] For details of production in Pennsylvania, see following table.
[4] A small amount of mill stock in Vermont included under "Other uses."
[5] Includes output of States entered as "(2)" above.

Maine.—Electrical slate, the principal product of the Maine quarries, made substantial gains in 1940, as shown in a 33-percent increase in the value of slate products sold in the State during 1940 compared with 1939. Sales of roofing slate, which is of minor importance in Maine, declined 23 percent.

New York-Vermont.—The attractive green, purple, mottled, and red roofing slates of this northern area are generally popular with architects and builders, but in 1940 there was a decided shrinkage in sales, which declined 18 percent in both quantity and value. Mill-stock sales receded 4 percent in quantity and 18 percent in value. The value of other products, chiefly granules and flour, fell 14 percent. The value of all slate products sold in Vermont in 1940 was 20 percent lower and in New York 3 percent higher than in 1939.

Peach Bottom district.—Blue-black slate has been quarried for more than 200 years on the Maryland-Pennsylvania border near Delta, Pa. Roofing slate is now produced only on the Pennsylvania side of the line, but granules and slate flour are manufactured in both States.

Lehigh district.—The most productive slate area in the United States is comprised within Lehigh and Northampton Counties, Pa. All kinds of slate products are manufactured in this district. As separate figures cannot be shown for York County, Pa., it is included with Northampton County in the accompanying table for Pennsylvania.

Slate sold by producers in Pennsylvania in 1940, by counties and uses

County	Operators	Roofing slate		Mill stock					
				Electrical		Structural and sanitary		Vaults and covers	
		Squares (100 square feet)	Value	Square feet	Value	Square feet	Value	Square feet	Value
Lehigh	9	12,280	$79,256	29,600	$15,117	7,140	$2,542	(1)	(1)
Northampton and York [2]	18	203,740	1,365,440	18,840	6,993	670,800	202,174	[1] 251,070	[1] $57,604
	27	216,020	1,444,696	48,440	22,110	677,940	204,716	251,070	57,604

County	Mill stock—Continued						Other uses (value)	Total value
	Blackboards and bulletin boards		Billiard-table tops		School slates			
	Square feet	Value	Square feet	Value	Square feet	Value		
Lehigh	316,480	$72,055			413,860	$8,637	(3)	[1 3] $177,607
Northampton and York [2]	706,770	157,632	243,700	$80,364			[3] $561,987	[1 3] 2,432,194
	1,023,250	229,687	243,700	80,364	413,860	8,637	561,987	2,609,801

[1] Small amount of slate for grave vaults and covers produced in Lehigh County included under Northampton and York Counties.
[2] York County produced roofing slate, granules, and flour only.
[3] Small amount of flagging produced in Lehigh County included under Northampton and York Counties.

The value of total sales of slate products in the district was 15 percent lower in 1940 than in 1939. Sales of roofing slate declined 9 percent in quantity and 10 percent in value. Items that show increases in 1940 are electrical slate (10 percent in both quantity and value), school slates (50 percent in quantity and value), billiard-table tops (143 percent in quantity and 121 percent in value), and vaults and covers (4 percent in quantity and 6 percent in value). Mill-stock items that show recession in sales in 1940 are blackboards and bulletin boards, with a loss of 50 percent in quantity and 54 percent in value, and structural and sanitary slate products, which declined 26 percent in quantity and 25 percent in value. Other products, chiefly granules and flour, show a slight increase in value in 1940.

Virginia.—Sales of blue-black roofing slate, which constitute the principal product of the Buckingham County area, suffered a sharp decline in 1940. Small quantities of flagging are produced, but no mill-stock products are made. Granules are manufactured at Esmont, Albemarle County, and New Canton, Buckingham County.

Other districts.—Small quantities of granules alone, or granules and flour, were produced near Mena, Polk County, Ark.; at Placerville, Eldorado County, and near Jamestown, Tuolumne County, Calif.; and near Fair Mount, Bartow County, Ga.

NEW DEVELOPMENTS

The possibility of using waste slate for making lightweight aggregate has been demonstrated at the Eastern Experiment Station of the Bureau of Mines. One company that manufactures roofing slate

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is now investigating the feasibility of making such products from its mill waste.

Slate producers in Pennsylvania, who operate wire saws to great advantage in their quarries, may be interested in a new type consisting of a single ribbon-shaped steel strand twisted in the form of a wire. It has not yet been used in quarries, but when employed in slabbing marble blocks its rate of cutting was twice as great as that obtained with the ordinary three-strand wire. The accomplishments of this new type of equipment are described in a forthcoming paper entitled "The Single-strand Wire Saw," by Oliver Bowles and P. de Vitry, to be published by the American Institute of Mining and Metallurgical Engineers, 29 West 39th Street, New York, N. Y.

FOREIGN TRADE [1]

Imports.—Imports of slate for consumption in the United States are unimportant in normal times, and in 1940 they were insignificant. No roofing slate was imported in that year. The value of slate imports by country of origin, 1936–40, appears in the following table.

Slate imported for consumption in the United States, 1936–40, by countries

Country	1936	1937	1938	1939	40
Canada	$1,074	$826	$543	$570	
China			3	26	$21
Czechoslovakia	1,904	990	1,037		
France			895		
Germany		17			
Hong Kong	21	20	59	4	
Italy	1,386	349	994	356	324
Japan	195	222	68	61	175
Norway		381			
United Kingdom	271	2,019	3,089		
	4,851	4,824	6,688	1,017	520

Exports.—The following table lists exports of slate products from 1938 to 1940, as reported to the Bureau of Mines by shippers. School slates, electrical slate, and billiard-table tops made substantial gains, while roofing and blackboard exports declined. The value of slate exports was 11 percent higher than in 1939.

Slate exported from the United States, 1938–40, by uses [1]

Use	1938		1939		1940	
	Quantity	Value	Quantity	Value	Quantity	Value
Roofing squares	660	$5,070	569	$5,244	475	$5,547
School slates cases [2]	4,642	35,717	[3] 2,151	[3] 17,739	[3] 3,658	[3] 36,503
Electrical square feet	1,885	1,239	2,672	1,726	6,324	4,721
Blackboards do	46,253	10,400	28,201	8,448	18,952	4,688
Billiard tables do	17,788	10,182	37,326	18,111	45,122	24,197
Structural [4] do	18,188	1,314	15,202	5,791	(5)	(5)
Slate granules and flour short tons	11,229	93,675	13,316	120,731	(5)	(5)
Undistributed						121,038
		157,597		177,790		196,694

[1] Figures collected by Bureau of Mines from shippers of products named.
[2] Cases weigh 130 to 165 pounds each; average is 135 pounds. They contain 8 to 18 dozen slates, depending on size. Sizes run from 5 by 7 to 9 by 13 inches (inside frame).
[3] Value includes slate used for pencils and educational toys; quantity not available.
[4] Includes slate for floors and walkways.
[5] Included under "Undistributed."

[1] Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

SAND AND GRAVEL

By Duncan McConnell and G. E. Tucker

SUMMARY OUTLINE

Production of sand and gravel reached a new peak in 1940, surpassing the output for 1939 as well as that for 1929. Commercial operations accounted for the entire increase, as there was a slight decrease in the tonnages from plants operated by or for States, counties, municipalities, and other Government agencies. The steady rise in quantity and value produced since 1933 was interrupted only in 1938 (see fig. 1).

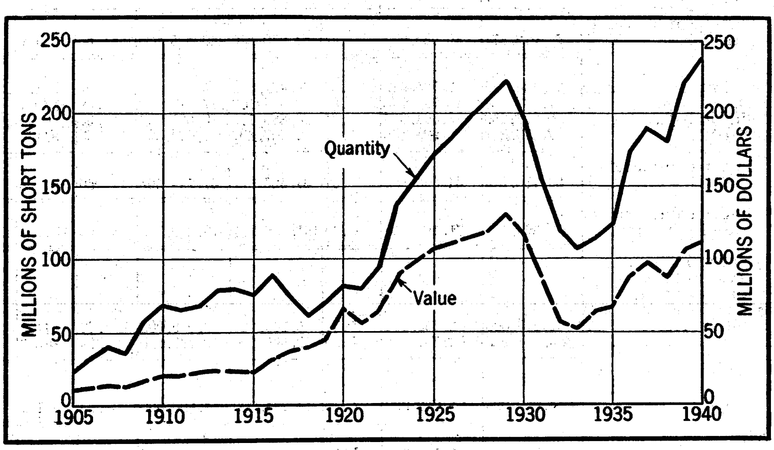

Figure 1.—Total production of sand and gravel in the United States, 1905-40. Data for 1939 revised.

According to the Bureau of Foreign and Domestic Commerce, the value of total construction during 1940 was moderately larger than in 1939. There was little change in public construction, as the increase in defense activities merely compensated the curtailment of work-relief construction; the net effect, according to preliminary figures, was a slight decline for 1940. New private construction gained 16 percent in value, with the percentage of increase in factory building much larger than that in residential building.

Total sand and gravel for building and paving increased in 1940, although Government-and-contractor[1] output declined slightly. All industrial uses of sand except sand for filtering gained in 1940. The change in volume was greatest in molding sand, as might be expected from the increase in defense activity.

Salient statistics on sand and gravel for 1939 and 1940 are summarized in the following table.

[1] Formerly classified as "noncommercial"; details of change in designation given in Minerals Yearbook, 1940, p. 1213.

Sand and gravel sold or used by producers in the United States, 1939–40, by commercial and Government-and-contractor operations and by uses

	1939			1940				
	Short tons	Value		Short tons	Value		Percent of change in—	
		Total	Average		Total	Average	Tonnage	Average value
COMMERCIAL OPERATIONS								
Sand:								
Glass	2,468,290	$4,280,936	$1.73	2,759,544	$4,881,508	$1.77	+11.8	+2.3
Molding	3,728,389	4,039,082	1.08	5,004,807	5,268,974	1.05	+34.2	−2.8
Building	26,406,323	14,166,111	.54	29,591,644	15,243,151	.52	+12.1	−3.7
Paving	19,468,018	10,205,641	.52	20,812,866	10,930,249	.53	+7.0	+2.0
Grinding and polishing [1]	668,027	895,989	1.34	856,309	915,925	1.07	+28.2	−20.1
Fire or furnace	172,348	197,500	1.15	270,715	325,713	1.20	+57.1	+4.3
Engine	1,469,562	854,939	.58	1,634,968	1,069,630	.65	+11.3	+12.1
Filter	173,013	195,142	1.13	118,600	164,061	1.38	−31.5	+22.1
Railroad ballast [2]	1,259,367	332,715	.26	957,745	256,439	.27	−24.0	+3.8
Other [3]	1,799,537	1,417,617	.79	1,923,042	1,469,979	.76	+6.9	−3.8
Total commercial sand	57,612,874	36,585,672	.64	63,930,240	40,525,629	.63	+11.0	−1.6
Gravel:								
Building	21,106,812	13,785,942	.65	23,429,541	15,205,100	.65	+11.0	------
Paving	27,387,327	16,791,795	.61	30,308,100	17,879,012	.59	+10.7	−3.3
Railroad ballast [4]	9,972,259	3,094,013	.31	10,880,779	3,627,796	.33	+9.1	+6.5
Other [5]	2,313,848	925,136	.40	2,707,607	1,032,597	.38	+17.0	−5.0
Total commercial gravel	60,780,246	34,596,886	.57	67,326,027	37,744,505	.56	+10.8	−1.8
Total commercial sand and gravel	118,393,120	71,182,558	.60	131,256,267	78,270,134	.60	+10.9	------
GOVERNMENT-AND-CONTRACTOR OPERATIONS [6]								
Sand:								
Building	[7] 5,815,000	[7] 2,255,000	[7] .39	5,149,000	2,039,000	.40	−11.5	+2.6
Paving	[7] 9,114,000	[7] 2,767,000	[7] .30	9,595,000	2,767,000	.29	+5.3	−3.3
Total Government-and-contractor sand	[7] 14,929,000	[7] 5,022,000	[7] .34	14,744,000	4,806,000	.33	−1.2	−2.9
Gravel:								
Building	[7] 10,896,000	[7] 5,586,000	[7] .51	9,866,000	4,922,000	.50	−9.5	−2.0
Paving	[7] 81,790,000	[7] 24,275,000	[7] .30	82,442,000	22,690,000	.28	+.8	−6.7
Total Government-and-contractor gravel	[7] 92,686,000	[7] 29,861,000	[7] .32	92,308,000	27,612,000	.30	−.4	−6.3
Total Government-and-contractor sand and gravel	[7] 107,615,000	[7] 34,883,000	[7] .32	107,052,000	32,418,000	.30	−.5	−6.3
COMMERCIAL AND GOVERNMENT-AND-CONTRACTOR OPERATIONS								
Sand	[7] 72,542,000	[7] 41,608,000	[7] .57	78,674,000	45,332,000	.58	+8.5	+1.8
Gravel	[7] 153,466,000	[7] 64,458,000	[7] .42	159,634,000	65,356,000	.41	+4.0	−2.4
Grand total	[7] 226,008,000	[7] 106,066,000	[7] .47	238,308,000	110,688,000	.46	+5.4	−2.1

[1] Includes blast sand as follows: 1939, 220,240 short tons valued at $542,915; 1940, 256,104 tons, $597,198.
[2] Includes ballast sand produced by railroads for their own use as follows: 1939, 152,723 short tons valued at $21,998; 1940, 57,741 tons, $9,506.
[3] Includes some sand used by railroads for fills and similar purposes as follows: 1939, 137,158 short tons valued at $21,366; 1940, 207,941 tons, $44,064.
[4] Includes ballast gravel produced by railroads for their own use as follows: 1939, 4,617,468 short tons valued at $752,670; 1940, 4,913,809 tons, $914,990.
[5] Includes some gravel used by railroads for fills and similar purposes as follows: 1939, 824,959 short tons valued at $80,090; 1940, 793,709 tons, $133,405.
[6] Approximate figures for States, counties, municipalities, and other Government agencies directly or under lease.
[7] Revised figures.

PRODUCTION

In the sand and gravel industry stocks are inconsequential, therefore the quantities of materials sold or used are virtually equivalent to production. Throughout this report, sales and production are used interchangeably.

Incomplete coverage by the canvass for 1939 has necessitated significant upward revision of the Government-and-contractor output for that year. This production reached its peak in 1939 and declined slightly during 1940. In contrast with Government-and-contractor production, the output of commercial sand and gravel increased 10.9 percent from 1939 to 1940.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States, 1936–40

Year	Sand		Gravel (including railroad ballast)		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1936	60,303,394	$35,926,994	118,026,420	$54,380,758	178,329,814	$90,307,752
1937	63,385,071	40,412,497	126,275,352	57,060,500	189,660,423	97,472,997
1938	57,113,828	33,935,725	124,206,405	51,987,122	181,320,233	85,922,847
1939 [1]	72,542,000	41,608,000	153,466,000	64,458,000	226,008,000	106,066,000
1940	78,674,000	45,332,000	159,634,000	65,356,000	238,308,000	110,688,000

[1] Revised figures.

New York, California, Illinois, Ohio, Michigan, and Pennsylvania were the leading States in commercial output of sand and gravel in 1940—each produced over 8 million tons; Pennsylvania, however, ranked first according to value, followed by New York and Ohio.

Details for production in 1940, according to States and uses, are presented in the following tables.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1940, by States

State	Short tons	Value	State	Short tons	Value
Alabama	1,840,945	$936,724	Nevada	1,803,924	$543,036
Alaska	515,011	103,217	New Hampshire	2,132,525	266,338
Arizona	245,602	114,500	New Jersey	4,918,350	3,846,902
Arkansas	2,664,178	1,068,701	New Mexico	[1] 2,364,939	[1] 1,141,380
California	18,913,301	8,988,894	New York	[2] 13,225,133	[2] 7,639,668
Colorado	1,853,359	508,403	North Carolina	3,213,855	1,439,457
Connecticut	1,646,870	736,317	North Dakota	3,202,167	298,646
Delaware	[2] 167,138	[2] 91,913	Ohio	9,558,904	7,182,453
Florida	1,162,075	800,085	Oklahoma	1,030,435	284,010
Georgia	490,136	231,591	Oregon	[2] 1,622,921	[2] 859,943
Hawaii	2,297	1,294	Pennsylvania	8,431,656	8,000,225
Idaho	1,943,723	657,848	Puerto Rico	11,572	4,392
Illinois	[2] 10,103,214	[2] 5,578,309	Rhode Island	515,129	333,612
Indiana	6,265,163	3,306,165	South Carolina	515,247	260,857
Iowa	[2] 3,464,803	[2] 1,852,285	South Dakota	2,910,331	524,842
Kansas	2,264,871	893,962	Tennessee	3,104,382	2,255,287
Kentucky	1,226,325	815,688	Texas	6,930,975	3,446,085
Louisiana	2,580,478	1,381,044	Utah	1,899,563	582,708
Maine	3,836,131	878,820	Vermont	[1] 873,325	[1] 217,661
Maryland	3,426,525	2,763,322	Virginia	2,671,412	1,778,576
Massachusetts	3,563,760	1,681,222	Washington	6,987,761	4,278,251
Michigan	13,650,528	4,978,006	West Virginia	2,297,610	2,240,650
Minnesota	8,729,205	1,924,716	Wisconsin	6,742,882	2,304,197
Mississippi	2,319,073	724,777	Wyoming	1,676,954	594,111
Missouri	4,057,571	2,311,221	Undistributed [3]	44,704,000	14,010,000
Montana	4,978,353	1,953,009			
Nebraska	3,051,706	1,072,935		238,308,000	110,688,000

[1] Output of commercial producers included under "Undistributed."
[2] Output of Government-and-contractor operations included under "Undistributed."
[3] Includes items covered by "1" and "2."

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1940, by States and uses

[Commercial unless otherwise indicated]

State	Sand							
	Glass		Molding		Building			
					Commercial		Government-and-contractor	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			65,993	$51,462	235,367	$100,618	6,740	$5,102
Alaska								
Arizona					(1)	(1)	1,253	778
Arkansas	(1)	(1)	(1)	(1)	235,653	126,108	56,223	641
California	(1)	(1)	48,724	137,751	4,502,934	1,987,657	972,761	360,767
Colorado			(1)	(1)	201,906	85,980	25,802	8,168
Connecticut					451,736	248,766		
Delaware			1,250	500	39,607	23,691	(1)	(1)
Florida			(1)	(1)	618,141	401,309	1,340	976
Georgia	4,608	$3,686	1,505	2,566	240,779	96,027	4,322	3,252
Hawaii							315	193
Idaho					12,485	6,896	6,514	4,603
Illinois	(1)	(1)	553,472	530,402	1,702,712	790,558	(1)	(1)
Indiana			250,510	159,150	762,175	338,311	959	478
Iowa			(1)	(1)	795,494	472,689	(1)	(1)
Kansas					528,158	223,682	49,090	6,584
Kentucky			(1)	(1)	122,305	102,525	5,012	3,186
Louisiana					362,207	112,840	123	91
Maine					23,873	8,808	2,258	1,232
Maryland	9,277	16,041			858,125	600,912	507	261
Massachusetts			(1)	(1)	977,961	479,567		
Michigan	(1)	(1)	1,534,507	529,947	1,371,716	443,146	49,110	10,918
Minnesota	(1)	(1)	11,747	12,704	807,727	299,109	893,452	47,838
Mississippi					102,670	31,205	34,543	6,151
Missouri	(1)	(1)	42,114	27,116	997,171	530,669	809	933
Montana					95,830	60,280	5,669	6,111
Nebraska					222,199	65,789	6,403	7,510
Nevada	(1)	(1)	5,682	13,141	(1)	(1)	3,450	5,440
New Hampshire					(1)	(1)	207	52
New Jersey	277,980	540,493	764,403	1,134,310	1,169,580	525,911	1,200	960
New Mexico					(1)	(1)	53,753	26,039
New York			413,391	688,806	4,578,484	2,193,694	(1)	(1)
North Carolina					148,182	46,124	58,682	26,219
North Dakota					13,756	7,971	140,812	5,542
Ohio	(1)	(1)	651,253	1,081,718	1,639,896	1,047,852	1,363	1,000
Oklahoma	(1)	(1)	(1)	(1)	184,494	68,514	1,204	298
Oregon					227,387	163,421	(1)	(1)
Pennsylvania	(1)	(1)	334,905	503,536	1,753,497	1,526,490	955	1,669
Puerto Rico							3,406	736
Rhode Island			36,869	59,760	80,020	31,030	3,850	4,200
South Carolina	19,538	21,918			90,060	42,962	8,972	3,772
South Dakota					27,252	15,025	8,716	3,718
Tennessee	(1)	(1)	66,450	117,265	456,126	417,787	4,663	6,515
Texas	(1)	(1)	3,059	6,121	877,116	425,035	454,246	186,332
Utah			(1)	(1)	144,157	61,214	16,471	13,369
Vermont							280	200
Virginia	(1)	(1)	(1)	(1)	498,931	276,834	36,003	7,605
Washington			(1)	(1)	346,059	204,574	659,105	593,232
West Virginia	(1)	(1)	(1)	(1)	269,599	252,143	1,142	356
Wisconsin			78,886	54,603	760,410	261,906	76,992	41,266
Wyoming					8,513	8,421	8,052	11,914
Undistributed [2]	2,448,141	4,299,370	140,087	158,116	49,194	29,101	1,482,000	623,000
	2,759,544	4,881,508	5,004,807	5,268,974	29,591,644	15,243,151	5,149,000	2,039,000

See footnotes at end of table.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1940, by States and uses—Continued

State	Sand—Continued							
	Paving				Grinding and polishing [3]		Fire or furnace	
	Commercial		Government-and-contractor					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	412, 517	$163, 859	19, 894	$14, 435	(1)	(1)	(1)	(1)
Alaska								
Arizona	30, 658	23, 393	24, 761	15, 395				
Arkansas	150, 946	69, 543	1, 979	903				
California	1, 811, 936	751, 213	216, 471	80, 880	9, 191	$25, 730	(1)	(1)
Colorado	(1)	(1)	287, 571	42, 154	1, 985	1, 737	5, 100	$4, 080
Connecticut	143, 226	87, 962	394, 384	29, 341	(1)	(1)		
Delaware	33, 700	17, 155			4, 011	8, 024	2, 080	1, 535
Florida	126, 729	92, 405	16, 384	2, 356	600	420		
Georgia	142, 420	65, 517	9, 106	9, 671	13, 127	15, 462		
Hawaii								
Idaho	(1)	(1)	43, 791	8, 009				
Illinois	1, 363, 919	521, 022	(1)	(1)	(1)	(1)	68, 104	100, 652
Indiana	837, 662	475, 990	8, 407	3, 203			(1)	(1)
Iowa	398, 586	159, 378	(1)	(1)	(1)	(1)		
Kansas	560, 743	225, 670	107, 821	42, 062	780	495	(1)	(1)
Kentucky	370, 530	268, 946	1, 617	1, 072				
Louisiana	300, 412	170, 993	184	136	(1)	(1)		
Maine	7, 382	2, 585	122, 900	28, 231	(1)	(1)		
Maryland	932, 208	619, 618	11, 844	1, 184	(1)	(1)	(1)	(1)
Massachusetts	504, 518	198, 176	93, 648	14, 722	(1)	(1)	600	600
Michigan	1, 216, 260	488, 575	210, 242	66, 159	201, 950	54, 707	975	292
Minnesota	247, 501	111, 115	349, 668	33, 027	753	1, 883		
Mississippi	282, 430	108, 811	21, 184	1, 636	(1)	(1)		
Missouri	418, 858	233, 205	6, 001	4, 178	(1)	(1)	(1)	(1)
Montana	8, 678	7, 756	2, 309	2, 249				
Nebraska	197, 773	69, 293	534, 773	179, 459	698	174		
Nevada	22, 503	22, 930	1, 181	1, 103	1, 101	2, 763		
New Hampshire	82, 744	41, 879	509, 928	37, 960				
New Jersey	1, 306, 284	608, 999	5, 874	419	115, 687	132, 896	64, 011	66, 059
New Mexico			20, 000	14, 239				
New York	2, 811, 357	1, 367, 114	(1)	(1)	(1)	(1)		
North Carolina	354, 702	126, 350	1, 638, 346	390, 860				
North Dakota	20, 121	10, 105	952	365				
Ohio	1, 243, 026	731, 011	11, 530	1, 334	(1)	(1)	(1)	(1)
Oklahoma	72, 946	27, 205	50, 507	4, 133	(1)	(1)		
Oregon	81, 446	46, 441	(1)	(1)				
Pennsylvania	2, 179, 457	1, 870, 596	1, 140	1, 200	223, 546	172, 484	19, 028	30, 414
Puerto Rico			694	375				
Rhode Island	43, 206	17, 923	92, 199	49, 872				
South Carolina	80, 774	22, 435	50, 264	11, 443	814	2, 987		
South Dakota	34, 663	18, 440	100, 825	99, 162				
Tennessee	323, 862	235, 586	45, 056	13, 893	19, 337	26, 130	662	728
Texas	561, 519	277, 537	59, 472	19, 192	2, 414	4, 526		
Utah	49, 569	15, 539	54, 446	21, 610				
Vermont	(1)	(1)	8, 518	2, 453	(1)	(1)		
Virginia	267, 179	138, 198	225, 968	45, 892			(1)	(1)
Washington	101, 529	71, 333	93, 375	35, 418				
West Virginia	168, 432	130, 574	51, 530	37, 031	(1)	(1)		
Wisconsin	403, 541	159, 631	260, 232	74, 606	21, 411	41, 908		
Wyoming	19, 533	14, 331	12, 563	11, 405				
Undistributed [2]	84, 881	43, 912	3, 816, 000	1, 313, 000	238, 904	423, 599	110, 155	121, 353
	20, 812, 866	10, 930, 249	9, 595, 000	2, 767, 000	856, 309	915, 925	270, 715	325, 713

See footnotes at end of table.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1940, by States and uses—Continued

State	Sand—Continued							
	Engine		Filter		Railroad ballast [4]		Other [5]	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	34,131	$11,483						
Alaska								
Arizona	6,239	2,495	106	$77	380	$152	2,204	$881
Arkansas	(1)	(1)					(1)	(1)
California	(1)	(1)	(1)	(1)	(1)	(1)	83,351	39,836
Colorado	(1)	(1)			(1)	(1)	28,383	13,525
Connecticut	(1)	(1)	3,000	2,700			26,413	16,298
Delaware	53,800	17,900	597	1,194			14,392	9,388
Florida	(1)	(1)			20,146	3,830		
Georgia	19,950	4,643	1,323	3,969			(1)	(1)
Hawaii								
Idaho	(1)	(1)					530	280
Illinois	50,638	30,505	(1)	(1)	(1)	(1)	156,465	188,512
Indiana	64,374	24,041	(1)	(1)	51,978	23,569	54,875	16,739
Iowa	35,814	19,941	(1)	(1)	(1)	(1)	14,101	7,160
Kansas	38,187	18,908	(1)	(1)	1,178	388	24,172	5,460
Kentucky	36,289	20,175			(1)	(1)	5,061	3,543
Lousiana	13,593	5,159			(1)	(1)	(1)	(1)
Maine	1,587	473					(1)	(1)
Maryland	(1)	(1)					(1)	(1)
Massachusetts	(1)	(1)	1,350	600			61,002	21,621
Michigan	(1)	(1)	2,700	1,200	205,280	28,705	55,370	18,318
Minnesota	(1)	(1)	562	1,545	(1)	(1)	120,345	20,099
Mississippi	15,126	6,073			(1)	(1)	4,300	2,140
Missouri	26,496	19,679			43,398	13,304	(1)	(1)
Montana	600	600			936	199	46,978	8,883
Nebraska	36,485	13,095	190	70	(1)	(1)	34,594	9,869
Nevada							(1)	(1)
New Hampshire							(1)	(1)
New Jersey	17,204	10,488	40,958	60,445			25,519	18,884
New Mexico	(1)	(1)						
New York	56,113	24,150	(1)	(1)	(1)	(1)	162,944	64,441
North Carolina	48,702	23,801			30,132	18,076	32,836	27,363
North Dakota							(1)	(1)
Ohio	63,242	41,020	2,917	5,221	10,172	1,813	189,667	351,252
Oklahoma	18,681	9,313			2,842	895	6,665	1,516
Oregon	(1)	(1)			7,267	2,477	(1)	(1)
Pennsylvania	283,754	316,062	(1)	(1)			246,181	259,051
Puerto Rico								
Rhode Island			880	1,125			(1)	(1)
South Carolina	(1)	(1)	(1)	(1)	18,592	3,289	(1)	(1)
South Dakota					5,050	1,250		
Tennessee	20,261	17,596					18,331	18,328
Texas	23,986	9,288	(1)	(1)	77,640	23,254	64,844	43,411
Utah	(1)	(1)					16,302	3,329
Vermont	(1)	(1)					(1)	(1)
Virginia	75,726	30,500					57,754	31,758
Washington	26,199	5,635			(1)	(1)	134,145	41,575
West Virginia	274,993	243,418			(1)	(1)	(1)	(1)
Wisconsin	40,921	9,228	(1)	(1)	25,898	7,833	(1)	(1)
Wyoming							4,900	350
Undistributed [3]	251,877	133,961	64,017	85,915	456,856	127,405	230,418	226,169
	1,634,968	1,069,630	118,600	164,061	957,745	256,439	1,923,042	1,469,979

See footnotes at end of table.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1940, by States and uses—Continued

State	Gravel							
	Building				Paving			
	Commercial		Government-and-contractor		Commercial		Government-and-contractor	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	240,810	$137,397	48,279	$13,983	668,215	$404,321	96,329	$24,680
Alaska							515,011	103,217
Arizona	(1)	(1)	2,123	1,314	27,615	18,362	64,435	27,575
Arkansas	89,217	67,075	13,564	674	336,602	207,504	1,076,930	308,627
California	4,218,398	2,299,623	2,509,205	981,418	1,873,649	951,820	2,181,613	916,721
Colorado	(1)	(1)	91,878	24,031	21,945	17,551	928,074	146,095
Connecticut	373,693	250,946			103,467	70,375	130,200	23,250
Delaware	11,464	10,966						
Florida	(1)	(1)	781	494	(1)	(1)	3,286	785
Georgia			20,746	10,404			1,151	570
Hawaii			1,982	1,101				
Idaho	45,673	29,278	28,171	10,031	299,433	108,518	1,322,082	428,085
Illinois	1,553,123	825,323	(1)	(1)	2,061,883	849,165	(1)	(1)
Indiana	751,905	498,520	89,646	18,660	1,856,842	1,132,183	403,315	93,985
Iowa	356,567	276,538	(1)	(1)	1,541,238	737,427	(1)	(1)
Kansas	61,989	35,467	24,034	6,866	538,698	259,076	292,823	44,648
Kentucky	132,076	128,935	8,400	600	281,784	218,769	115,780	10,000
Louisiana	688,974	422,324	340	114	612,362	446,162	211,081	2,045
Maine	17,190	11,678			35,679	11,254	3,472,953	758,065
Maryland	658,193	655,092	132	158	781,016	796,921	100,798	9,165
Massachusetts	633,827	493,761	65	5	599,543	313,659	427,324	40,783
Michigan	1,333,880	665,049	528,142	136,638	1,952,524	789,073	4,310,186	1,382,668
Minnesota	515,466	457,306	149,513	56,257	506,726	234,362	3,817,565	307,019
Mississippi	152,427	42,899	340	114	801,720	443,631	707,089	29,959
Missouri	598,018	287,825	51,126	28,253	630,333	301,366	682,597	310,110
Montana	257,488	126,831	376,099	175,073	188,522	134,479	3,242,277	1,297,330
Nebraska	274,178	104,322	6,547	5,860	1,418,692	512,376	287,332	93,306
Nevada	(1)	(1)	41,548	13,048	127,013	18,438	1,549,125	371,168
New Hampshire	(1)	(1)	161	80	70,892	60,393	1,451,863	117,774
New Jersey	466,312	327,523			603,044	392,914	2,027	145
New Mexico	(1)	(1)	98,131	65,569			2,193,055	1,035,533
New York	2,776,930	1,760,122	(1)	(1)	2,286,134	1,483,021	(1)	(1)
North Carolina	231,856	222,815	7,824	10,715	464,486	456,309	167,554	72,329
North Dakota	15,254	14,890	280	125	184,183	42,816	2,657,214	191,332
Ohio	1,411,683	994,597	1,196	755	2,475,660	1,607,687	491,870	77,700
Oklahoma	15,634	8,349	3,116	322	142,141	74,129	483,626	17,857
Oregon	394,615	205,559	(1)	(1)	676,764	347,255	(1)	(1)
Pennsylvania	1,227,583	1,076,969			1,511,554	1,279,574	66,515	15,712
Puerto Rico			6,091	3,008			1,381	273
Rhode Island	62,031	41,258	3,416	2,600	49,750	39,013	131,526	82,227
South Carolina	57,652	53,850	753	901	60,543	57,174	51,162	11,859
South Dakota	24,303	11,698	279,827	15,747	11,250	3,007	2,241,774	325,054
Tennessee	353,544	299,678	280,972	171,401	523,503	439,091	871,575	396,226
Texas	832,368	625,382	401,815	172,440	1,371,472	961,343	1,174,937	218,572
Utah	297,258	116,753	29,007	22,138	388,564	149,533	704,086	122,765
Vermont			7,225	52	(1)	(1)	857,302	214,956
Virginia	400,535	445,396	2,060	1,075	538,246	524,098	446,799	122,938
Washington	441,893	277,147	2,276,902	1,956,106	552,402	363,245	1,623,107	619,649
West Virginia	196,713	182,280	19,692	7,877	307,957	238,372	430,514	137,223
Wisconsin	743,922	322,777	463,685	117,717	683,652	281,223	2,175,147	665,034
Wyoming	14,667	10,897	12,511	11,463	95,675	52,047	1,053,216	413,638
Undistributed [2]	500,232	380,005	1,979,000	877,000	44,727	49,976	37,226,000	11,101,000
	23,429,541	15,205,100	9,866,000	4,922,000	30,308,100	17,879,012	82,442,000	22,690,000

See footnotes at end of table.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1940, by States and uses—Continued

State	Gravel—Continued				Sand and gravel			
	Railroad ballast [6]		Other [7]		Total commercial		Total Government-and-contractor	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			(1)	(1)	1,669,703	$878,524	171,242	$58,200
Alaska							515,011	103,217
Arizona	(1)	(1)	(1)	(1)	153,030	69,438	92,572	45,062
Arkansas	548,968	$149,329	28,290	$10,858	1,515,482	757,856	1,148,696	310,845
California	264,544	31,523	94,650	38,503	13,033,251	6,649,108	5,880,050	2,339,786
Colorado	(1)	(1)	(1)	(1)	520,034	287,955	1,333,325	220,448
Connecticut	5,000	800	14,111	5,099	1,122,286	683,726	524,584	52,591
Delaware	6,237	1,560			167,138	91,913	(1)	(1)
Florida					1,140,284	795,474	21,791	4,611
Georgia			(1)	(1)	454,811	207,694	35,325	23,897
Hawaii							2,297	1,294
Idaho	127,154	39,291	21,616	4,069	543,165	207,120	1,400,558	450,728
Illinois	1,506,732	608,034	84,474	39,873	10,103,214	5,578,309	(1)	(1)
Indiana	987,363	461,246	76,390	32,391	5,762,836	3,189,839	502,327	116,326
Iowa	(1)	(1)	24,680	17,828	3,464,803	1,852,285	(1)	(1)
Kansas	213	79	34,056	20,629	1,791,103	793,802	473,768	100,160
Kentucky	37,966	17,085	(1)	(1)	1,095,516	800,830	130,809	14,858
Louisiana	361,437	205,744	1,762	141	2,368,750	1,378,658	211,728	2,386
Maine	86,760	23,548	50,941	27,814	238,020	91,292	3,598,111	787,528
Maryland			(1)	(1)	3,313,244	2,752,554	113,281	10,768
Massachusetts	(1)	(1)	161,801	33,964	3,042,723	1,625,712	521,037	55,510
Michigan	334,067	110,331	231,163	67,432	8,552,848	3,381,623	5,097,680	1,596,383
Minnesota	916,242	258,977	287,679	47,453	3,519,007	1,480,575	5,210,198	444,141
Mississippi	178,504	46,068	9,517	3,434	1,555,917	686,917	763,156	37,860
Missouri	169,836	98,186	(1)	(1)	3,317,038	1,967,747	740,533	343,474
Montana	590,338	100,204	162,629	33,014	1,351,999	472,246	3,626,354	1,480,763
Nebraska	(1)	(1)	8,527	8,681	2,216,651	786,800	835,055	286,135
Nevada					208,620	152,277	1,595,304	390,759
New Hampshire					170,366	110,472	1,962,159	155,866
New Jersey	1,775	1,154	56,492	25,302	4,909,249	3,845,378	9,101	1,524
New Mexico					(1)	(1)	2,364,939	1,141,380
New York	(1)	(1)	81,566	34,284	13,225,133	7,639,668	(1)	(1)
North Carolina	30,553	18,496			1,341,449	939,334	1,872,406	500,123
North Dakota	147,378	20,353	(1)	(1)	402,909	101,282	2,799,258	197,364
Ohio	834,848	392,761	218,050	120,855	9,052,945	7,101,664	505,959	80,789
Oklahoma					491,982	261,400	538,453	22,610
Oregon	110,599	48,759	98,089	30,223	1,622,921	859,943	(1)	(1)
Pennsylvania			69,969	57,599	8,363,046	7,981,644	68,610	18,581
Puerto Rico							11,572	4,392
Rhode Island			(1)	(1)	284,138	194,713	230,991	138,899
South Carolina	29,325	4,994			404,096	232,882	111,151	27,975
South Dakota	161,984	30,599	14,687	1,142	279,189	81,161	2,631,142	443,681
Tennessee	87,475	58,802	17,666	13,913	1,902,116	1,667,252	1,202,266	588,035
Texas	912,441	323,134	(1)	(1)	4,840,505	2,849,549	2,090,470	596,536
Utah	175,263	45,873			1,095,553	402,826	804,010	179,882
Vermont	(1)	(1)	(1)	(1)	(1)	(1)	873,325	217,661
Virginia	60,000	83,423	15,467	7,734	1,960,582	1,601,066	710,830	177,510
Washington	585,375	86,458	146,013	20,078	2,335,272	1,073,846	4,652,489	3,204,405
West Virginia	18,976	9,102	34,998	31,498	1,794,732	2,058,163	502,878	182,487
Wisconsin	734,627	167,651	227,325	77,577	3,766,826	1,405,574	2,976,056	898,623
Wyoming	447,324	59,645			590,612	145,691	1,086,342	448,420
Undistributed [2]	421,475	124,587	434,999	221,209	201,173	96,352	44,503,000	13,914,000
	10,880,779	3,627,796	2,707,607	1,032,597	131,256,267	78,270,134	107,052,000	32,418,000

[1] Included under "Undistributed."
[2] Includes in addition to items entered as "1," sand and gravel produced on W. P. A. projects.
[3] Includes 256,104 short tons of blast sand valued at $597,198.
[4] Includes 57,741 short tons of ballast sand valued at $9,506, produced by railroads for their own use.
[5] Includes 207,941 short tons of sand valued at $44,064, used by railroads for fills and similar purposes.
[6] Includes 4,913,809 short tons of ballast gravel valued at $914,990, produced by railroads for their own use.
[7] Includes 793,709 short tons of gravel valued at $133,405, used by railroads for fills and similar purposes.

Government-and-contractor production.—The quantity of sand and gravel reported by State governmental agencies for 1940 increased slightly over that reported for 1939 and represented 34 percent of the total Government-and-contractor output during 1940. Of this amount, 56 percent was produced by contractors; counties reported 20 percent and municipalities 2 percent of the total. The remaining 44 percent was produced largely by Federal agencies, including the Forest Service, National Park Service, Bureau of Public Roads, Bureau of Reclamation, Soil Conservation Service, and W. P. A.

In general, the average values of the materials declined slightly, except the production by or for municipalities. Other details are shown in the following tables.

Sand and gravel sold or used by Government-and-contractor producers in the United States, 1936–40, by uses

Year	Sand				Gravel				Total Government-and-contractor sand and gravel	
	Building		Paving		Building		Paving			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1936	810,196	$410,686	4,897,922	$872,904	1,251,901	$896,454	51,449,400	$15,895,317	58,409,419	$18,075,361
1937	1,540,280	595,953	4,704,764	1,157,162	2,961,360	1,396,202	55,111,541	15,209,362	64,317,945	18,358,679
1938	2,157,501	890,224	6,623,073	1,373,556	7,299,822	2,454,783	59,480,051	16,188,406	75,560,447	20,906,969
1939 [1]	5,815,000	2,255,000	9,114,000	2,767,000	10,896,000	5,586,000	81,790,000	24,275,000	107,615,000	34,883,000
1940	5,149,000	2,039,000	9,595,000	2,767,000	9,866,000	4,922,000	82,442,000	22,690,000	107,052,000	32,418,000

[1] Revised figures.

Sand and gravel sold or used by Government-and-contractor producers in the United States, 1937–40, by types of producers

Type of producer	1937		1938		1939 [1]		1940	
	Short tons	Average value per ton	Short tons	Average value per ton	Short tons	Average value per ton	Short tons	Average value per ton
Construction and maintenance crews	38,637,673	$0.21	44,745,693	$0.21	71,934,000	$0.29	78,615,000	$0.28
Contractors	25,680,272	.40	30,814,754	.37	35,681,000	.39	28,437,000	.37
	64,317,945	.29	75,560,447	.28	107,615,000	.32	107,052,000	.30
States	34,501,864	.29	38,434,738	.31	35,770,000	.29	36,657,000	.26
Counties	20,903,014	.22	23,892,718	.19	16,588,000	.24	21,685,000	.22
Municipalities	1,616,489	.29	2,232,786	.33	2,093,000	.26	1,923,000	.28
Other agencies	7,296,578	.42	11,000,205	.34	53,164,000	.38	46,787,000	.38
	64,317,945	.29	75,560,447	.28	107,615,000	.32	107,052,000	.30

[1] Revised figures.

Method of transportation.—Although the quantity of sand and gravel shipped by commercial producers by rail increased in 1940, the percentage of the total declined from 1939. This decline in percentage of sand and gravel movements by rail has been continuous since 1934, when rail shipments were 57.4 percent of the total.

Sand and gravel sold or used by commercial producers in the United States, 1939–40, by methods of transportation [1]

Method of transportation	1939		1940	
	Short tons	Percent of total reported	Short tons	Percent of total reported
Truck	48,040,422	45.2	54,063,146	45.8
Rail	42,118,042	39.6	45,254,984	38.4
Waterway	16,208,607	15.2	18,600,060	15.8
Total reported	106,367,071	100.0	117,918,190	100.0
Percent of total commercial production		89.8		89.8

[1] For practical purposes the entire output of Government-and-contractor operations commonly is moved by truck. Including Government-and-contractor production, sand and gravel moved as follows—1939: Truck 73 percent, rail 20 percent, and waterway 7 percent (revised); 1940: Truck 72 percent, rail 20 percent, and waterway 8 percent.

Preparation.—The average value per ton of sand and gravel reported by commercial producers is characteristically much higher than that of Government-and-contractor operations. The difference is explainable in terms of the cost of washing, screening, or other preparation, as 88 percent of the commercial material was prepared, compared with 33 percent of the Government-and-contractor production.

Sand and gravel (prepared or unprepared) sold or used by producers in the United States, 1939–40, by commercial and Government-and-contractor operations

	1939			1940		
	Quantity		Average value per ton	Quantity		Average value per ton
	Short tons	Percent		Short tons	Percent	
Commercial operations:						
Prepared	103,771,791	88	$0.64	115,425,213	88	$0.63
Unprepared	14,621,329	12	.31	15,831,054	12	.36
	118,393,120	100	.60	131,256,267	100	.60
Government-and-contractor operations:						
Prepared	[1] 36,280,000	34	[1].45	35,633,000	33	.43
Unprepared	[1] 71,335,000	66	.26	71,419,000	67	.24
	[1] 107,615,000	100	[1].32	107,052,000	100	.30
Grand total	[1] 226,008,000		[1].47	238,308,000		.46

[1] Revised figures.

Size of plants.—More than half of the commercial sand and gravel plants are small—have annual tonnages of less than 25,000—and the percentage of total production contributed by these plants was only 8.3 percent in 1939. However, 61 percent of the total commercial output came from plants having an annual production of less than 200,000 tons. Details of production, by size groups, for 1938 and 1939, are given in the following table.

Comparison of number and output of commercial sand and gravel plants in the United States, 1938–39, by size groups [1]

Size groups in short tons	1938				1939			
	Plants [2]		Production		Plants [2]		Production	
	Number	Percent of total	Short tons	Percent of total	Number	Percent of total	Short tons	Percent of total
Less than 25,000	1,195	56.6	10,300,000	10.2	1,133	54.5	9,398,000	8.4
25,000 to less than 50,000	380	18.0	13,364,000	13.3	365	17.5	13,011,000	11.6
50,000 to less than 100,000	290	13.7	20,726,000	20.6	286	13.7	20,431,000	18.2
100,000 to less than 200,000	161	7.6	22,147,000	22.0	186	8.9	25,686,000	22.8
200,000 to less than 300,000	39	1.9	9,349,000	9.3	50	2.4	12,077,000	10.7
300,000 to less than 400,000	17	.8	5,774,000	5.7	26	1.3	9,086,000	8.1
400,000 to less than 500,000	10	.5	4,406,000	4.4	11	.5	4,948,000	4.4
500,000 to less than 600,000	11	.5	5,892,000	5.8	11	.5	4,884,000	4.3
600,000 to less than 700,000	1	(3)	658,000	.6	3	.2	2,077,000	1.8
700,000 to less than 800,000	3	.1	2,123,000	2.1				
800,000 to less than 900,000	5	.2	4,382,000	4.3	4	.2	3,289,000	2.9
900,000 to less than 1,000,000								
1,000,000 and over	1	.1	1,698,000	1.7	6	.3	7,666,000	6.8
	2,113	100.0	100,819,000	100.0	2,081	100.0	112,553,000	100.0

[1] Plants operated by or for States, counties, and municipalities are not included; also not included are approximately 186 railroad plants with an output of 4,941,000 short tons of sand and gravel in 1938 and 194 plants with an output of 5,840,000 tons in 1939.
[2] May include a few companies operating more than 1 plant but not submitting separate returns for individual plants.
[3] Less than 0.1 percent.

PRINCIPAL TRENDS

The steady improvement in sales of sand and gravel that has prevailed since 1932—with the exception of the regression in 1938—is expected to continue as the demand becomes adjusted to the expanding construction program. The acceleration of the national defense program, which has lately given added impetus to production of aggregates, probably will stimulate the preparation of certain industrial sands to an even greater degree.

Sand and gravel for construction.—Before 1926 the quantities of sand and gravel used were approximately equal, but during recent years the proportion of gravel to sand has increased greatly. The marked increase in the use of gravel is to be attributed primarily to the growing demand for aggregates to satisfy the expanded program of highway construction that was begun in 1924. Figure 2 shows the correlation between highway construction and sales of gravel, as well as the relation of sand output to construction activity in general.

A more complete study of the trends of various building materials, including sand and gravel, has recently been presented in a report by Colby.[2]

Industrial sands.—Figure 3 shows graphically the history of production of industrial sands since 1916. Molding sand is the most important upon a quantity basis, and is subject to greater fluctuations than the other types. The 7 years 1923–29 marked a period of major productivity, the peak of production occurring in 1929. In 1940 production reached 81 percent of that for 1929.

[2] Colby, Shirley F., Influence of Expanding Construction on Shipments of Building Materials: Bureau of Mines Inf. Cir. 7157, 1941, 6 pp.

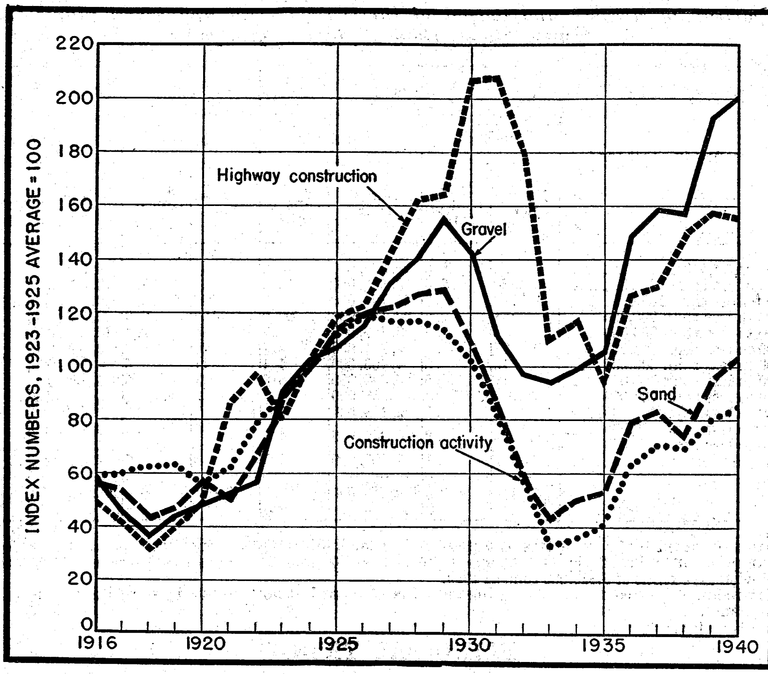

Figure 2.—Comparison of production of sand and gravel with physical volume of highway construction and physical volume of total construction activity in the United States, 1916–40. Data on highway construction and construction activity from Bureau of Foreign and Domestic Commerce.

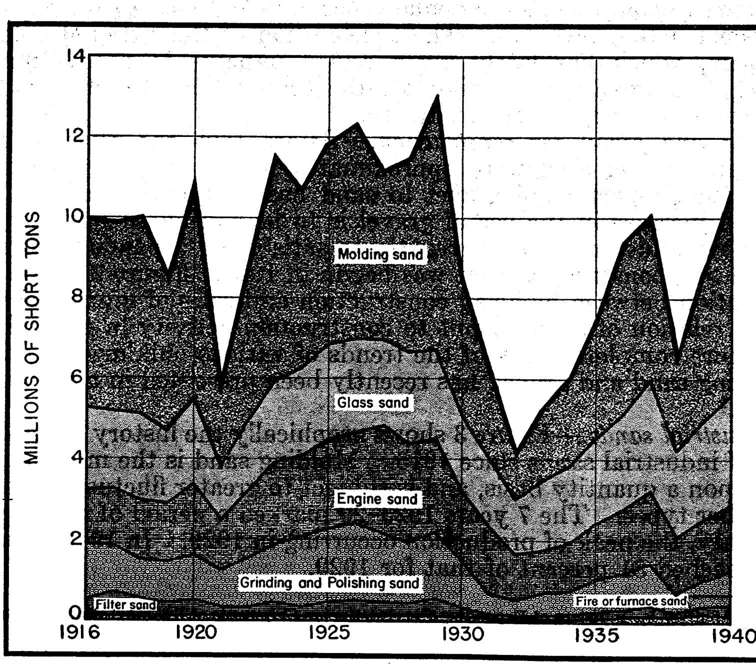

Figure 3.—Production of industrial sands in the United States, 1916–40.

With the advent of mass production of automobiles, sales of molding sand show marked correlation with the number of automobiles manufactured. These relations, with a comparison of industrial production, are shown in figure 4.

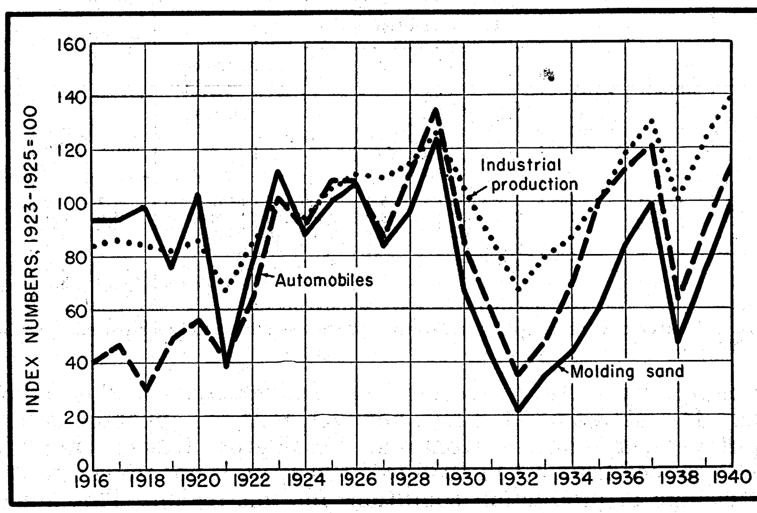

FIGURE 4.—Trends in sales of molding sand compared with automobiles manufactured and industrial production, 1916–40. Statistics on automobiles from Bureau of the Census. Index of industrial production from Federal Reserve Board.

EMPLOYMENT AND PRODUCTIVITY [3]

Data for 1939 are based upon operations reporting about four-fifths of the total production of commercial sand and gravel. The number of men employed increased about 4 percent, and the average number of days employed increased 6 percent, accompanied by a small decrease in the average time for each shift.

The average productivity increased from 3.2 to 3.5 short tons per man per hour—a new high since 1933, when employment data were first recorded by the Bureau of Mines. The increase probably is due to numerous improvements in plants and equipment, as expenditures for improvements during 1939 were higher than at any time during the previous decade.[4]

[3] Statistics on employment and productivity compiled by Elva T. Shuey from records of the employment statistics section, Bureau of Mines.
[4] Pit and Quarry, 1939 in Review—Sand and Gravel: Vol. 32, No. 7, January 1940, pp. 60–69.

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, 1934–39 [1]

Year	Employment					Production			Percent of commercial industry represented
	Average number of men	Time employed				Commercial sand and gravel, short tons	Average per man, short tons		
		Average number of days	Total man-shifts	Man-hours			Per shift	Per hour	
				Average per man per day	Total				
1934	14,611	168	2,452,835	8.1	19,897,633	59,018,238	24.1	3.0	78.4
1935	11,926	197	2,351,453	8.3	19,578,368	60,826,691	25.9	3.1	75.4
1936	16,127	207	3,332,532	8.6	28,672,615	95,219,468	28.6	3.3	83.8
1937	16,062	215	3,458,994	8.6	29,754,746	97,113,001	28.1	3.3	81.8
1938	14,971	201	3,001,796	8.5	25,578,807	81,742,896	27.2	3.2	81.1
1939	15,617	214	3,335,321	8.4	28,054,960	96,755,364	29.0	3.5	81.7

[1] Does not include plants operated by or directly for States, counties, municipalities, and other Government agencies.

Productivity data by regions are summarized in the following table. It must be pointed out, however, that the apparent decline in output per man-hour in Montana, Washington, Oregon, and Idaho, which dropped from 6.1 in 1938 to 4.1 in 1939, is not to be interpreted as a change in production conditions for this region. This apparent decline arises through the calculation of an average figure for operations that differ widely in their output per man-hour, combined with reclassification of one major producer as noncommercial. In other words, the change is due to differences in coverage of the industry during the two periods.

Comparable data, by regions, for 1935 to 1938 were published in Minerals Yearbook, 1940 (pp. 1219–1221), for 1934 in Minerals Yearbook, 1936 (p. 844), and for 1933 in Minerals Yearbook, 1935 (p. 942).

Employment in the commercial sand and gravel industry, sand and gravel produced at plants included in the study, and average output per man in the United States in 1939, 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				
Maine, New Hampshire, Vermont, Rhode Island, Massachusetts, and Connecticut	547	118	101,010	9.3	836,127	3,958,726	39.2	4.7	79.8
New York	1,270	220	278,831	8.2	2,286,742	9,790,771	35.1	4.3	77.7
Pennsylvania, New Jersey and Delaware	2,068	239	494,427	8.4	4,156,614	10,526,341	21.3	2.5	95.1
West Virginia, Virginia, Maryland and District of Columbia	705	256	180,385	8.6	1,550,869	3,416,177	18.9	2.2	51.9

[1] Does not include plants operated by or directly for States, counties, municipalities, and other Government agencies.

Employment in the commercial sand and gravel industry, sand and gravel produced at plants included in the study, and average output per man in the United States in 1939, by regions—Continued

Region	Employment					Production			Percent of commercial industry represented
	Average number of men	Time employed				Commercial sand and gravel (short tons)	Average per man (short tons)		
		Average number of days	Total man-shifts	Man-hours					
				Average per man per day	Total		Per shift	Per hour	
South Carolina, Georgia, Alabama, Florida, and Mississippi	946	248	234, 521	8.7	2, 039, 505	3, 796, 950	16.2	1.9	86.6
North Carolina, Kentucky, and Tennessee	692	245	169, 882	8.4	1, 427, 613	3, 590, 351	21.1	2.5	86.0
Arkansas, Louisiana, and Texas	983	205	201, 432	8.5	1, 719, 482	4, 826, 155	24.0	2.8	59.3
Ohio	1, 475	232	342, 016	8.4	2, 860, 175	7, 526, 094	22.0	2.6	91.7
Illinois and Indiana	1, 617	206	332, 340	8.5	2, 813, 987	13, 000, 999	39.1	4.6	89.3
Michigan and Wisconsin	1, 201	181	217, 137	8.6	1, 857, 547	9, 700, 481	44.7	5.2	87.2
North Dakota, South Dakota, and Minnesota	450	149	67, 101	8.4	562, 937	2, 503, 479	37.3	4.5	64.4
Nebraska and Iowa	661	167	110, 418	9.3	1, 031, 143	3, 624, 172	32.8	3.5	86.5
Kansas, Missouri, and Oklahoma	839	192	161, 371	8.2	1, 327, 452	4, 514, 150	28.0	3.4	83.7
Wyoming, Colorado, New Mexico, Utah, and Arizona	240	162	38, 966	8.0	310, 002	1, 316, 868	33.8	4.3	70.3
California and Nevada	1, 293	233	301, 360	8.2	2, 463, 954	11, 358, 534	37.7	4.6	95.0
Montana, Washington, Oregon, and Idaho	630	165	104, 124	7.8	810, 811	3, 305, 116	31.7	4.1	63.1
Total United States	15, 617	214	3, 335, 321	8.4	28, 054, 960	96, 755, 364	29.0	3.5	81.7

PRICES

In general, there was little change in the prices of commercial sand and gravel from 1939 to 1940. Higher values were reported for engine sand and filter sand—gains from 58 to 65 cents and from $1.13 to $1.38, respectively. Grinding and polishing sand dropped 27 cents from $1.34 a ton. Other changes were less than 5 percent of the 1939 figures; glass sand, fire or furnace sand, and paving sand advanced, whereas building sand declined from 54 to 52 cents and molding sand from $1.08 to $1.05.

Average values reported for commercial gravel did not change more than 2 cents a ton. Paving gravel declined to 59 cents, and railroad ballast advanced to 33 cents; both of these were changes of 2 cents from values reported in 1939. Building gravel showed no change from 65 cents.

The average values for Government-and-contractor materials likewise remained nearly stationary and were much lower than those for commercial sand and gravel because large tonnages of unprepared material are included. Sand for building advanced to 40 cents, but paving sand declined to 29 cents, both changes being 1 cent a ton. Gravel for building declined 1 cent and paving gravel 2 cents—to 50 and 28 cents, respectively.

NEW DEVELOPMENTS

Although many medium and small plants were built during 1940, expenditures by producers were made chiefly for improving or enlarging existing plants.[5] A large-capacity portable plant was put into operation near Burnett, Minn.[6] Nearly 3 miles of conveyor belting are used in the plant that is supplying aggregate for the Friant dam near Fresno, Calif.[7]

The installation of crushing equipment continues to expand,[8] and one plant in California has adopted the unique arrangement of mounting its crusher on rails.[9]

The series of articles on washing and classification by Shaw [10] have continued to appear. In October the Georgia Department of Natural Resources issued Information Circular 11, Glass Sands and Glass Making Materials in Georgia. Parker [11] contributed a rather comprehensive article on slag aggregates, dealing particularly with the industry in England.

Seasonal exemption from the hours provision of the Fair Labor Standards Act for the northern branch of the industry was made final and extended to certain additional plants as applicable.

The graduate research fellow of the National Sand and Gravel Association at the University of Maryland is investigating the effect of characteristics of aggregates on the durability of concrete.

FOREIGN TRADE[12]

Imports of sand and gravel in 1940 were 63 percent higher than in 1939; however, they were considerably below those of 1938 (700,976 short tons).

Approximately 94 percent of all sand and gravel imports during 1940 represented movements of construction materials from Canada. Imports of glass sand from Belgium dropped to less than one-fifth of the quantity obtained from that source in 1939.

Exports of sand and gravel were not recorded separately during 1940; they were included in a classification with various other nonmetallic mineral substances.

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[5] Pit and Quarry, Plants Serving Federal Dam Projects Exemplify Trends in Gravel Industry: vol. 33, No. 7, January 1941, pp. 62–68.

[6] Trauffer, W. E., Portable Plant of Large Capacity on Iron Range to Fill Ballast Contract: Pit and Quarry, vol. 33, No. 5, November 1940, pp. 50–51.

[7] Herrick, H. K., Long Field Conveyors and Tractors Solve Transportation Problem: Rock Products, vol. 43, No. 11, November 1940, pp. 36–38.

[8] Utley, H. F., Installs Latest Type of Equipment to Cope with Changing Specifications: Pit and Quarry, vol. 33, No. 5, November 1940, pp. 56–57.

[9] Nordberg, Bror, Crusher Mounted on Rails to Salvage Boulders: Rock Products, vol. 43, No. 4, April 1940, pp. 29–30, 40.

[10] Shaw, Edmund, Articles on Washing and Classifying Sand: Rock Products, vol. 43, No. 5, March 1940, pp. 39–40; vol. 43, No. 4, April 1940, p. 51; vol. 43, No. 5, May 1940, pp. 49–50; vol. 43, No. 7, July 1940, pp. 28–29, 40; vol. 43, No. 8, August 1940, pp. 73–74; vol. 43, No. 9, September 1940, pp. 27, 30; vol. 43, No. 10, October 1940, pp. 41–42; vol. 44, No. 1, January 1941, pp. 37–38.

[11] Parker, T. W., Blast-furnace Slag Aggregates in Building and Road Construction: Chem. and Ind., vol. 60, February 1941, pp. 59–63.

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

Sand and gravel imported for consumption in the United States, 1939–40, by classes and countries

Country	Glass sand[1]		Other sand[2]		Gravel		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1939								
North America:								
Canada			187,151	$57,789	59,743	$7,937	246,894	$65,726
Other North America			32	31	404	462	436	493
Europe:								
Belgium	23,690	$33,604	289	581			23,979	34,185
Denmark			1,820	200			1,820	200
France			516	1,291			516	1,291
Germany			1,243	14,791			1,243	14,791
Netherlands			111	1,249			111	1,249
United Kingdom			940	3,197			940	3,197
Asia:								
Japan			1	55			1	55
Other Asia			3	88			3	88
	23,690	33,604	192,106	79,272	60,147	8,399	275,943	121,275
1940								
North America: Canada			249,829	78,088	175,140	25,313	424,969	103,401
Europe:								
Belgium	4,337	8,722	336	750			4,673	9,472
Denmark			2,106	360			2,106	360
France			101	480			101	480
Netherlands			814	327			814	327
Norway			224	25			224	25
United Kingdom			17,723	17,625	418	373	18,141	17,998
Asia: Japan			(3)	9			(3)	9
Oceania: Australia			6	61			6	61
	4,337	8,722	271,139	97,725	175,558	25,686	451,034	132,133

1 Classification reads "Sand containing 95 percent silica and not more than 0.6 percent oxide of iron and suitable for manufacture of glass."
2 Classification reads "Sand, n. s. p. f."
3 Less than 1 ton.

Sand and gravel exported from the United States, 1936–40

Year	Short tons	Value	Year	Short tons	Value
1936	49,906	$58,453	1939[1]	27,746	$31,931
1937	67,141	80,197	1940	(2)	(2)
1938	35,572	30,303			

1 Classification reads: "Gravel and building stone."
2 Not separately classified.

BLAST-FURNACE SLAG

It is appropriate to include all available statistics on production of blast-furnace slag because this material is used for purposes similar to those of sand and gravel and crushed stone.

Continuing the policy inaugurated in 1938, the National Slag Association conducted a canvass of 34 companies (70 plants) that prepare blast-furnace slag. The total output for 1940 was 10,353,042 short tons valued at $7,780,641, which represents an increase in tonnage of 14 percent over 1939. Of the total, 78.6 percent (8,132,396 short tons) was screened air-cooled slag valued at $7,015,616 or an average of 86 cents a ton. Air-cooled slag increased 18 percent in tonnage compared with 1939.

About 75 percent of all slag is processed in Ohio, Alabama, and Pennsylvania; however, it is marketed in all States east of the Mississippi River except several New England States too far removed from sources of supply to permit economic utilization.

As in previous years, blast-furnace slag is used chiefly for highway and building construction and for railroad ballast. These uses consumed 89 percent of the total air-cooled output in 1940. Other uses and the quantities involved are shown in the accompanying table.

Shipments of slag, by methods of transportation, were as follows: Railroad, 53.9 percent; truck, 44.7 percent; and waterway, 1.4 percent.

Air-cooled blast-furnace slag sold or used by producers in the United States, 1939–40, by States [1]

State	1939			1940		
	Quantity		Value	Quantity		Value
	Short tons	Percent of total		Short tons	Percent of total	
Alabama	2,285,317	28.9	$1,399,612	2,609,273	27.9	$1,718,872
Ohio	2,560,748	32.3	2,205,144	3,021,039	32.3	2,647,087
Pennsylvania	1,125,748	14.2	1,014,859	1,363,002	14.5	1,295,579
Other States [2]	1,948,468	24.6	1,503,103	2,369,914	25.3	1,861,366
	7,920,281	100.0	6,122,718	9,363,228	100.0	7,522,904

[1] National Slag Association.
[2] Colorado, Illinois, Kentucky, Maryland, Michigan, New York, Tennessee, and West Virginia.

Blast-furnace slag sold or used by producers in the United States in 1940, by uses [1]

Use	Air-cooled				Granulated and foamed	
	Unscreened		Screened			
	Short tons	Value per ton	Short tons	Value per ton	Short tons	Value per ton
Concrete (pavements, buildings, bridges, etc.)			1,867,398	$0.80	(2)	(2)
Roads other than concrete	237,602	$0.50	4,358,680	.92		
Railroad ballast	707,475	.38	1,167,389	.66		
Mineral wool	(2)	(2)	63,358	.98		
Roofing			64,113	1.38		
Fill and sub-base cushion courses, etc.	122,449	.32	154,374	.91	455,825	$0.11
Sewage trickle filter			122,471	.80		
Airport runways	(2)	(2)	(2)	(2)		
Roofing granules			(2)	(2)		
Agricultural purposes			32,242	.93	30,030	.89
Cement manufacture					(2)	(2)
Other uses	172	.40	111,729	1.02	28,671	.50
Use not given	88,094	.41	161,458	1.00		
Total: 1940	1,230,832	.41	8,132,396	.86	989,814	.26
1939	812,220	.45	7,108,061	.83	1,188,094	.10

[1] National Slag Association.
[2] Concealed to avoid revealing data of individual company; figures included in total.

GYPSUM

By Forrest T. Moyer

SUMMARY OUTLINE

Stimulated by the advanced rates of building activity and industrial production, sales of gypsum products in 1940 reached an aggregate value of nearly 53½ million dollars—an annual volume of business 16 percent higher than in 1939 and comparing favorably with that of the peak year of the industry in 1925. The total supply of crude was 13 percent greater than the 1939 tonnage, mainly because of the sharply increased domestic production, and for the first time since 1929 exceeded 5 million tons. The improvement in the calcining division of the industry is indicated by the 15-percent gain in production of calcined gypsum (kettle and kiln output). Contrary to the general uptrend of commodity prices, those of most calcined products for building uses declined slightly from 1939 levels; however, prices of uncalcined products and those calcined for industrial uses were higher in 1940 than in 1939.

According to sales volumes listed in the Bureau of Mines Quarterly Gypsum Reports, most gypsum building products showed an increasing rate of consumption through the first three quarters of the year and, after allowing for seasonal variations, were in greater demand during the October-December quarter than in any other quarter. This strong year-end position resulted principally from the sustained demand of a persistently high level of private residential construction to which, in the last 4 to 6 months of the year, were added the requirements of the emergency housing necessitated by the defense program for industrial workers and conscriptees into the Army. Continuation of this high rate of consumption into 1941 was indicated by F. W. Dodge Corporation data on dollar volumes of residential contracts awarded, which were higher for December and the last quarter of 1940 than for any other similar periods of the year. Letting of contracts usually precedes actual purchase of gypsum products by 2 to 4 months.

Although strikingly increased sales over 1939 were recorded for agricultural gypsum, lath, and wallboard, the outstanding product in 1940 was gypsum sheathing board, which heretofore had been a backward product with only a limited market. Sales jumped from 5¼ million square feet in 1939 to more than 89½ million square feet in 1940. The new demand for this product was created by the rapid construction of cantonments to house the selective service draftees—a totally unexpected and sizable market that caused a temporary shortage of and a rise in the price of the common sheathing material, wood. These combined factors gave gypsum sheathing a decided price advantage over wood and other competitive materials, both in original cost and in cost of the finished wall, so that producers were able to secure a considerable portion of the market. This demonstration of its availability and adaptability plus the continued high price of lumber reportedly induced more widespread use of gypsum sheathing in private residential construction—a market that annually consumes many millions of square feet of sheathing material.

Consumption of lath continued to grow throughout 1940 as it has in every year since 1933 and advanced to a record annual total of nearly 1½ billion square feet. Indicative of the strong market for lath, the net gain over 1939 of 313 million square feet was one of the largest annual increments in the history of the product.

The record volume of crude imports in 1940—7 percent greater than the previous high in 1939—apparently represented the efforts of operators to increase and maintain large stocks at tidewater calcining plants, which depend on deposits outside the country for supplies of crude. This precautionary measure against possible interruption of shipments is predicated by experience in 1918 during the World War, when no ships were available to transport gypsum from Canada and imports of crude fell to 50,653 short tons. In the present war shipping facilities for gypsum were greatly reduced at the close of 1940, and history may repeat itself.

Salient statistics of the gypsum industry in the United States, 1937–40

	1937	1938	1939	1940
Active establishments [1]	92	90	92	91
Crude gypsum: [2]				
Mined short tons	3,058,166	2,684,205	3,226,737	3,699,015
Imported do	897,484	789,429	1,308,078	1,405,210
Apparent supply do	3,955,650	3,473,634	4,534,815	5,104,225
Calcined gypsum produced: [3]				
Short tons	2,411,362	2,252,878	2,881,269	3,307,709
Value	$11,076,205	$10,989,626	$14,620,597	$17,254,667
Gypsum products sold: [3]				
Uncalcined:				
Short tons	860,825	756,565	867,782	929,119
Value	$1,920,706	$1,681,371	$1,927,415	$2,250,857
Calcined:				
Short tons	2,643,075	2,556,296	3,224,216	3,704,110
Value	$36,879,814	$34,574,937	$44,000,824	$51,241,787
Total value	$38,800,520	$36,256,308	$45,928,239	$53,492,644
Gypsum and gypsum products:				
Imported for consumption	$1,167,872	$1,002,001	$1,363,967	$1,427,966
Exported	$271,142	$282,782	$309,453	$264,128

[1] Each mine, plant, or combination mine and plant is counted as 1 establishment.
[2] Excludes byproduct gypsum.
[3] Made from domestic, imported, and byproduct crude gypsum.

The Federal grand jury investigation of the gypsum industry, instigated in 1940 by the Antitrust Division of the Department of Justice, resulted in indictments [1] involving five corporations and nine individuals on charges of illegal control of resale prices of gypsum board and use of an allegedly invalid patent to fix prices on perforated lath. The Department of Justice also filed a civil action [2] against

[1] United States of America v. Certain-teed Products Corporation et al., No. 66007, in the District Court of the United States for the District of Columbia, April term 1940, 54 pp.
United States of America v. United States Gypsum Company et al., No. 66008, in the District Court of the United States for the District of Columbia, April term 1940, 22 pp.
[2] United States of America, Plaintiff, v. United States Gypsum Co., et al., Defendants, Civil Action No. 8017, in the District Court of the United States for the District of Columbia, Filed August 15, 1940, 127 pp.

six companies and eight officers of these companies, charging the use of allegedly improper methods to establish a monopoly and to control prices of gypsum products in violation of sections 1, 2, and 3 of the Sherman Antitrust Act.

Gypsum products (made from domestic, imported, and byproduct crude gypsum) sold or used in the United States, 1928–40, by uses

Year	Uncalcined products [1]		Calcined products							
			Industrial [2] plasters		Building uses					
					Base-coat plasters		Keene's cement		Other building plasters [3]	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1928	[4] 1,139,000	[4] $2,460,000	248,827	$1,913,729	(5)	(5)	54,020	$848,504	[6,7] 3,003,812	[6,7] $17,692,683
1929	[4] 1,162,500	[4] 2,500,000	[7] 208,894	[7] 1,640,180	(5)	(5)	52,330	767,621	[6] 2,698,079	[6] 15,939,968
1930	[4] 1,098,000	[4] 2,360,000	197,665	1,636,528	(5)	(5)	39,446	571,044	[6,7] 1,802,966	[6,7] 14,515,396
1931	[4] 876,500	[4] 2,020,000	[7] 78,943	[7] 632,894	1,032,855	$8,684,749	27,449	394,219	396,262	4,097,293
1932	516,136	1,216,388	[7] 61,025	[7] 572,624	632,217	5,516,966	14,607	217,549	180,280	2,172,759
1933	491,273	1,089,100	[7] 65,053	[7] 584,675	554,852	4,911,523	13,563	194,919	152,054	1,924,910
1934	578,947	1,266,945	76,547	770,482	580,298	5,547,323	18,643	209,552	[7] 172,082	[7] 2,120,629
1935	595,130	1,329,140	[7] 103,632	[7] 978,565	785,821	7,750,424	22,554	280,229	[7] 235,041	[7] 2,871,724
1936	830,683	1,865,673	[7] 118,687	[7] 1,140,692	1,032,110	9,625,132	32,167	497,228	366,797	4,237,818
1937	860,825	1,920,706	125,853	1,363,130	1,288,539	11,621,507	34,260	530,863	346,351	3,857,884
1938	756,565	1,681,371	94,248	1,154,517	1,161,762	10,400,557	23,496	366,813	299,705	3,142,885
1939	867,782	1,927,415	110,395	1,373,564	1,413,291	12,768,526	27,191	424,341	339,222	3,897,606
1940	929,119	2,250,857	123,643	1,532,738	1,475,033	13,012,665	26,962	419,177	360,532	3,896,953

Year	Calcined products—Continued									Total value
	Building uses—Continued									
	Lath			Wallboard [8]			Tile [9]			
	M square feet	Short tons	Value	M square feet	Short tons	Value	M square feet	Short tons	Value	
1928	[4] 405,500	[4] 365,500	[4] $5,775,000	[4] 605,500	[4] 522,500	[4] $11,475,000	[4] 50,500	[4] 293,000	[4] $2,400,000	[4] $42,575,000
1929	[4] 412,000	[4] 363,500	[4] 5,475,000	[4] 667,000	[4] 584,000	[4] 12,275,000	[4] 54,600	[4] 320,000	[4] 2,400,000	[4] 41,000,000
1930	[4] 341,000	[4] 286,000	[4] 5,625,000	[4] 449,500	[4] 378,000	[4] 11,350,000	[4] 40,800	[4] 240,500	[4] 1,780,000	[4] 37,850,000
1931	[4] 226,500	[4] 180,500	[4] 3,425,000	[4] 366,500	[4] 296,500	[4] 9,450,000	[4] 27,300	[4] 154,000	[4] 1,160,000	[4] 29,875,000
1932	[4] 128,000	[4] 102,500	[4] 2,100,000	[4] 211,000	[4] 165,000	[4] 6,050,000	[4] 10,100	[4] 61,500	[4] 550,000	[4] 18,400,000
1933	[4] 117,000	[4] 87,000	[4] 1,675,000	[4] 208,000	[4] 159,500	[4] 5,425,000	[4] 7,700	[4] 47,000	[4] 430,000	[4] 16,225,000
1934	[4] 127,000	[4] 98,000	[4] 1,850,000	[4] 212,000	[4] 161,500	[4] 5,675,000	[4] 9,800	[4] 57,000	[4] 550,000	[4] 18,000,000
1935	[4] 252,000	[4] 179,500	[4] 3,800,000	[4] 260,000	[4] 182,500	[4] 6,875,000	[4] 12,200	[4] 72,500	[4] 740,000	[4] 24,625,000
1936	[4] 479,000	[4] 339,000	[4] 7,325,000	[4] 344,500	[4] 242,000	[4] 8,250,000	[4] 22,300	[4] 128,000	[4] 1,380,000	[4] 34,325,000
1937	738,929	469,970	9,604,372	385,307	241,096	8,349,810	23,820	137,006	1,552,248	38,800,520
1938	809,471	594,659	10,287,935	371,767	269,949	7,921,400	19,942	112,477	1,300,830	36,256,308
1939	1,137,415	850,768	14,598,868	410,876	308,569	8,871,833	30,191	174,780	2,066,086	45,928,239
1940	1,450,069	1,072,555	18,189,358	580,922	467,070	12,227,933	30,026	178,315	1,962,963	53,492,644

[1] Includes portland-cement retarder, agricultural gypsum, fillers, and miscellaneous uncalcined products.
[2] Includes plasters sold to plate-glass, terra-cotta, and pottery works and orthopedic, dental, and all other plasters sold or used for industrial or manufacturing uses.
[3] Includes calcined gypsum sold to mixing plants and sanded, gaging, molding, prepared finishing, insulating, roof-deck, and all other plasters sold or used for building.
[4] Revised figures, partly estimated.
[5] Data not available.
[6] Includes data on all plasters, except Keene's cement, used for building.
[7] Revised figures.
[8] Includes all types of gypsum wallboard and sheathing board.
[9] Includes partition, roof, floor, soffit, shoe, and all other gypsum tiles and gypsum plank.

Bureau of Mines canvasses of the gypsum industry since 1927 have undergone several changes in classification of products and one change in coverage, so that comparable data on sales are available only for the relatively short periods between changes in the canvass. In 1928 a new classification separated the industrial or manufacturing plasters from building plasters and also requested data on square footages of lath and wallboard for the first time. This was changed somewhat for the 1931 canvass, in which square footages of gypsum tile and block were obtained for the first time. In 1937 a new classification that differed but slightly from the preceding one was used; however, the scope of this and subsequent canvasses was enlarged to include sales of products made from byproduct crude and also those made by companies that neither mined nor calcined gypsum but only processed the calcined material into finished products. This expanded survey represents complete coverage of the domestic market for gypsum products, regardless of the source of raw material. In the accompanying table annual sales of gypsum products from 1928 through 1936 are made comparable with those of 1937 and later years, partly by reports from producers not included in the canvasses before 1937 and partly by estimations from the data on hand. The new classification that became effective for the first time in 1928 precludes any extension of the series to preceding years—an unfortunate situation with regard to prices or average unit values, which were forced considerably below normal by the vicious price war in 1928 and 1929.

Noteworthy features of the series are the precipitous declines in sales volumes of all products from 1929 through 1932 and 1933 and the slow, steady recovery (interrupted only in 1938) from the depression years to the present. Lath is the only product for which sales in 1940 were greater (3½ times in square footage) than in 1928; annual sales of all other products were well below those of the late 1920's.

DOMESTIC PRODUCTION

The increased output of domestic mines—15 percent greater than in 1939—was obtained in 15 States from 59 active operations, which comprised 28 underground mines, 26 open quarries, and 5 combinations of mine and quarry. Production increased in 1940 in all States except Utah and Wyoming. New York continued to be the leading producing State, followed in order of tonnage by Michigan, Iowa, and Texas. The largest proportional gain—38 percent over 1939—was recorded for California, which ranked fifth.

The average value of run-of-mine gypsum (not an open-market value) in 1940 was $1.41 a ton, 4 cents higher than in 1939. Data in the accompanying table apply only to natural crude and do not include byproduct gypsum.

Crude gypsum mined in the United States, 1938–40, by States

State	1938			1939			1940		
	Active mines	Short tons	Value	Active mines	Short tons	Value	Active mines	Short tons	Value
California	5	162,056	$334,208	5	188,364	$306,350	6	259,321	$437,504
Colorado	3	21,591	41,080	3	24,013	40,694	3	24,641	36,787
Iowa	8	364,920	495,856	9	430,712	510,120	8	487,379	587,223
Michigan	5	483,324	775,908	5	643,180	834,856	5	746,982	1,017,126
Nevada	3	168,515	366,869	4	205,762	484,621	4	250,632	618,050
New York	10	601,394	941,744	9	709,495	971,229	9	798,229	1,037,181
Oklahoma	3	141,341	231,910	3	161,748	207,503	3	176,166	227,534
Texas	5	246,990	260,094	6	283,912	266,265	7	328,261	368,882
Utah	3	43,144	45,823	4	58,146	65,269	4	45,421	60,055
Other States [1]	11	450,930	778,182	12	521,405	744,098	10	581,983	837,568
	56	2,684,205	4,271,674	60	3,226,737	4,431,005	59	3,699,015	5,227,910

[1] 1938: 1 active mine each in Idaho, South Dakota, and Wyoming; 2 each in Kansas, Montana, Ohio, and Virginia. 1939: 1 active mine each in Arizona and South Dakota; 2 each in Kansas, Montana, Ohio, Virginia, and Wyoming. 1940: 1 active mine each in South Dakota and Wyoming; 2 each in Kansas, Montana, Ohio, and Virginia.

PROCESSING PLANTS AND EQUIPMENT

Calcined gypsum was produced in 25 States by 55 plants; 42 processed domestic crude, 12 imported crude, and 1 byproduct crude gypsum. The total output was 3,307,709 short tons—a net gain of 426,440 tons over 1939. Reflecting rising fuel and other costs, the average unit value of this intermediate material in 1940, as estimated by the producers, increased slightly to $5.22 a ton.

Active calcining plants and equipment in the United States, 1938–40, by States

State	1938				1939				1940			
	Calcining plants	Equipment			Calcining plants	Equipment			Calcining plants	Equipment		
		Kettles	Beehive kilns	Rotary kilns		Kettles	Beehive kilns	Rotary kilns		Kettles	Beehive kilns	Rotary kilns
California	3	10	------	------	4	10	------	[1] 2	4	10	------	[2] 3
Iowa	6	21	------	------	6	20	------	------	5	18	------	------
Michigan	5	22	------	------	5	21	------	------	5	21	------	------
New York	8	26	------	8	7	21	------	6	7	22	------	6
Texas	4	29	------	------	4	25	------	------	4	25	------	------
Utah	3	6	5	------	4	8	5	------	4	8	5	------
Other States [3]	25	63	4	8	26	63	4	8	26	65	4	8
	54	177	9	16	56	168	9	[1] 16	55	169	9	[2] 17

[1] Includes 2 grinding-calcining units.
[2] Includes 3 grinding-calcining units.
[3] 1938: 1 calcining plant each in Arizona, Connecticut, Florida, Illinois, Indiana, Massachusetts, Nevada, New Hampshire, Oklahoma, Pennsylvania, South Dakota, Vermont, and Wyoming; 2 each in Colorado, Kansas, Montana, New Jersey, Ohio, and Virginia. 1939–40: 1 calcining plant each in Arizona, Connecticut, Georgia, Indiana, Massachusetts, Nevada, New Hampshire, Oklahoma, Pennsylvania, South Dakota, Vermont, and Wyoming; 2 each in Colorado, Florida, Kansas, Montana, New Jersey, Ohio, and Virginia.

Although record sales of lath and sheathing, plus sharply increased sales of wallboard, taxed the capacity of the manufacturing machines it is reported that producers could meet commitments for all standard types and in only a few instances were shipments delayed. According to Minerals Yearbook 1940 (p. 1230) the average capacity of the active board machines is estimated to be 87,500 square feet in 8 hours or 78,750,000 square feet of ⅜-inch lath per 300-day operating year. Applying this figure to the 34 active board machines the producing capacity of the industry at the end of 1940 would be about 2,700 million square feet of ⅜-inch lath. The total surface area of all gypsum board sold in 1940 was just over 2,000 million square feet, which is estimated—by allowing for different thicknesses and types (thicker boards and certain types slow the process)—to be equivalent to roughly 2,333 million square feet of ⅜-inch lath. These figures indicate that the board machines operated at approximately 85 percent of capacity during 1940.

DISTRIBUTION OF SALES

Sales of agricultural gypsum in 1940 were 23 percent above 1939, principally because of sharply increased consumption in the peanut-growing regions of the Southeastern States—an area that consumed roughly 60,000 short tons of this fertilizer and soil conditioner. Although most of the tonnage was used in the Jumbo peanut region of southern Virginia the consumption of gypsum in the Spanish peanut region of South Carolina and Georgia is said to be expanding. Sales of the other major uncalcined product—portland-cement retarder—increased 6 percent over 1939—a gain in close agreement with the 7-percent rise in production of cement.

The indicated consumption of the major classes of building plasters—"base-coat" and "gaging and molding"—were 4 and 9 percent, respectively, above 1939 data. The 14-percent increase in sales of ready-sanded plasters by the primary producers more than compensated for the recession in tonnage of calcined gypsum sold to mixing plants and indicated a further withdrawal of the independent mixing plants from the ready-sanded plaster market.

Gypsum products (made from domestic, imported, and byproduct crude gypsum) sold or used in the United States, 1939–40, by uses

Use	1939		1940	
	Short tons	Value	Short tons	Value
Uncalcined:				
Portland-cement retarder	774,982	$1,406,129	820,828	$1,599,511
Agricultural gypsum	75,091	364,711	92,232	502,298
Other uses [1]	17,709	156,575	16,059	149,048
Total uncalcined	867,782	1,927,415	929,119	2,250,857
Calcined:				
For building uses:				
Plasters:				
Base-coat	1,413,291	12,768,526	1,475,033	13,012,665
Sanded	116,459	662,211	132,306	732,503
To mixing plants	19,485	119,391	17,456	107,671
Gaging and molding	150,175	1,923,109	163,650	2,036,150
Prepared finishes	14,136	491,788	12,455	344,908
Insulating and roof-deck	24,798	214,397	18,561	162,100
Other [2]	14,169	486,710	16,104	513,621
Keene's cement	27,191	424,341	26,962	419,177
Lath [3]	850,768	14,598,868	1,072,555	18,189,358
Wallboard [4]	303,472	8,766,184	380,125	10,595,245
Sheathing board [5]	5,097	105,649	86,945	1,632,688
Tile [6]	174,780	2,066,086	178,315	1,962,963
Total for building uses	3,113,821	42,627,260	3,580,467	49,709,049
For industrial uses:				
To plate-glass and terra-cotta works	35,777	242,671	40,741	276,891
To pottery works	18,121	234,725	20,138	264,975
Orthopedic and dental plasters	9,586	313,930	9,787	324,567
Other industrial uses [7]	46,911	582,238	52,977	666,305
Total for industrial uses	110,395	1,373,564	123,643	1,532,738
Total calcined	3,224,216	44,000,824	3,704,110	51,241,787
Grand total value		45,928,239		53,492,644

[1] Includes uncalcined gypsum sold for use as filler and rock dust, in paint manufacturing, and for minor purposes.
[2] Includes joint filler, patching and painter's plaster, and unclassified building plasters.
[3] 1939: 1,137,415 M square feet. 1940: 1,450,069 M square feet.
[4] 1939: 405,655 M square feet. 1940: 491,291 M square feet.
[5] 1939: 5,221 M square feet. 1940: 89,631 M square feet.
[6] 1939: 30,191 M square feet. 1940: 30,026 M square feet.
[7] Includes statuary, industrial casting and molding plasters, dead-burned filler, and miscellaneous sales.

Sales of all types of gypsum board were exceptionally good in 1940—those of lath climbing 27 percent to a new high annual total and those of wallboard advancing 21 percent over the square footages of 1939. Data on sheathing board, listed separately for the first time in this chapter, had been included in prior years in the "wallboard" classification because only small quantities were sold annually. To provide a measure of the new demand for gypsum sheathing created by the construction of Army and Navy barracks in the latter part of 1940 the producing companies supplied sales data for both 1939 and 1940. The exceptional 16-fold increase to 89½ million square feet occurred almost entirely in the last half of 1940 and indicates ready acceptance of this board as a common building material. The extensive construction of barracks in the latter part of 1940 also is responsible for most of the large gain in sales of wallboard over the 1939 volume.

The square footage of gypsum tile sold in 1940 was virtually unchanged from that in 1939, a year in which consumption had advanced markedly to the highest rate since 1930. Sales of partition tile, which comprise the major part of the classification, were nearly 10 percent higher in 1940, but sales of all other tile (roof, floor, etc.) declined approximately one-fourth from 1939.

Sales of all groups of industrial plasters were greater than in 1939; plate-glass and terra-cotta plaster made the largest gain—14 percent. Total shipments of industrial plasters were 12 percent above 1939.

PRICES

As indicated by the average unit values, f. o. b. plant, prices of most calcined gypsum products in 1940 were slightly lower than in 1939. Base-coat plasters declined 21 cents to $8.82 per ton, and lath was off 30 cents to $12.54 per M square feet, but the prices of wallboard and Keene's cement differed only slightly from 1939. This weak but comparatively stable condition of prices of gypsum building products has proved advantageous in securing markets from competitive materials that have been advanced in price, as has been pointed out for gypsum sheathing and wallboard. The 59-cent increase to $5.45 a ton for agricultural gypsum in 1940 was caused by the growing difficulty of obtaining supplies from Canada for the market in the Southeastern States. The price of portland-cement retarder rose slightly to $1.95 a ton—a figure 27 percent lower than in 1925.

RECENT DEVELOPMENTS

Results released by the Bureau of Mines of a comprehensive study [3] of the thermodynamic properties of materials in the $CaSO_4$-H_2O system show the existence of six substances with individual properties—one double hydrate, two hemihydrates (alpha and beta), two soluble anhydrites (alpha and beta), and one insoluble anhydrite. Application of the data listed in this important publication may help to explain some of the perplexing properties exhibited by commercial calcined gypsum. A so-called "elementary application" analyzing the heat utilization of the kettle-calcining process shows that only 10 percent of the total heat supplied to the kettle may be considered usefully consumed. Stability diagrams are included in the report.

Research [4] on flotation of impurities from gypsum indicates that certain cationic reagents have merit for removing silica from crude gypsum.

[3] Kelley, K. K., Southard, J. C., and Anderson, C. T., Thermodynamic Properties of Gypsum and Its Dehydration Products: Bureau of Mines Tech. Paper 625, 1941, 73 pp.
[4] Clemmer, J. Bruce, and DeVaney, F. D., Cationic Reagents in the Flotation of Silica from Gypsum Ores: Bureau of Mines Rept. of Investigations 3553, 1941, 12 pp.

A statistical study [5] of production and employment in operations on crude gypsum reveals a rise in productivity per man-hour in underground mines from 0.30 short ton in 1900 to 1.06 tons in 1938 and for open-pit mines from 0.40 ton to 2.59 tons for the same years.

Descriptions [6] of the properties of pottery plasters that indicate good serviceability for jigger or casting services were published recently. Other papers [7] discussed some factors that cause early failure of plaster molds used to form ceramic ware and point out that the pottery plaster seldom is at fault.

In Europe experimental work [8] on the new sursulfate (or supersulfate) cements indicates that one of the best mixtures is 81 percent slag, 4 percent portland cement, and 15 percent anhydrite. The most suitable slags are free of manganese and high in alumina. These slag cements are claimed to have normal hardening action, low heat of set, and high resistance to salt and sulfate waters.

A process [9] of producing a high-strength hemihydrate by heating gypsum in a magnesium sulfate solution was claimed to be feasible upon a commercial basis after being tested by pilot-plant operation. The process consists of four steps: (1) Cooking in an agitated, jacketed kettle, (2) filtering in a centrifugal or Vallez filter, (3) drying in a steam-jacketed rotary drier, and (4) evaporating in a forced-circulation, vertical-tube evaporator.

A new use for gypsum was developed by the kraft-paper industry by utilizing a mixture of gypsum and salt in the manufacturing process as a substitute for salt cake, which formerly had been supplied from continental Europe.

In 1940 two new gypsum-board plants began operations; one in New Jersey replaced an old plant destroyed by fire early in the year, and the other was in New York. Both use calcined gypsum made from imported crude. A new operation producing crude gypsum for use as portland-cement retarder was begun in Kern County, Calif., during the year.

Committee C-11 on Gypsum of the American Society for Testing Materials made further progress on specifications. Definitions of gypsum lath, gypsum sheathing board, gypsum wallboard, and perforated gypsum lath were revised and advanced to standard. The tentative revision of the Standard Specification for Gypsum (C22-25), raising the $CaSO_4.2H_2O$ content from 64.5 to 75 percent, met some objection and was continued as tentative. Progress was made in developing the ammonium acetate method for determining the purity of calcined gypsum.

[5] Newcomb, Robinson, and Peterson, Knute, Production, Employment, and Output per Man in Gypsum Mining: Bureau of Mines Inf. Circ. 7134, 1940, 17 pp.

[6] McMahon, J. F., and Schurecht, H. G., Serviceability of Pottery Plasters: Bull. Am. Ceram. Soc., vol. 18, No. 12, December 1939, pp. 454-457.

[7] Dailey, M. C., and Nies, B., Some Factors Affecting Plaster Mold Life: Bull. Am. Ceram. Soc., vol. 19, No. 9, September 1940, pp. 323-329.
Gerber, Charles I., Pottery Plaster for Molds: Ceram. Ind., vol. 35, 1940, No. 1, pp. 37-38; No. 2, pp. 39-40.

[8] Anderegg, F. O., Slag and Gypsum Cements: Rock Products, vol 43, No. 3, March 1940, p. 52.

[9] American Institute of Chemical Engineers, Abstract of paper presented at December 1940 meeting: Chem. and Met. Eng., vol. 47, No. 12, December 1940, p. 872.

FOREIGN TRADE [10]

Imports.—Imports of crude gypsum for processing at tidewater calcining plants constitute the bulk of foreign trade in gypsum. Although a record annual tonnage was brought into the country in 1940 some importers were reported to have had difficulty in obtaining shipping facilities during the latter part of the year. As usual, more than 90 percent of the crude imports came from tidewater quarries in Nova Scotia and New Brunswick, Canada. The small tonnage of alabaster nodules imported from Italy each year since 1935 ceased in the middle of 1940, when the consuming firm stopped making lamp bases.

Gypsum and gypsum products imported for consumption in the United States, 1936–40

Year	Crude (including anhydrite)		Ground		Calcined		Keene's cement		Alabaster manufactures [1]	Other manufactures n. e. s.	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value			
1936	676,990	$657,125	1,374	$16,937	450	$8,778	20	$816	$173,554	$34,722	$891,932
1937	897,484	854,835	1,711	22,165	353	7,917	25	675	203,824	78,456	1,167,872
1938	789,429	772,026	1,486	17,674	372	7,649	9	223	159,551	44,878	1,002,001
1939	1,308,078	1,174,117	1,475	17,606	302	6,551	4	145	110,136	55,412	1,363,967
1940	1,405,210	1,300,450	1,137	16,206	223	5,087	9	265	69,820	36,138	1,427,966

[1] Includes imports of jet manufactures, which are reported to be negligible.

Crude gypsum (including anhydrite) imported for consumption in the United States, 1938–40, by countries

Country	1938		1939		1940	
	Short tons	Value	Short tons	Value	Short tons	Value
Canada	739,172	$723,780	1,243,390	$1,112,967	1,368,194	$1,260,076
China			(1)	18		
Italy	124	2,943	116	2,942	184	4,495
Mexico	50,133	45,303	58,955	53,341	32,134	29,056
United Kingdom			5,617	4,849	4,698	6,823
	789,429	772,026	1,308,078	1,174,117	1,405,210	1,300,450

[1] Less than 1 ton.

Exports.—A sizable demand for wallboard as an efficient and ready means of repairing buildings damaged by bombs is reported [11] to have been created in England. More wallboard probably would be imported into England if shipping restrictions were lifted.

[10] 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.
[11] Rock Products, vol. 44, No. 2, p. 106.

Gypsum and gypsum products exported from the United States, 1936–40

Year	Crude, crushed, or ground		Plasterboard and wallboard		Plaster, calcined, and manufactures		Other manufactures, n. e. s.	Total value
	Short tons	Value	Square feet	Value	Short tons	Value		
1936	(1)	(1)	(1)	(1)	(1)	(1)	(1)	$255,903
1937	4,777	$26,692	4,360,404	$96,019	2,847	$61,383	$87,048	271,142
1938	2,844	17,762	3,658,647	88,822	3,833	71,914	104,284	282,782
1939	10,342	41,012	5,258,249	130,073	2,913	69,577	68,791	309,453
1940	5,209	31,564	4,152,452	101,680	2,208	56,419	74,465	264,128

[1] Data not available; value reported as follows: "Crude, crushed, calcined, or ground," $107,732; "Plasterboard, wallboard, plaster, and manufactures, n. e. s.," $148,171.

WORLD PRODUCTION

Although few figures are available regarding the production of gypsum in the various countries the United States doubtless has continued to be the principal producer. The European War probably has curtailed the output of all other countries that formerly produced large quantities, except Canada, where mining activity is determined largely by the condition of the gypsum market in the United States.

World production of gypsum, 1936–40, by countries, in metric tons [1]

[Compiled by L. P. Lounsbery]

Country [1]	1936	1937	1938	1939	1940
Algeria	45,265	46,175	33,325	(2)	(2)
Anglo-Egyptian Sudan	2,997	-------	-------	-------	(2)
Argentina [3]	55,706	68,220	70,813	87,328	(2)
Australia:					
New South Wales	4,390	9,300	12,712	(2)	(2)
South Australia	108,871	117,985	148,943	147,266	(2)
Victoria	7,581	21,197	13,596	11,966	(2)
Western Australia	6,768	9,219	13,645	14,570	(2)
Brazil [4]	2,000	2,000	2,000	2,000	2,000
Canada	763,044	1,044,222	915,169	1,289,950	1,314,311
Chile	22,674	24,980	24,551	22,209	(2)
China	68,800	(2)	(2)	(2)	(2)
Cyprus [5]	16,603	13,576	9,729	5,058	(2)
Egypt	256,211	253,641	212,088	700,166	(2)
Eire	6,096	11,647	13,364	16,168	(2)
Estonia	13,849	12,748	13,915	(2)	(2)
France	1,376,150	1,320,400	(2)	(2)	(2)
Germany	(2)	(2)	(2)	(2)	(2)
Austria [6]	47,000	47,000	(2)	(2)	(2)
Greece	13,779	17,924	16,609	15,219	(2)
India, British	55,277	46,830	70,944	69,786	(2)
Iraq	-------	-------	-------	69,545	(2)
Italy	324,789	416,198	425,299	(2)	(2)
Latvia [5]	123,503	196,911	196,964	(2)	(2)
Luxemburg	29,110	19,722	19,901	(2)	(2)
Mexico	61,711	(2)	(2)	(2)	(2)
New Caledonia	-------	984	1,070	(2)	3,000
Palestine	6,209	3,934	3,984	4,524	(2)
Peru	12,560	12,895	14,026	15,655	(2)
Portugal	6,850	11,390	9,036	(2)	(2)
Rumania	53,603	70,620	69,079	(2)	(2)
Sweden	93	108	95	102	(2)
Tunisia	11,200	22,800	(2)	(2)	(2)
Union of South Africa	31,962	33,186	38,849	40,782	(2)
United Kingdom	1,018,562	1,111,669	1,109,928	(2)	(2)
United States	2,460,735	2,774,307	2,435,057	2,927,231	3,355,672

[1] In addition to the countries listed, gypsum is produced in Chosen, Cuba, Japan, French Morocco-Poland, Spain, Switzerland, U.S.S.R., and Yugoslavia, but production data are not available.
[2] Data not available.
[3] Rail and river shipments.
[4] Approximate production.
[5] Exports of crude and calcined gypsum.
[6] Estimate furnished by Bundesministerium für Handel und Verkehr.

LIME

By Duncan McConnell and A. T. Coons

SUMMARY OUTLINE

Production of lime attained a new peak in 1940—an output of 4,886,929 short tons. The previous record—4,580,823 short tons—was established in 1925. The total quantity in 1940 exceeded that in 1939 by 14.9 percent; this marked increase in output was accompanied by a decrease of 11 cents a ton in average value for all lime at producing plants.

Agricultural lime declined most sharply in value, although sales in 1940 increased slightly from 1939 and were about the same as for 1938. The quantity of lime used for application to the soil fluctuates, but it does not undergo pronounced changes, such as those experienced by the building, chemical, and industrial outlets.

Sales of building lime in 1939 made substantial gains over 1938 both in quantity and unit value; in 1940 there was a further 1-percent advance in volume of sales compared with 1939, but the value declined 1.3 percent.

Sales of lime for chemical and industrial purposes increased for all of the major categories. The total advance from 1939 was 19.1 percent. Sales of refractory lime gained 29.2 percent from 1939 to 1940, but imports from Canada ceased.

Among chemical and industrial uses the most noteworthy gains were that of metallurgical lime, which advanced 33 percent, and that of lime for paper manufacture, which increased 22 percent compared with 1939. The quantity of metallurgical lime consumed reached a new record during 1940, surpassing the previous one established in 1939. Of special interest is the fact that, although production of steel ingots was unusually high in 1940, sales of metallurgical lime were proportionately much higher and far outstripped normal requirements. As indicated in the chapter on Stone, the same condition prevailed with respect to metallurgical limestone.

Data on prices indicate a gradual, steady decline in averages since 1937, interrupted by a rise in the value of building lime during 1939 and of chemical and industrial lime during 1938.

Exports of lime—31,912 short tons—established a new peak in 1940. The previous record (29,475 short tons) was in 1913. Exports to

Latin American countries increased considerably; and imports of lime, which are always rather insignificant and come chiefly from Canada, increased slightly during 1940.

Salient statistics of the lime industry in the United States, 1939–40

	1939			1940				
	Short tons	Value		Short tons	Value		Percent of change in—	
		Total	Average		Total	Average	Tonnage	Average value
Lime sold or used by producers:								
By classes:								
Quicklime	2,936,295	$19,925,153	$6.79	3,501,104	$23,433,807	$6.69	+19.2	−1.5
Hydrated lime	1,318,053	10,124,241	7.68	1,385,825	10,522,578	7.59	+5.1	−1.2
Total lime	4,254,348	30,049,394	7.06	4,886,929	33,956,385	6.95	+14.9	−1.6
By uses:								
Agricultural	362,335	2,214,759	6.11	364,823	2,084,462	5.71	+.7	−6.5
Building	1,000,498	8,563,792	8.56	1,010,435	8,542,207	8.45	+1.0	−1.3
Chemical and industrial	2,219,954	13,823,289	6.23	2,643,762	16,404,388	6.20	+19.1	−.5
Refractory (dead-burned dolomite)	671,561	5,447,554	8.11	867,909	6,925,328	7.98	+29.2	−1.6
Imports for consumption:								
Quicklime and hydrated lime	7,694	71,902	9.35	9,205	81,888	8.90	+19.6	−4.8
Dead-burned dolomite [1]	186	4,260	22.90					
Exports	21,477	236,497	11.01	31,912	311,619	9.76	+48.6	−11.4

[1] Dead-burned basic refractory material containing 6 percent or more lime and consisting chiefly of magnesia and lime.

PRODUCTION

Quicklime is a semiperishable commodity; and for this reason, stocks are inconsequential. Quantities sold or used may be considered equivalent to production, and these terms are employed interchangeably in this chapter.

In 1940 the production of quicklime gained about 19 percent compared with 1939, and hydrated lime increased about 5 percent.

Average values declined slightly, except for agricultural lime, which decreased appreciably. Other data on values appear in a later part of the chapter. Data for recent years are presented in the following table.

Lime sold or used by producers in the United States, 1936–40

Year	Plants in operation	Short tons [1]	Value [2]	
			Total [1]	Average
1936	301	3,749,383	$26,933,719	$7.18
1937	314	4,124,165	30,091,168	7.30
1938	321	3,346,954	24,137,638	7.21
1939	311	4,254,348	30,049,394	7.06
1940	314	4,886,929	33,956,385	6.95

[1] Includes lime used by producers (captive tonnage) as follows—1936, 224,693 short tons valued at $1,179,820; 1937: 270,192 tons, $1,388,052; 1938: 168,245 tons, $985,003; 1939: 270,087 tons, $1,454,285; 1940: 339,441 tons, $1,804,017.

[2] Value given represents value of bulk lime f. o. b. at point of shipment and does not include cost of barrel or package.

Production by States.—Lime was produced in 38 States and 2 Territories during 1940. This output came from 314 plants (3 more than in 1939) and gained during 1940 in most States. Ohio, Pennsylvania, Missouri, and West Virginia produced 61 percent of the total; Ohio alone contributed 26 percent.

Lime sold or used by producers in the United States, 1939–40, by States

State	1939			1940		
	Active plants	Short tons	Value	Active plants	Short tons	Value
Alabama	8	176,513	$1,004,785	8	234,147	$1,359,371
Arizona	3	57,233	448,860	4	67,882	502,998
Arkansas	2	(1)	(1)	2	(1)	(1)
California	8	87,407	833,326	12	112,522	1,031,352
Colorado	4	10,699	103,097	5	7,944	82,486
Connecticut	1	(1)	(1)	1	(1)	(1)
Florida	4	22,843	215,472	4	25,038	227,440
Georgia	1	6,815	57,663	1	13,774	92,281
Hawaii	2	(1)	(1)	1	(1)	(1)
Idaho	1	(1)	(1)	2	(1)	(1)
Illinois	8	147,729	1,064,154	7	161,358	1,150,113
Indiana	5	94,741	534,688	4	84,462	457,629
Kentucky	1	(1)	(1)	1	(1)	(1)
Maine	2	(1)	(1)	2	(1)	(1)
Maryland	18	59,504	396,201	15	63,745	355,771
Massachusetts	6	111,734	1,005,485	6	108,797	965,333
Michigan	4	45,180	324,765	4	41,814	308,926
Minnesota	2	(1)	(1)	2	(1)	(1)
Missouri	11	516,988	2,800,379	10	607,062	3,184,293
Montana	2	(1)	(1)	4	18,797	77,658
Nevada	2	(1)	(1)	2	(1)	(1)
New Jersey	4	22,636	148,605	4	28,854	206,326
New Mexico	2	(1)	(1)	2	(1)	(1)
New York	6	42,225	314,457	5	54,364	408,645
North Carolina	1	(1)	(1)	1	(1)	(1)
Ohio	22	1,106,250	8,907,195	23	1,284,877	10,180,785
Oklahoma	1	(1)	(1)	2	(1)	(1)
Oregon				1	(1)	(1)
Pennsylvania	93	691,460	4,744,197	90	833,038	5,622,725
Puerto Rico	1	(1)	(1)	4	3,719	33,120
Rhode Island	1	(1)	(1)	1	(1)	(1)
South Dakota	2	(1)	(1)	2	(1)	(1)
Tennessee	10	163,006	893,161	10	192,133	1,050,199
Texas	9	62,048	524,748	9	64,274	543,130
Utah	8	38,437	268,557	8	49,413	306,357
Vermont	5	63,316	452,045	5	61,026	430,178
Virginia	23	166,542	990,796	23	178,036	1,044,229
Washington	5	47,485	484,667	6	53,428	582,416
West Virginia	11	249,987	1,461,002	10	278,300	1,727,844
Wisconsin	12	64,290	541,787	11	65,632	542,749
Undistributed [2]		199,280	1,529,302		192,493	1,482,031
	311	4,254,348	30,049,394	314	4,886,929	33,956,385

[1] Included under "Undistributed."

[2] Includes items entered as "(1)."

Production by uses.—The average values of lime used for tanning, sugar refining, water purification, and metallurgical purposes were higher in 1940 than in 1939. The value of lime used by sugar refineries increased from $8.89 in 1939 to $10.33 in 1940. The unit value of lime for all other purposes decreased; the most pronounced drop was for agricultural lime, which decreased from $6.11 to $5.71.

Production of hydrated lime rose in tonnage but declined slightly in proportion of the total from 31 percent in 1939 to 28.4 in 1940. The increase in output was accompanied by a decrease of 9 cents a ton in average value.

Lime sold or used by producers in the United States in 1940, by States and uses

State	Agricultural		Building		Chemical and industrial												Total	
					Metallurgical		Paper mills		Refractory		Tanneries		Water purification		Other			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(1)	(1)	51,671	$350,450	105,168	$543,339	52,241	$290,911	(1)	(1)	-----	-----	6,067	$47,594	4,706	$31,080	234,147	$1,359,371
Arizona	-----	-----	12,352	154,766	(1)	(1)	(1)	(1)	-----	-----	-----	-----	-----	-----	-----	-----	67,882	502,998
Arkansas	-----	-----	(1)	(1)	(1)	(1)	(1)	(1)	-----	-----	-----	-----	(1)	(1)	(1)	(1)	(1)	(1)
California	1,196	$8,714	24,808	275,165	30,556	280,597	(1)	(1)	-----	-----	(1)	(1)	7,046	55,184	45,590	382,168	112,522	1,031,352
Colorado	(1)	(1)	2,521	28,719	(1)	(1)	-----	-----	(1)	(1)	-----	-----	(1)	(1)	(1)	(1)	7,944	82,486
Connecticut	(1)	(1)	(1)	(1)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	(1)	(1)	(1)	(1)
Florida	(1)	(1)	6,260	59,038	-----	-----	-----	-----	-----	-----	-----	-----	8,725	80,811	(1)	(1)	25,038	227,440
Georgia	3,899	16,523	9,875	75,758	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	13,774	92,281
Hawaii	-----	-----	(1)	(1)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	(1)	(1)	(1)	(1)
Idaho	(1)	(1)	(1)	(1)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	(1)	(1)
Illinois	(1)	(1)	18,819	154,836	66,859	425,551	6,566	37,376	(1)	(1)	(1)	(1)	20,026	139,573	12,648	89,739	161,358	1,150,113
Indiana	(1)	(1)	5,427	33,020	17,040	93,076	14,768	77,295	-----	-----	(1)	(1)	12,021	67,999	32,454	169,765	84,462	457,629
Kentucky	(1)	(1)	(1)	(1)	-----	-----	-----	-----	-----	-----	-----	-----	(1)	(1)	-----	-----	(1)	(1)
Maine	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	-----	-----	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Maryland	50,768	261,422	(1)	(1)	-----	-----	(1)	(1)	-----	-----	-----	-----	-----	-----	(1)	(1)	63,745	355,771
Massachusetts	7,102	48,813	67,240	653,040	(1)	(1)	7,965	65,662	-----	-----	9,937	$79,474	(1)	(1)	12,784	90,163	108,797	965,333
Michigan	(1)	(1)	2,043	17,220	(1)	(1)	30,127	217,254	-----	-----	(1)	(1)	2,159	18,863	4,822	37,923	41,814	308,926
Minnesota	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	-----	-----	-----	-----	(1)	(1)	(1)	(1)	(1)	(1)
Missouri	(1)	(1)	45,807	306,723	137,997	632,034	77,403	368,932	(1)	(1)	(1)	(1)	95,122	499,822	174,555	872,171	607,062	3,184,293
Montana	(1)	(1)	757	10,204	(1)	(1)	-----	-----	-----	-----	-----	-----	-----	-----	(1)	(1)	18,797	77,658
Nevada	(1)	(1)	(1)	(1)	(1)	(1)	-----	-----	-----	-----	-----	-----	(1)	(1)	(1)	(1)	(1)	(1)
New Jersey	(1)	(1)	(1)	(1)	-----	-----	-----	-----	-----	-----	-----	-----	(1)	(1)	(1)	(1)	28,854	206,326
New Mexico	-----	-----	(1)	(1)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	(1)	(1)
New York	3,117	19,924	3,513	25,395	(1)	(1)	(1)	(1)	-----	-----	(1)	(1)	(1)	(1)	9,235	70,031	54,364	408,645
North Carolina	-----	-----	(1)	(1)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	(1)	(1)
Ohio	25,130	172,122	443,471	3,838,345	58,013	323,450	31,751	177,805	514,517	$4,254,741	-----	-----	23,161	131,737	188,834	1,282,585	1,284,877	10,180,785
Oklahoma	-----	-----	(1)	(1)	-----	-----	(1)	(1)	-----	-----	-----	-----	(1)	(1)	(1)	(1)	(1)	(1)
Oregon	-----	-----	(1)	(1)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	(1)	(1)
Pennsylvania	204,556	1,177,169	84,583	609,414	237,300	1,482,002	66,390	445,957	(1)	(1)	25,040	174,917	(1)	(1)	79,314	610,578	833,038	5,622,725
Puerto Rico	-----	-----	170	1,680	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	3,549	31,440	3,719	33,120
Rhode Island	(1)	(1)	(1)	(1)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	(1)	(1)	(1)	(1)
South Dakota	-----	-----	(1)	(1)	(1)	(1)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	(1)	(1)
Tennessee	(1)	(1)	37,669	264,729	22,376	94,941	88,645	429,939	-----	-----	3,626	21,592	17,753	102,164	(1)	(1)	192,133	1,050,199
Texas	(1)	(1)	28,864	275,882	(1)	(1)	13,328	62,897	-----	-----	-----	-----	11,348	102,551	10,170	96,938	64,274	543,130
Utah	-----	-----	4,577	49,330	43,999	247,755	-----	-----	(1)	(1)	-----	-----	(1)	(1)	(1)	(1)	49,413	306,357
Vermont	9,928	50,930	11,839	96,911	(1)	(1)	22,031	156,298	-----	-----	(1)	(1)	(1)	(1)	15,484	110,056	61,026	430,178
Virginia	23,250	119,759	32,638	226,660	50,325	272,682	(1)	(1)	-----	-----	(1)	(1)	7,674	56,511	43,204	244,593	178,036	1,044,229
Washington	3,202	25,243	11,988	188,486	5,927	58,767	29,658	282,756	-----	-----	-----	-----	(1)	(1)	(1)	(1)	53,428	582,416
West Virginia	16,145	75,927	(1)	(1)	64,340	338,484	(1)	(1)	(1)	(1)	(1)	(1)	11,028	64,827	22,229	128,302	278,300	1,727,844
Wisconsin	2,092	11,697	30,780	241,215	(1)	(1)	16,326	118,230	-----	-----	(1)	(1)	(1)	(1)	14,386	154,701	65,632	542,749
Undistributed [2]	14,438	96,219	72,763	605,221	159,315	1,000,067	109,619	726,042	353,392	2,670,587	33,814	219,881	43,958	348,213	65,260	540,343	192,493	1,482,031
	364,823	2,084,462	1,010,435	8,542,207	999,215	5,792,745	566,818	3,457,354	867,909	6,925,328	72,417	495,864	266,088	1,715,849	739,224	4,942,576	4,886,929	33,956,385

[1] Included under "Undistributed."

[2] Includes items entered as "(1)".

Lime sold or used by producers in the United States, 1939–40, by uses

Use	1939 Quantity: Percent of total	1939 Quantity: Short tons	1939 Value: Total	1939 Value: Average	1940 Quantity: Percent of total	1940 Quantity: Short tons	1940 Value: Total	1940 Value: Average
Agricultural	8.5	362,335	$2,214,759	$6.11	7.5	364,823	$2,084,462	$5.71
Building	23.5	1,000,498	8,563,792	8.56	20.7	1,010,435	8,542,207	8.45
Chemical and industrial:								
Glassworks	3.5	148,102	1,003,843	6.78	3.4	168,044	1,139,381	6.78
Metallurgy	17.6	748,853	4,328,564	5.78	20.4	999,215	5,792,745	5.80
Paper mills	10.9	464,224	2,904,160	6.26	11.6	566,818	3,457,354	6.10
Sugar refineries	.4	18,831	167,480	8.89	.4	19,089	197,251	10.33
Tanneries	1.7	70,446	475,841	6.75	1.5	72,417	495,864	6.85
Water purification	5.9	251,193	1,594,214	6.35	5.4	266,088	1,715,849	6.45
Other uses [1]	12.2	518,305	3,349,187	6.46	11.3	552,091	3,605,944	6.53
	52.2	2,219,954	13,823,289	6.23	54.0	2,643,762	16,404,388	6.20
Refractory lime (dead-burned dolomite	15.8	671,561	5,447,554	8.11	17.8	867,909	6,925,328	7.98
Total lime	100.0	[2] 4,254,348	[2] 30,049,394	7.06	100.0	[2] 4,886,929	[2] 33,956,385	6.95
Hydrated lime (included in above totals)	31.0	1,318,053	10,124,241	7.68	28.4	1,385,825	10,522,578	7.59

[1] Details of distribution shown in a following table.
[2] Includes lime used by producers (captive tonnage) as follows—1939: 270,087 short tons valued at $1,454,285; 1940: 339,441 tons, $1,804,017.

Agricultural lime and other liming materials.—Although lime has certain advantages for application to soil, it is not used as extensively as pulverized limestone because of the low cost and availability of the latter. Data on the use of various liming materials are given in the following table.

Agricultural lime and other liming materials sold or used by producers in the United States, 1939–40, by kinds

Kind	1939 Short tons: Gross	1939 Short tons: Effective lime content [1]	1939 Value: Total	1939 Value: Average	1940 Short tons: Gross	1940 Short tons: Effective lime content [1]	1940 Value: Total	1940 Value: Average
Lime from limestone:								
Quicklime	149,903	126,000	$753,325	$5.03	165,764	139,330	$802,677	$4.84
Hydrated	212,432	149,000	1,461,434	6.88	199,059	139,620	1,281,785	6.44
Lime from oyster shells [2]	12,589	10,220	73,653	5.85	(3)	(3)	(3)	(3)
Oyster shells (crushed) [2]	83,004	35,100	295,975	3.57	(3)	(3)	(3)	(3)
Limestone	5,459,260	2,347,000	6,592,827	1.21	8,724,160	3,751,000	9,910,373	1.14
Calcareous marl	22,114	10,000	38,492	1.74	25,516	11,500	42,481	1.66

[1] Estimated by method described in Mineral Resources of the United States, 1921, pt. II, p. 164.
[2] Bureau of Fisheries.
[3] Data not yet available.

Building lime.—The quantities and average values per ton for lime sold or used in construction during 1940 were as follows: Finishing lime, 444,996 short tons, $8.97; mason's lime, 427,956 short tons, $8.18; for manufacture of prepared masonry mortars, 75,517 short tons, $6.49; and for unspecified purposes, 61,966 short tons, $9.03.

Chemical and industrial lime.—The quantities and average values a ton reported by producers of metallurgical lime during 1940 are as follows: Flux for open-hearth steel manufacture, 721,459 short tons, $5.64; flux for electric steel furnaces, 26,185 short tons, $6.73; flux for smelting nonferrous metals, 4,504 short tons, $7.57; ore concentration (including cyanidation), 196,053 short tons, $5.97; wire drawing, 11,973 short tons, $6.86; other uses (including unspecified), 39,041 short tons, $6.76.

The quantity and value of chemical and industrial lime, listed as "Other uses" in a previous table, were reported for 1940 as follows:

Chemical and industrial lime sold or used by producers in the United States for "Other uses" in 1940

Use	Short tons	Value	Use	Short tons	Value
Alcohol	2,530	$16,742	Insecticides, fungicides, and disinfectants	54,630	$376,437
Alkalies (ammonium, potassium, and sodium compounds)	15,238	95,957	Magnesia	45,658	323,251
Asphalts and other bituminous material	1,232	9,154	Paints (calcimine, pigments, etc.)	28,083	141,872
Bleach, liquid and powder (excludes bleach for paper manufacture)	10,608	59,499	Petroleum refining	29,344	214,727
Brick, sand-lime and slag	19,620	127,452	Polishing and buffing compounds	6,346	115,987
Brick, silica (refractory)	15,356	117,201	Rubber	1,879	12,838
Calcium carbide and cyanamide	88,011	427,525	Salt refining	5,381	29,922
Calcium carbonate, precipitated	6,034	44,105	Sewage and trade-wastes treatment	19,158	117,518
Coke and gas (gas purification and plant byproducts)	14,139	84,709	Soap and fat	6,855	29,938
Food products:			Textiles	1,698	11,699
Creameries and dairies	257	6,605	Tobacco	5,375	27,140
Gelatin	4,083	27,858	Varnish	4,540	31,181
Phosphate baking powders	742	6,604	Wood distillation	2,457	17,870
Unspecified	2,143	10,861	Undistributed [1]	37,964	244,423
Glue	8,057	53,434	Unspecified	113,059	811,409
Grease, lubricating	1,614	12,026		552,091	3,605,944

[1] Includes acid neutralization, calcium phosphate, cement, chemicals (unspecified), chromates and bichromates, citric acid, depilatories, explosives, ice, poultry food, retarder, rock wool, starfish control, and sulfur.

HYDRATED LIME

Production.—Hydrated lime was reported by 161 plants during 1940 (159 reported for 1939). The increase from 1,318,053 short tons in 1939 to 1,385,825 in 1940 was accompanied by a decrease of 9 cents a ton in average value. Three States—Ohio, Pennsylvania, and Missouri—produced 62 percent of the total. Other data on hydrated lime appear in the following tables.

Hydrated lime sold or used by producers in the United States, 1936–40

Year	Plants in operation	Short tons	Value	
			Total	Average
1936	168	1,225,829	$9,529,743	$7.77
1937	170	1,301,333	10,344,470	7.95
1938	165	1,169,804	9,111,575	7.79
1939	159	1,318,053	10,124,241	7.68
1940	161	1,385,825	10,522,578	7.59

Hydrated lime sold or used by producers in the United States, 1939–40, by States

State	1939		1940	
	Short tons	Value	Short tons	Value
Alabama	26,148	$186,133	23,470	$187,803
California	17,142	175,504	22,898	222,199
Florida	12,260	117,643	12,129	127,528
Georgia	6,815	57,663	13,737	91,932
Illinois	26,417	208,580	26,092	198,194
Indiana	32,368	206,262	20,375	126,503
Maryland	25,615	182,005	22,730	116,006
Massachusetts	39,757	294,758	39,144	292,724
Michigan	8,757	63,655	10,772	87,386
Missouri	135,663	776,977	153,213	878,521
New York	12,809	94,825	14,089	102,423
Ohio	463,786	4,015,450	494,057	4,168,505
Pennsylvania	187,228	1,387,578	217,774	1,529,138
Tennessee	41,331	297,403	44,096	328,215
Texas	23,735	221,476	22,822	231,459
Virginia	59,499	389,987	59,425	378,790
Washington	(1)	(1)	9,243	86,974
West Virginia	54,003	300,579	36,828	234,912
Wisconsin	12,040	94,726	10,808	81,485
Other States [2]	132,680	1,053,037	132,123	1,051,881
	1,318,053	10,124,241	1,385,825	10,522,578

[1] Included under "Other States."
[2] 1939: Arizona, Arkansas, Colorado, Connecticut, Hawaii, Kentucky, Maine, Minnesota, Montana, Nevada, New Jersey, Oklahoma, Rhode Island, South Dakota, Utah, Vermont, and Washington. 1940: Arizona, Arkansas, Colorado, Connecticut, Hawaii, Kentucky, Maine, Minnesota, Montana, Nevada, New Jersey, Oklahoma, Rhode Island, South Dakota, Utah, and Vermont.

Uses.—Sales of hydrated lime were higher than in 1939 for all major uses except agriculture and sugar refining; both of these declined in 1940 and had also declined from 1938 to 1939. Sales of hydrated lime for water purification and for metallurgy increased in 1940 by 17 and 10 percent, respectively.

Hydrated lime sold or used by producers in the United States, 1939–40, by uses

Use	1939		1940	
	Short tons	Value	Short tons	Value
Agricultural	212,432	$1,461,434	199,059	$1,281,785
Building	694,919	5,849,189	723,888	6,002,015
Chemical and industrial:				
Glassworks	1,780	10,904	2,229	13,925
Metallurgy	48,656	317,766	53,554	351,945
Paper mills	37,986	251,386	39,644	262,234
Sugar refineries	12,454	119,412	11,603	137,345
Tanneries	30,336	218,516	32,259	233,661
Water purification	108,188	727,151	126,967	884,199
Other uses	171,302	1,168,483	196,622	1,355,469
	410,702	2,813,618	462,878	3,238,778
Total hydrated lime	1,318,053	10,124,241	1,385,825	10,522,578

TRENDS IN PRINCIPAL USES

All major uses of lime increased during 1940. Chemical and industrial uses gained 19 percent from 1939, whereas agricultural and building uses gained only 0.7 and 1 percent, respectively.

The gains in metallurgical and refractory lime were disproportionate, however, being 33 and 29 percent, respectively. The increase

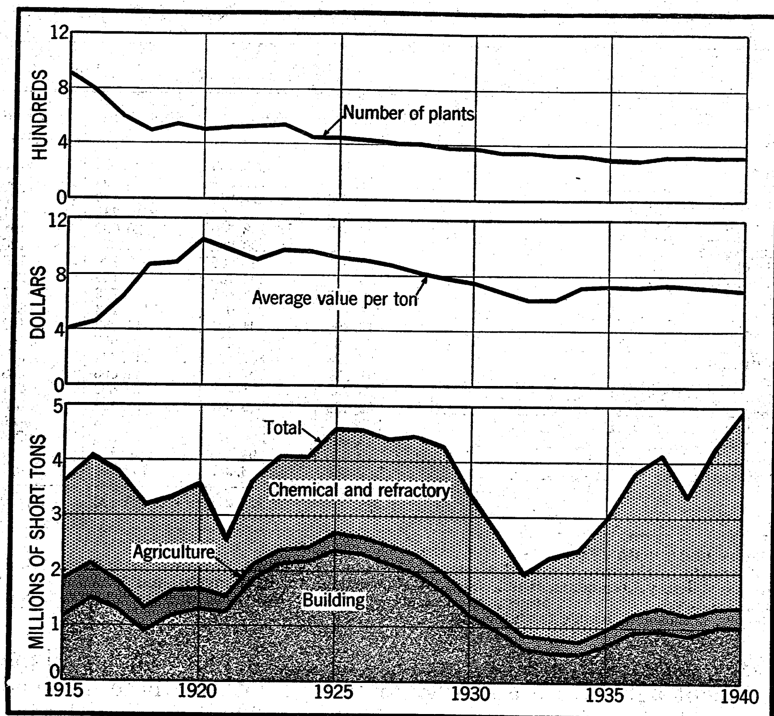

FIGURE 1.—Trends in number of active lime plants, average value per ton, and principal uses, 1915–40.

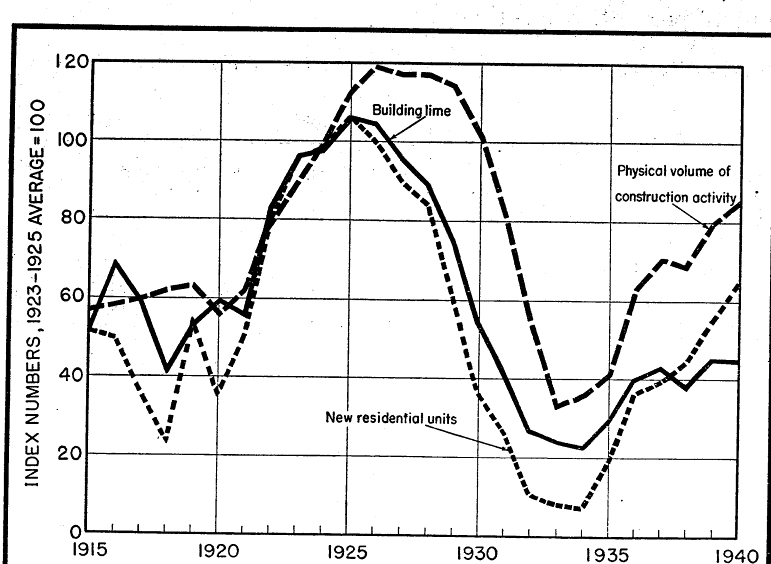

FIGURE 2.—Building-lime (quick and hydrated) sales compared with total construction and residential building, 1915–40. Data for physical volume of construction, 1915–39, from Bureau of Foreign and Domestic Commerce. Data for new residential dwelling units from Bureau of Foreign and Domestic Commerce and Bureau of Labor Statistics.

in chemical and industrial uses also was accentuated by a marked increase in the use of lime by paper mills (22-percent increase over 1939), part of which is attributed to use of lime in treating wastes. Trends in the principal uses over a 26-year period are indicated in figure 1.

A graphic comparison of the total quantity of lime consumed in building with construction activity for the past 26 years is shown in figure 2.

Successive increases in the consumption of metallurgical lime have taken place since 1932, except for the regression of 1938, but the rate of increase has never been as great as it was during the period 1939–40 (see fig. 3.) The gain in production of metallurgical lime has been accompanied by a similar increase (32 percent from 1939 to 1940) in limestone for flux. Inasmuch as the curve for metallurgical lime is rising more rapidly than that of steel-ingot production, a relative decrease in the amount of scrap iron and steel being employed is indicated.

Raw dolomite, as well as refractory lime, is used for lining furnaces. During 1940, 857,954 short tons of raw dolomite were sold, although part of this may have been calcined by the consumer before use. The data on dolomite are given in the chapter on Stone.

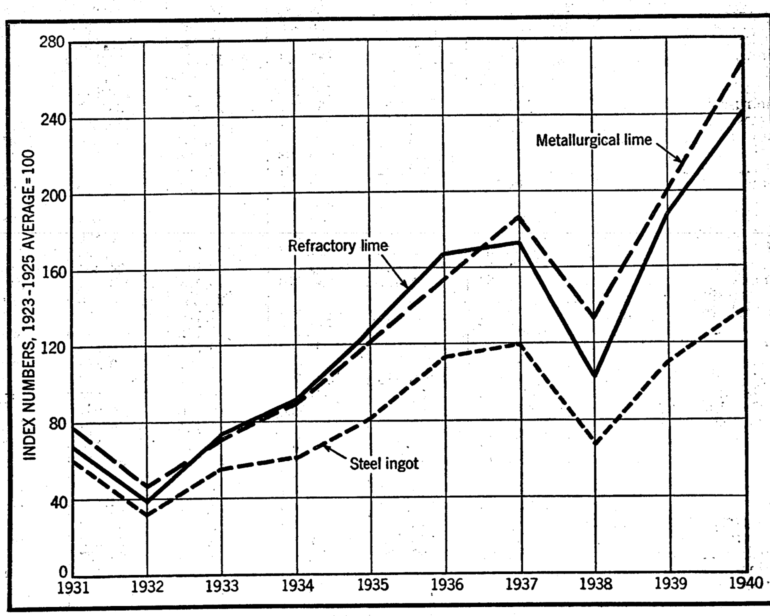

FIGURE 3.—Sales of metallurgical lime and refractory lime (dead-burned dolomite) compared with steel-ingot production, 1931–40. Index numbers for steel ingots computed by Federal Reserve Board from data of American Iron and Steel Institute.

SHIPMENTS

Total shipments.—Sales, shipments, and supplies of lime available for consumption in continental United States by States and groups of States that comprise approximate freight zones are listed in the two tables that follow. Reshipments beyond original destinations are not indicated, and foreign shipments and tonnages for which distribution is not recorded are omitted.

Production of lime exceeds apparent consumption in 12 States, but only Ohio, Missouri, and Tennessee show large tonnages moving out of the State in excess of inward-moving shipments. Four leading apparent consumers—Pennsylvania, New York, Illinois, and Michigan—consumed more than they produced.

Lime supplies available in continental United States in 1940, by States, in short tons

State	Sales by producers	Shipments from State [1]	Shipments into State	Supply		
				Hydrated	Quicklime	Total
Alabama	234,147	72,374	31,482	13,044	180,211	193,255
Arizona	67,882	30,692	976	1,153	37,013	38,166
Arkansas	(2)	(2)	(2)	4,796	9,510	14,306
California	112,522	10,586	8,090	24,971	85,055	110,026
Colorado	7,944	100	27,929	10,216	25,557	35,773
Connecticut	(2)	(2)	(2)	11,354	11,379	22,733
Delaware			45,923	15,511	30,412	45,923
District of Columbia			15,397	12,947	2,450	15,397
Florida	25,038		41,049	29,683	36,404	66,087
Georgia	13,774	1,264	58,166	38,902	31,774	70,676
Idaho	(2)		(2)	1,379	1,388	2,767
Illinois	161,358	76,140	230,446	74,787	240,877	315,664
Indiana	84,462	59,311	161,820	34,306	152,665	186,971
Iowa			63,086	14,806	48,280	63,086
Kansas			30,450	15,157	15,293	30,450
Kentucky	(2)		(2)	15,342	62,807	78,149
Louisiana			81,571	17,217	64,354	81,571
Maine	(2)	(2)	(2)	8,402	59,482	67,884
Maryland	63,745	11,742	101,228	49,625	103,606	153,231
Massachusetts	108,797	85,302	35,922	28,532	30,885	59,417
Michigan	41,814	23,251	210,297	69,334	159,526	228,860
Minnesota	(2)	(2)	(2)	12,927	28,512	41,439
Mississippi			16,298	4,306	11,992	16,298
Missouri	607,062	492,542	16,331	52,399	78,452	130,851
Montana	18,797		3,038	3,135	18,700	21,835
Nebraska			8,667	7,095	1,572	8,667
Nevada	(2)	(2)	(2)	29,783	4,658	34,441
New Hampshire			8,955	3,086	5,869	8,955
New Jersey	28,854	8,843	124,353	96,865	47,499	144,364
New Mexico	(2)		(2)	2,019	24,454	26,473
New York	54,364	5,192	294,396	140,154	203,414	343,568
North Carolina	(2)		(2)	27,821	27,170	54,991
North Dakota			4,954	4,758	196	4,954
Ohio	1,284,877	902,831	147,249	115,712	413,583	529,295
Oklahoma	(2)	(2)	(2)	10,991	16,643	27,634
Oregon	(2)		(2)	2,621	10,865	13,486
Pennsylvania	833,038	288,418	324,573	180,761	688,432	869,193
Rhode Island	(2)	(2)	(2)	6,032	4,974	11,006
South Carolina			22,450	13,466	8,984	22,450
South Dakota	(2)		(2)	2,705	2,874	5,579
Tennessee	192,133	126,130	16,061	25,344	56,720	82,064
Texas	64,274	12,340	2,002	20,958	32,978	53,936
Utah	49,413	555	1,090	4,048	45,900	49,948
Vermont	61,026	52,047	884	1,524	8,339	9,863
Virginia	178,036	126,036	61,855	40,287	73,568	113,855
Washington	53,428	13,363	2,076	7,141	35,000	42,141
West Virginia	278,300	245,515	162,790	20,245	175,330	195,575
Wisconsin	65,632	26,226	59,957	30,226	69,137	99,363
Wyoming			1,048	860	188	1,048
Undistributed [3]	184,805	64,609	280,692			
	4,875,522	[1] 2,735,409	2,703,551	1,358,733	3,484,931	4,843,664

[1] Includes 31,858 tons exported or unclassified as to destination.
[2] Included under "Undistributed."
[3] Includes items entered as "(2)."

Hydrated lime.—Apparent consumption of hydrated lime in the Middle Atlantic States has been high during recent years. During 1940 it increased in all regions, but the percentage of increase from 1939 to 1940 was greatest in the Western States.

Lime shipped (supply) in continental United States in 1940, by origin and destination of shipments, in short tons

Destination	Illinois, Indiana, Michigan, Ohio			Maryland, New Jersey, New York, Pennsylvania, West Virginia			Connecticut, Maine, Massachusetts, Rhode Island, Vermont			Florida, Georgia, North Carolina, Virginia			Alabama, Kentucky, Tennessee		
	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total
Illinois, Indiana, Michigan, Ohio	241,065	659,334	900,399	5,259	41,710	46,969	--------	--------	--------	1,167	21,173	22,340	1,189	788	1,977
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	170,537	262,104	432,641	294,474	846,436	1,140,910	25,950	56,511	82,461	17,267	51,533	68,800	700	6,795	7,495
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	22,664	1,051	23,715	2,336	25,952	28,288	32,750	89,717	122,467	155	4,022	4,177	--------	--------	--------
Florida, Georgia, North Carolina, South Carolina, Virginia	51,892	3,610	55,502	7,192	19,560	26,752	--------	50	50	62,025	54,779	116,804	28,332	93,631	121,963
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	26,229	57,644	83,873	102	184	286	--------	--------	--------	292	--------	292	36,407	257,710	294,117
Arkansas, Kansas, Nebraska, Oklahoma, Texas	3,538	477	4,015	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
Iowa, Minnesota, Missouri, Wisconsin	32,807	32,704	65,511	--------	2	2	--------	--------	--------	--------	--------	--------	--------	--------	--------
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	2,364	1,401	3,765	6	49	55	--------	281	281	--------	--------	--------	--------	--------	--------

Destination	Arkansas, Oklahoma, Texas			Minnesota, Missouri, Wisconsin			Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, South Dakota, Utah, Washington			United States		
	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total
Illinois, Indiana, Michigan, Ohio	148	--------	148	45,371	243,646	289,017	--------	--------	--------	294,199	966,651	1,260,850
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	20	328	348	7,160	27,436	34,596	--------	--------	--------	516,108	1,251,143	1,767,251
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	--------	--------	--------	1,025	186	1,211	--------	--------	--------	58,930	120,928	179,858
Florida, Georgia, North Carolina, South Carolina, Virginia	--------	--------	--------	718	6,270	6,988	--------	--------	--------	150,159	177,900	328,059
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	2,533	18,783	21,316	9,690	41,763	51,453	--------	--------	--------	75,253	376,084	451,337
Arkansas, Kansas, Nebraska, Oklahoma, Texas	31,895	57,621	89,516	23,564	17,898	41,462	--------	--------	--------	58,997	75,996	134,993
Iowa, Minnesota, Missouri, Wisconsin	197	699	896	77,294	190,976	268,270	--------	--------	--------	110,298	224,381	334,679
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	1,224	1,050	2,274	9,602	7,936	17,538	81,593	281,131	362,724	94,789	291,848	386,637

Shipments of hydrated lime from plants in continental United States and in Ohio in 1940, by destinations

Destination	From all plants		From Ohio plants		
	Short tons	Distribution (percent)	Short tons	Distribution (percent)	Percent of total shipments
Illinois, Indiana, Michigan, Ohio	294,199	21.3	200,442	40.6	68.1
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	516,108	37.4	169,454	34.3	32.8
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	58,930	4.3	22,664	4.6	38.5
Florida, Georgia, North Carolina, South Carolina, Virginia	150,159	10.9	51,892	10.5	34.6
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	75,253	5.5	22,949	4.7	30.5
Arkansas, Kansas, Nebraska, Oklahoma, Texas	58,997	4.3	3,538	.7	6.0
Iowa, Minnesota, Missouri, Wisconsin	110,298	8.0	20,889	4.2	18.9
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	94,789	6.9	2,029	.4	2.1
Undistributed and exports	19,465	1.4	200	(1)	1.0
	1,378,198	100.0	494,057	100.0	35.8

1 Less than one-tenth of 1 percent.

Lime shipped to noncontiguous Territories of the United States, 1939–40

Territory	1939		1940	
	Short tons	Value	Short tons	Value
Alaska	117	$2,651		
Canton and Enderbury Islands			(1)	$40
Hawaii	1,102	14,336	700	12,140
Puerto Rico	1,560	19,270	799	10,779
Virgin Islands	43	527		
	2,822	36,784	1,499	22,959

1 Less than 1 ton.

PRICES

During the past decade the highest average prices were those during 1937, except for building and chemical and industrial lime, which were slightly higher in 1935. Since 1937 the price of lime for all uses except building has declined steadily. The price of building lime, however, decreased from 1939 to 1940. Values for the past 10 years are compared in the following table.

Average values of lime according to uses, 1931–40 [1]

Use	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940
Agricultural	$6.47	$5.59	$5.36	$6.66	$6.73	$6.26	$6.74	$6.52	$6.11	$5.71
Building	7.33	6.45	7.18	8.33	8.70	8.52	8.66	8.38	8.56	8.45
Chemical and industrial	6.51	6.13	5.73	6.52	6.50	6.42	6.47	6.53	6.23	6.20
Refractory	7.66	7.78	7.89	8.31	8.32	8.19	8.45	8.44	8.11	7.98
Total	6.90	6.28	6.28	7.16	7.28	7.18	7.30	7.21	7.06	6.95
Hydrated	6.91	6.30	6.69	7.63	7.90	7.77	7.95	7.79	7.68	7.59

1 Value at place of manufacture, exclusive of containers.

SIZE OF PLANTS

A study of active commercial companies, comparing volumes of sales for groups of companies of similar size, was made by Bowles and Coons in 1939.[1] This study indicated that companies producing 25,000 to 49,999 short tons were increasing in numbers and total output. The accompanying table indicates that such a trend was pronounced from 1935 to 1940. Thus it seems that smaller companies increase their production to fall within this range when operating near capacity and larger companies limit their output to fall within this range when conditions are less favorable, because this size range is generally the most economic in that it attains a favorable balance between efficiency of operation and cost of transportation to market.

Comparison of number of companies and sales of lime (including dead-burned dolomite) in the United States, 1930, 1935, and 1940, by size groups

Size groups in short tons	1930			1935			1940		
	Companies	Plants	Short tons	Companies	Plants	Short tons	Companies	Plants	Short tons
Less than 1,000	143	143	37,110	89	89	22,162	91	91	29,359
1,000 to 4,999	80	80	210,198	77	79	195,910	70	70	174,894
5,000 to 9,999	38	40	279,385	34	37	242,011	33	36	236,440
10,000 to 24,999	38	44	648,764	32	34	493,020	32	32	526,701
25,000 to 49,999	20	31	747,105	21	29	700,684	31	39	1,106,400
50,000 to 99,999	12	20	833,732	8	17	562,980	9	10	592,886
100,000 to 199,999	5	17	631,586	6	16	770,366	7	18	919,706
200,000 and over							5	18	1,300,543
	336	375	3,387,880	267	301	2,987,133	278	314	4,886,929

NEW DEVELOPMENTS

Interest in the use of lime for stabilizing clay roadbeds has prompted the National Lime Association to publish a bulletin on this subject.[2] Lime is being employed for this purpose on highways in Texas, and a potential market involving large tonnages is anticipated.

During 1940 one new plant was under construction, and several existing plants were improved or enlarged.[3]

Lime-putty plants were erected at Richmond, Va., and Birmingham, Ala. Two Florida concerns are supplying plant-mixed colored plaster.[4]

A research development of note was the establishment of a project at Rutgers University for investigation of the uses of lime in treating sewage and industrial wastes. This project is sponsored by the National Lime Association.

The problem of obtaining virtually complete hydration of the magnesia in dolomitic limes is attracting widespread attention. When hydration is conducted in pressure hydrators the conversion of magnesium oxide to the hydrate is relatively rapid and complete. Several companies in Ohio are cooperating in research on hydration equipment and methods.

1 Bowles, Oliver, and Coons, A. T., Graphic Survey of the Lime Industry, 1910–38: Bureau of Mines Inf. Circ. 7088, 1939, 8 pp.

2 Lesesne, S. D., Stabilization of Clay Roadbeds with Lime: Nat. Lime Assoc., Bull. 325, 1940, 15 pp.

3 Azbe, V. J., Lime Industry Building New Plants: Rock Products, vol. 43, No. 11, November 1940, p. 45. Trauffer, W. E., Second 290-foot Rotary Kiln Installed in Millard Lime Plant at Annville: Pit and Quarry, vol. 32, No. 12, June 1940, pp. 26–28.

4 Candell, Newell, Colored Plaster Winning Favor; Rock Products, vol. 43, No. 10, October 1940, p. 55.

X-ray investigation [5] has permitted distinction between soft- and hard-burned high-calcium limes and points toward particle shape as a factor controlling the plasticity of lime hydrates. Clark, Bradley, and Azbe found that good plastic hydrates contained thin, flake-shaped crystals, which result from slow hydration with a minimum accumulation of heat. Calcination in the presence of an alkali chloride vapor is said to produce a more porous and more friable quicklime.[6]

Moyer [7] studied fuel efficiencies in the lime industry and found that the average efficiency for all types of fuel and for all operations was greatest for pot kilns, intermediate for shaft kilns, and least for rotary kilns. However, shaft kilns using coke or producer gas showed higher efficiencies than any of the pot kilns. Azbe's contributions to the technology of lime manufacture have continued as a portion of an extended series.[8]

In 1940, 43 plants participated in the National Lime Association Safety contest conducted by the Bureau of Mines in cooperation with the National Lime Association. Of these 43 plants, 11 had accident-free records for a period of time equal to 935,113 man-hours.[9]

FOREIGN TRADE [10]

Imports.—Production of magnesian refractories in the United States has increased, compensating to some extent a marked decline in the importation of dead-burned dolomite from Canada; none of this material was imported during 1940. The quantities, values, and sources of lime imports are given in the accompanying tables.

Figure 4 gives the data for exports and imports since 1915.

Lime imported for consumption in the United States, 1936–40

Year	Hydrated lime		Other lime		Dead-burned dolomite [1]		Total	
	Short tons [2]	Value	Short tons [2]	Value	Short tons	Value	Short tons	Value
1936	1,345	$12,212	7,859	$74,946	13,928	$349,678	23,132	$436,836
1937	1,174	13,885	7,614	76,720	9,083	231,084	17,871	321,689
1938	858	10,001	5,960	56,202	2,875	67,340	9,693	133,543
1939	1,148	11,242	6,546	60,660	186	4,260	7,880	76,162
1940	712	6,558	8,493	75,330			9,205	81,888

[1] Classification changed in 1936 to "dead-burned basic refractory material containing 6 percent or more of lime and consisting chiefly of magnesia and lime."
[2] Includes weight of immediate container.

[5] Clark, G. L., Bradley, W. F., and Azbe, V. J., Problems in Lime Burning: A New X-ray Approach: Ind. Eng. Chem., vol. 32, No. 7, 1940, pp. 972–976.
[6] Noda, Tokiti, Calcination of Lime. XV. The Effect of Addition of Salts on the Crystal Growth Calcium Oxide: Jour. Soc. Chem. Ind., Japan, vol. 43, 1940, No. 40B.
[7] Moyer, Forrest T., Lime-fuel Ratios of Commercial Lime Plants in 1939: Bureau of Mines Inf. Circ. (In press.)
[8] Azbe, V. J., Lime Forum: Rock Products, vol. 43, No. 2, February 1940, pp. 53–54; No. 3, March 1940, pp. 53–54; No. 5, May 1940, pp. 51–52; No. 6, June 1940, pp. 47, 51; No. 7, July 1940, pp. 43–45; No. 9, September 1940, pp. 55–56; No. 10, October 1940, pp. 36, 42.
[9] Bureau of Mines, The National Lime Association safety competition, 1940: Health and Safety Statistics 287, 1940, 8 pp.
[10] 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.

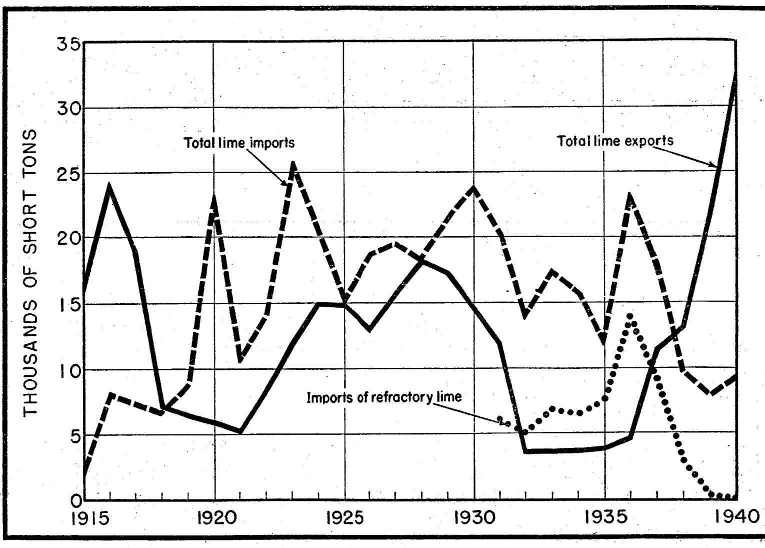

FIGURE 4.—Exports, total imports, and imports of refractory lime (dead-burned dolomite), 1915–40. Imports of refractory lime were not reported separately before 1931. Data from Bureau of Foreign and Domestic Commerce.

Lime imported for consumption in the United States, 1939–40, by countries and customs districts [1]

Country	Customs district	1939 Short tons [2]	1939 Value	1940 Short tons [2]	1940 Value
Belgium	Florida	22	$101		
	New York	228	1,052		
	Loredo	22	103		
Canada	Los Angeles	268	2,590	529	$4,913
	Maine and New Hampshire			53	546
	Michigan	1	7	5	68
	St. Lawrence	19	174	92	362
	San Francisco	3,383	33,360	3,865	34,410
	Washington	3,653	32,541	4,641	41,039
Germany	New York	7	596		
	Pittsburgh	(3)	66		
Japan	Washington	(3)	12	(3)	11
Mexico	Laredo	43	108		
Norway	Los Angeles	1	38		
Sweden	do	6	288		
	San Francisco			3	120
Switzerland	New York	(3)	25		
United Kingdom	do	41	841	17	419
		7,694	71,902	9,205	81,888

[1] Exclusive of dead-burned basic refractory material.
[2] Includes weight of immediate container.
[3] Less than 1 ton.

Exports.—In 1940 exports of lime reached a new record of 31,912 short tons valued at $311,619, the previous record was established in 1913, when 29,475 short tons valued at $212,345 were exported. The marked decline in exports to Canada during 1940 was more than compensated by the increase in exports to Latin American countries.

Lime exported from the United States, 1936–40

Year	Short tons	Value	Year	Short tons	Value
1936	4,601	$71,109	1939	21,477	$236,497
1937	11,300	122,895	1940	31,912	311,619
1938	13,222	121,662			

Lime exported from the United States, 1939–40, by countries

Country	1939		1940	
	Short tons	Value	Short tons	Value
Argentina	130	$2,613	41	$1,641
Australia	30	444	5	15
Brazil	24	462	55	1,272
Canada	8,714	74,261	4,843	29,276
Chile	15	392	29	623
China			35	1,750
Colombia	281	7,252	1,433	15,627
Costa Rica	1,001	10,067	3,510	32,170
Ecuador	62	1,645	132	2,315
El Salvador	57	784	44	578
France	36	1,113	6	213
Guatemala	2,434	21,673	6,272	60,541
Honduras	3,146	27,096	9,469	85,039
Japan	1,386	32,042	145	4,764
Mexico	1,374	9,719	1,133	9,110
Netherlands Indies	2	43	67	979
Newfoundland and Labrador			101	1,087
New Zealand	30	391	14	352
Nicaragua	276	4,096	351	4,085
Panama	278	5,261	1,811	17,425
Peru	859	10,526	1,114	15,483
Philippine Islands	1	32	26	248
Saudi Arabia	100	1,856		
Sweden	117	4,162		
Union of South Africa	123	2,013		
United Kingdom	290	9,719	499	16,249
West Indies:				
British	247	3,111	287	3,738
Cuba	148	1,908	122	1,739
Haiti	246	2,445	140	1,432
Netherlands: Curacao	32	296	101	1,022
Other countries	38	1,075	127	2,846
	21,477	236,497	31,912	311,619

CLAYS

By Paul M. Tyler and A. Linn [1]

SUMMARY OUTLINE

Extending previous trends and favored by the broad upturn in general industrial and building activity, the domestic clay-mining industry reached new high ground in 1940. Shipments of kaolin or china clay, ball clay, and bentonite increased notably above their previous high records established in 1939. Fire-clay shipments rose sharply above those in 1939 but fell a little short of the figures in 1937, which in turn were below those of the late 1920's, notwithstanding the greater activity in consuming industries. Consumption of natural bleaching clay or fuller's earth in recent years has failed to pace the steady expansion in oil-refining industries in which it is used, the increased output of artificially activated bleaching clays, made from bentonite, being only one of several retarding factors. The total production of all kinds of merchant clay in 1940 was 4,847,519 short tons valued at $19,633,568—an all-time record in both tonnage and value that compares with 3,927,764 tons valued at $17,046,773 produced and sold in 1939.

Increased use of American clays in ceramic whiteware, the last stronghold of imported clays, is reported. The European War eliminated further shipments of German and Czechoslovak clays but did not cut off deliveries of English clays. Even heavy bombing of the Channel ports failed to hinder seriously the shipping of clay from Devon and Cornwall. Ocean freight rates tended to be higher, although clay served as excellent ballast for some of the ships returning to the United States for more munitions. Notwithstanding increased consumption and some additions to already substantial stocks carried by American manufacturers of paper and sanitary ware, imports of china clay in 1940 were smaller than in 1939 and less than one-third the annual average for the 5-year period 1925–29. Sales of domestic kaolin in 1940 were nearly twice their 1925–29 average.

Total imports of clay of all kinds were 140,447 short tons valued at $1,159,790 compared with 151,957 tons having a foreign market value of $1,395,012 in 1939 and the 1925–29 annual average of 420,310 tons valued at $3,841,462. Notable is the increase in imports of "common blue and Gross Almerode" clays (chiefly English ball clay), which in 1940 were approximately three times the 1925–29 average,

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce. Domestic figures for fuller's earth compiled by R. W. Metcalf, of the Bureau of Mines.

reflecting the broad increase in demand for ball clays in the pottery and sanitary-ware industries.

Exports jumped to 184,168 tons valued at $2,071,336 in 1940 compared with 136,480 tons valued at $1,873,110 in 1939 and the 1925–29 annual average of 109,344 tons valued at $1,217,769.

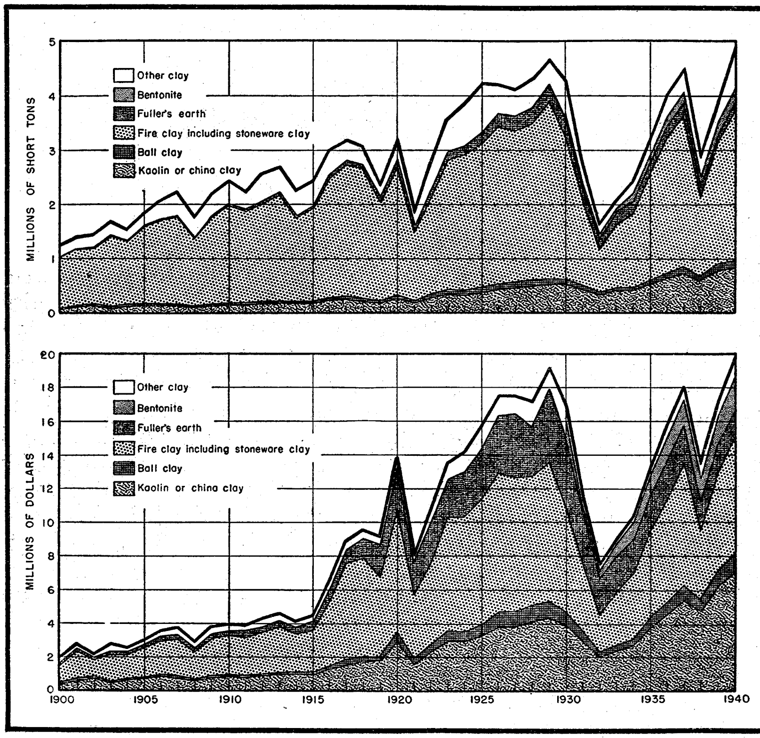

FIGURE 1.—Sales of domestic clay, by kinds, quantity and value, 1900–1940.

Bureau of Mines production figures as reported in this chapter refer only to clay sold or shipped raw. They do not include the many-times-greater quantities of clay mined by manufacturers of brick, tile, and other heavy-clay products for their own use in nearby plants.

Salient statistics of the clay industry in the United States, 1925–40

	1925–29 (average)	1930–34 (average)	1935–39 (average)	1939	1940
Domestic clay sold or used by producers:					
Kaolin, china clay short tons	453,618	431,932	654,147	780,804	833,450
Ball clay do	116,127	70,299	108,525	128,601	140,707
Fire clay (including stoneware clay) short tons	2,898,576	1,487,364	2,175,309	2,222,295	2,765,247
Bentonite do	(1)	84,762	188,385	219,720	251,032
Fuller's earth do	261,640	259,354	204,529	167,070	146,568
Miscellaneous clays do	[1] 575,708	305,973	360,602	409,274	710,515
Total domestic:					
Quantity do	4,305,669	2,639,684	3,691,497	3,927,764	4,847,519
Value	$17,568,812	$10,977,776	$15,455,392	$17,046,773	$19,633,568

[1] Sales of bentonite included under "Miscellaneous clay" before 1930.

Salient statistics of the clay industry in the United States, 1925–40—Continued

	1925–29 (average)	1930–34 (average)	1935–39 (average)	1939	1940
Imports:					
Kaolin or china clay short tons	339,014	140,888	122,232	114,696	105,567
Common blue and Gross-Almerode short tons	12,130	11,306	27,108	28,871	32,141
Fuller's earth do	8,118	4,708	2,256	1,818	474
Other clay do	61,048	24,713	16,922	6,572	2,265
Total imports:					
Quantity do	420,310	181,615	168,518	151,957	140,447
Value	$3,841,462	$1,595,101	$1,608,395	$1,395,012	$1,159,790
Exports:					
Fire clay short tons	55,316	39,709	61,247	57,317	96,501
Other clay (including fuller's earth) short tons	54,028	68,978	87,824	79,163	87,667
Total exports:					
Quantity do	109,344	108,687	149,071	136,480	184,168
Value	$1,217,769	$1,323,744	$1,819,242	$1,873,110	$2,071,336

CONSUMPTION AND USES

The accompanying table, which gives sales of specified domestic clays by kinds and uses in 1940, continues a series begun in 1921. Data for total clay used in 1939 and earlier years by major uses (except refractories) were summarized in a bar chart in Minerals Yearbook 1940 (p. 1268). Reference should also be made to figure 2 of the present chapter showing changes in the distribution of sales of kaolin only.

Fuller's earth is not included in this table; in 1940, all but 8,237 short tons (valued at $53,699), or 6 percent of the output, was used in refining oils, chiefly mineral oils.

Clay (excluding fuller's earth) sold or used by producers in the United States in 1940, by kinds and uses, in short tons

Use	Kaolin	Ball clay	Fire clay and stoneware clay	Bentonite	Miscellaneous clay including slip clay	Total
Pottery and stoneware:						
Whiteware, etc	71,646	110,447	2,109			184,202
Stoneware, including chemical stoneware		1,038	22,491		677	24,206
Art pottery	1	1,161	871		105	2,138
Flowerpots			2,796		6,303	9,099
Slip for glazing	2				647	649
	71,649	112,646	28,267		7,732	220,294
Tile, high-grade	19,339	20,211	11,990		173	51,713
Kiln furniture, etc.:						
Saggers, pins, stilts	2,749	166	37,475			40,390
Wads			7,833			7,833
	2,749	166	45,308			48,223
Architectural terra cotta		2,000	19,732		190	21,922
Paper:						
Filler	367,032	1,000	767			368,799
Coating	127,300					127,300
	494,332	1,000	767			496,099
Rubber	92,640		10,104			102,744
Linoleum and oilcloth	5,668	3,500	9,955			19,123
Paints:						
Filler or extender	7,144					7,144
Calcimine	2,872		2,843			5,715
	10,016		2,843			12,859
Cement manufacture	40,001		1,238	4,037	62,503	107,779

Clay (excluding fuller's earth) sold or used by producers in the United States in 1940, by kinds and uses, in short tons—Continued

Use	Kaolin	Ball clay	Fire clay and stoneware clay	Benton-ite	Miscel-laneous clay includ-ing slip clay	Total
Refractories:						
Fire brick and block	65,562		1,585,240			1,650,802
Bauxite, high-aluminum brick			16,646			16,646
Fire-clay mortar, including clay processed for laying fire brick	1,507		206,838		53	208,398
Clay crucibles			1,761			1,761
Glass pots	60	136	407			603
Other glass refractories	132		240			372
Zinc retorts and condensers			27,495			27,495
Foundries and steel works	3,086		565,475	74,135	41,575	684,271
	70,347	136	2,404,102	74,135	41,628	2,590,348
Miscellaneous:						
Rotary-drilling mud			503	45,296	105,953	151,752
Filtering and decolorizing oils (raw and activated earths)	90			95,300	(1)	[1] 95,390
Artificial abrasives	120	2			3,134	3,256
Asbestos products	1,826		1,091			2,917
Chemicals	4,713		18,587			23,300
Enameling		107	11,446			11,553
Plaster and plaster products	4,610					4,610
Heavy clay products			188,594		415,872	604,466
Other uses	15,350	939	10,720	32,264	[1] 73,330	[1] 132,603
	26,709	1,048	230,941	172,860	598,289	1,029,847
Grand total: 1940	833,450	140,707	2,765,247	251,032	710,515	4,700,951
1939	780,804	128,601	2,222,295	219,720	409,274	3,760,694

[1] Miscellaneous clay used for filtering and decolorizing oils included under "Other uses."

CHINA CLAY OR KAOLIN

Sales of kaolin or china clay by domestic miners continued their almost uninterrupted upswing since 1921 and rose in 1940 to another new record of 833,450 short tons valued at $6,994,106 compared with 780,804 tons worth $6,200,606 in 1939. Imports, virtually all from the heavily bombed Channel ports of southwest England, declined only moderately to 105,567 tons having a nominal value of $870,421 compared with 114,696 tons valued at $1,015,813 in 1939.

Kaolin sold or used by producers in the United States, 1938–40, by States

State	1938		1939		1940	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			(1)	(1)	(1)	(1)
California	7,057	$50,771	19,481	$111,719	14,407	$118,481
Delaware	(1)	(1)	(1)	(1)	(1)	(1)
Florida	(1)	(1)	(1)	(1)	(1)	(1)
Georgia	412,632	3,314,918	512,214	4,135,727	[2] 570,010	[2] 4,834,826
Maryland	(1)	(1)	(1)	(1)	(1)	(1)
North Carolina	(1)	(1)	11,308	165,896	14,602	202,642
Pennsylvania	44,312	146,289	49,657	164,562	49,541	169,981
South Carolina	98,924	865,177	158,629	1,297,813	152,227	1,302,812
Tennessee			(1)	(1)	(1)	(1)
Utah	(1)	(1)	(1)	(1)	(1)	(1)
Vermont			(1)	(1)	(1)	(1)
Virginia	(1)	(1)	(1)	(1)	(1)	(1)
Washington	(1)	(1)	(1)	(1)		
Undistributed [3]	32,129	363,725	29,515	324,889	32,663	365,364
	595,054	4,740,880	780,804	6,200,606	833,450	6,994,106

[1] Included under "Undistributed."
[2] For details of production in Georgia, see following table.
[3] Includes States indicated by "(1)."

Georgia kaolin sold or used by producers, 1936–40, 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
1936	367,463	$2,764,065	$7.52	51,932	$131,813	$2.54	419,395	$2,895,878	$6.90
1937	423,065	3,332,851	7.88	80,667	213,208	2.64	503,732	3,546,059	7.04
1938	367,612	3,199,169	8.70	45,020	115,749	2.57	412,632	3,314,918	8.03
1939	450,121	3,956,344	8.79	62,093	179,383	2.89	512,214	4,135,727	8.07
1940	497,881	4,625,080	9.29	72,129	209,746	2.91	570,010	4,834,826	8.48

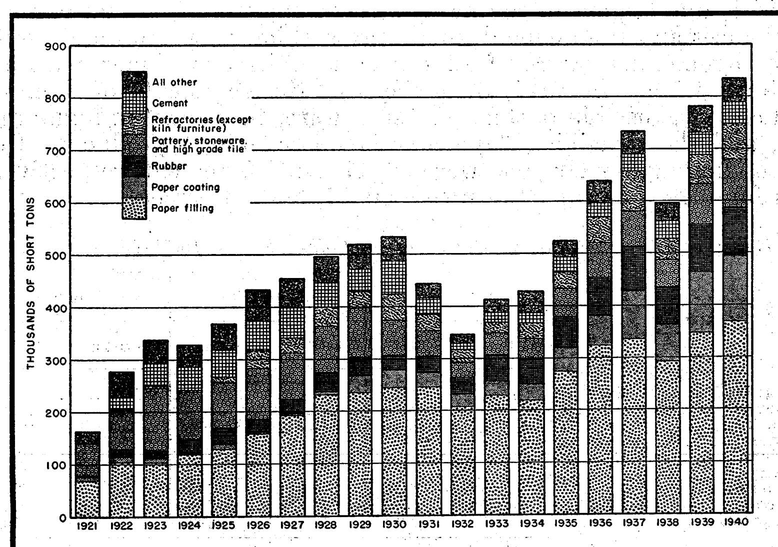

FIGURE 2.—Kaolin sold by domestic producers for specified uses, 1921–40.

Further expansion of the demand for American paper clays—both for coating and filling paper—explained most of the increased sales reported to the Bureau of Mines by the miners. There were substantial gains, however, in sales of high-grade clays to pottery manufacturers and of lower-price clays for refractory purposes. Of the total quantities sold or used the paper industry consumed 59 percent and the rubber industry 11 percent; another 11 percent went to pottery and tile manufacturers, 9 percent for refractories, and 5 percent for cement; the remaining 5 percent was used in the manufacture of a variety of commodities, of which paints, linoleum and oilcloth, chemicals, and miscellaneous fillers were of chief importance in the order named.

Price quotations for domestic clays have remained virtually unchanged for several years, and readjustments of English clay prices largely represent changes in ocean freight rates. The increase in the average value of domestic sales of kaolin from $7.94 a ton in 1939 to $8.39 in 1940 shows a larger proportion of the higher-grade clays rather than a general rise in prices.

BALL CLAY

Production of domestic ball clay advanced to 140,707 short tons valued at $1,065,432 in 1940 compared with 128,601 tons valued at $935,721 in 1939 and 121,470 tons valued at $890,705 in 1937, the previous record. Imports classified as "common blue and ball clay," all from the United Kingdom, also increased, amounting to 32,141 tons valued at $255,597 in 1940 compared with 28,540 tons valued at $233,094 (including 1,208 tons from Germany) in 1939. Consumption of ball clays, as calculated by adding domestic production and imports, has increased from an annual average of 128,257 tons in 1925–29 to 172,848 tons in 1940, exhibiting a growing tendency to use more ball clay in proportion to kaolin for various ceramic mixtures. This trend is due largely to mechanization or the use of new mechanical appliances and the demand for better working properties and denser body by manufacturers of American semivitreous dinner ware and sanitary ware. In 1940, 80 percent of the shipments of domestic ball clay was used in pottery and stoneware, 14 percent in high-grade tile, and the remaining 6 percent in miscellaneous products. Corresponding figures for 1935 were 70, 17, and 13 percent, respectively, and for 1929 the proportions were 60, 27, and 13 percent.

Ball clay sold or used by producers in the United States, 1938–40, by States

State	1938		1939		1940	
	Short tons	Value	Short tons	Value	Short tons	Value
California	(1)	(1)				
Illinois	(1)	(1)				
Kentucky	45,494	$362,094	66,461	$507,938	75,933	$600,264
Maryland	(1)	(1)	(1)	(1)	(1)	(1)
Missouri	(1)	(1)	(1)	(1)	(1)	(1)
Nevada					(1)	(1)
New Jersey	3,496	23,202	3,245	21,651	(1)	(1)
Tennessee	40,207	295,587	47,971	365,810	53,871	414,602
Undistributed [2]	5,771	58,808	10,924	40,322	10,903	50,566
	94,968	739,691	128,601	935,721	140,707	1,065,432

[1] Included under "Undistributed."
[2] Includes States indicated by "(1)."

FIRE CLAY

Shipments of domestic fire clay were 2,765,247 short tons valued at $7,046,746 in 1940 compared with 2,222,295 tons valued at $5,801,993 in 1939. Although the 1940 figures represented a substantial gain over the preceding year, they did not quite reach the 1937 total of 2,785,344 tons valued at $7,180,938. Ordinarily, consumption of fire clay follows fairly closely the index of iron and steel production, which made a new record in 1940, topping the previous high in 1929 by a 6-percent margin. In 1937, as noted in Minerals Yearbook, 1940, the sales of fire clay and other domestic clays for refractories ran well ahead of its principal barometer, but in 1940 sales of clay as well as other raw materials for refractories did not begin to respond to the rising tempo of the metallurgical industries until late in the year. During periods of industrial recovery sales of refractories always tend to lag behind the increasing activity in consuming industries at first and then to pyramid later when the upturn in industrial demand is confirmed. Total sales of clay for refractories, as shown by Bureau of Mines consumption figures (which date back to 1921), were larger in 1940 than in any previous year except 1937, whereas sales of fire clay alone were substantially less in 1940 than in the late 1920's, a peak being reached in 1929 when the total sales of fire clay and so-called "Stoneware clay" were 3,266,261 tons. A partial explanation of this apparent failure of sales of fire clay to pace demand for clay in the manufacture of refractories more closely has been the increased consumption of refractory kaolins. The latter, which were scarcely used at all in 1921, reached a peak of 37,771 tons in 1928 and, after recovering from the general depression, rose to 77,170 tons in 1937 and 70,347 in 1940. Other variable factors are the better quality and longer life of modern clay refractories, larger and better-designed furnaces, substitution of nonclay refractories for high-duty service, and variations in the relative requirements of steel makers, nonferrous metal smelters, public utilities, cement plants, and other consumers.

Fire clay, including stoneware clay, sold or used by producers in the United States, 1938–40, by States

State	1938		1939		1940	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	22,871	$38,885	27,715	$51,133	42,843	$74,868
California	146,296	338,072	162,244	389,448	193,713	459,680
Colorado	48,702	65,678	52,310	72,644	52,695	89,206
Illinois	89,743	203,582	124,778	267,254	147,148	308,711
Indiana	13,852	30,172	40,393	67,669	69,144	82,962
Kentucky	102,836	304,466	181,286	495,818	269,090	728,380
Maryland	13,189	40,977	24,091	83,541	12,582	67,479
Missouri [1]	258,656	904,522	384,567	1,171,643	487,650	1,391,045
New Jersey	69,944	358,876	92,884	499,720	91,325	512,546
New Mexico	3,927	6,923	(2)	(2)	3,263	10,928
Ohio	254,719	566,439	445,610	898,429	470,101	1,039,228
Pennsylvania	338,864	927,370	572,191	1,478,729	794,702	1,984,272
Tennessee	12,149	51,448	13,836	58,943	(2)	(2)
Texas	5,113	33,414	5,837	34,196	12,498	22,686
Utah	12,520	26,103	20,441	42,137	20,113	40,107
Washington	27,082	51,469	20,356	47,734	21,108	36,097
West Virginia	31,658	68,687	46,758	93,426	55,853	103,989
Other States [3]	6,820	43,077	6,998	49,529	21,419	94,562
	1,458,941	4,060,160	2,222,295	5,801,993	2,765,247	7,046,746

[1] Includes diaspore and burley clay as follows—1938: 33,408 short tons, valued at $151,623; 1939: 40,495 tons, $174,144; 1940: 34,359 tons, $156,603.
[2] Included under "Other States."
[3] Includes States indicated by "(2)" and Arkansas, Connecticut, Idaho, Iowa, Massachusetts, Minnesota, Nebraska, Nevada (1940 only), New York (1938 only), North Carolina, North Dakota (1939–40 only), Oregon, South Carolina, and Virginia.

BENTONITE

Topping by a wide margin their 1939 all-time record, sales of bentonite rose in 1940 to a new peak of 251,032 short tons valued at $1,919,461. The 1939 output was 219,720 tons valued at $1,702,393 and the previous record 194,768 tons valued at $1,500,758 in 1937. Although bentonite clay was used by pioneers in the Western country to grease the wheels of their covered wagons and instead of soap, this mineral is a relatively new commodity. As recently as 1925 the total output was less than 5,000 tons.

Bentonite is important to the defense effort principally because of its use in foundry molding and core sands. Although small admixtures of this remarkable clay have come to be employed extensively in sands for gray iron, malleable iron, and steel castings it is rarely used in casting aluminum and is not essential in making airplane motor blocks and certain other castings. In other words, foundry consumption of bentonite tends to increase when the output of castings, especially iron and steel castings, increases, but not necessarily in direct proportion. In 1939, 53,872 tons—25 percent of the total sales of domestic bentonite—were used in foundries and steel works, whereas in 1940 the quantity so used jumped to 74,135 tons comprising 30 percent of the total. By far the greater part of this bentonite is the swelling type produced in Wyoming and South Dakota. However, increasing quantities of southern bentonite are used for foundry work. This type, which exhibits no extraordinary swelling properties when moistened, is not a complete substitute but is even better than the Wyoming type for some kinds of castings.

Bentonite sold or used by producers in the United States, 1937–40, by States

State	1937		1938		1939		1940	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama					(1)	(1)		
Arizona	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
California	15,561	$204,672	15,703	$166,998	11,699	$143,314	7,867	$99,840
Colorado							(1)	(1)
Mississippi	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Nevada							(1)	(1)
New Mexico	(1)	(1)	(1)	(1)	(1)	(1)		
Oklahoma	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
South Dakota	(1)	(1)	20,565	155,821	31,528	217,622	40,481	274,714
Texas	19,910	144,661	21,744	207,084	18,132	148,139	14,399	127,949
Utah	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Wyoming	67,958	659,111	58,911	530,834	76,133	777,722	91,714	976,844
Undistributed [2]	91,339	492,314	75,260	312,445	82,228	415,596	96,571	440,114
	194,768	1,500,758	192,183	1,373,182	219,720	1,702,393	251,032	1,919,461

[1] Included under "Undistributed."
[2] Includes States indicated by "(1)."

As regards tonnage, oil refining is still the principal use of bentonite. Nonswelling clay, mostly Mississippi clay, is acid-treated or activated to convert it into an efficient bleaching agent, and a moderate quantity of raw bentonite is used as a filter aid and for other purposes in the oil-refining industry, which accounted for 95,300 tons or 38 percent of the 1940 sales compared with 95,247 tons or 43 percent of the total in 1939. The third largest use is in rotary well-drilling mud for the petroleum and natural-gas industries, which required 45,296 tons in 1940 as against 35,880 tons in the preceding year, the proportion of the total increasing slightly to 18 percent compared with 16 percent in 1939. Most of this was mined in South Dakota and Wyoming, although 5,000 tons, some of which may also have been swelling-type bentonite, were produced in California and another 5,000 tons in Texas and other States. Miscellaneous uses, including cement manufacture, took 36,301 tons in 1940 and 34,721 in 1939, most of which was from South Dakota or Wyoming.

A canvass of producers by the Bureau of Mines indicates that no shortage of bentonite for making essential munitions is anticipated. Production capacity has increased, and with the addition of certain items of equipment (which could be installed within 90 days or less) output in South Dakota and Wyoming could be stepped up 50 percent over maximum capacity last year. Reserves in the ground are more than ample, and the larger producers maintain extensive stock piles that could be drawn upon in emergency.

Imports of bentonite are insignificant, aggregating 23 short tons valued at $928 in 1940 compared with 62 tons valued at $895 in 1939 and 8 tons valued at $228 in 1938. Exports, as reported by producers to the Bureau of Mines and excluding any foreign shipment by dealers, increased in 1940 to over 27,000 tons. In addition, large quantities of acid-treated bentonite are exported to oil refineries throughout the world.

Notwithstanding increased demand, bentonite prices were not increased in 1940; in fact, some of the largest buyers were able to purchase at lower prices, and the average value of all sales declined to $7.65 a short ton compared with $7.75 in 1939, even though the proportion of high-price specialties actually increased. The most widely used bentonite is 200-mesh powder, which continued to be quoted at $10.25 a ton f. o. b. Black Hills shipping point in 100-pound bags, carload lots. However, Wyoming-type bentonite is also prepared in pellet form, 30- to 40-mesh; and a dried and finely crushed product, mostly 4- to 20-mesh, is sold in carload lots at $7 a ton in bulk and $8.75 in bags. Bags are an important item in cost and while not included in Bureau of Mines valuations represent as much as 14 percent of the sales dollar of certain companies.

According to a preliminary report of the Bureau of the Census the domestic production of bentonite in 1939 was 223,381 short tons valued at $1,982,129. This tonnage is only 2 percent larger than that reported by the Bureau of Mines (219,720), but the value is substantially higher because it includes packages and also the value added by or received for milling minerals other than bentonite. Of the total output of bentonite, the Census figures show 152,459 tons valued at $1,678,995 were prepared by such methods as crushing, screening, drying, and grinding; most of that reported as "crude" was intended for acid activation. The average number of wage earners was 357, and salaried employees numbered 62; and the average output (based upon wage earners at mines and preparation plants but excluding acid or other chemical treatment) was 0.33 ton a man-hour.

FULLER'S EARTH

Domestic production of fuller's earth or natural bleaching clays as reported to the Bureau of Mines was 146,568 short tons valued at $1,471,083 in 1940 compared with 167,070 tons valued at $1,691,855 in 1939 and a peak of 335,644 tons valued at $4,326,705 in 1930. The Bureau of the Census reports an output of 185,761 tons valued at $2,106,721 for 1939 compared with 369,933 tons valued at $4,811,629 in 1929 when production was close to the 1930 peak. Both sets of figures reveal an apparent shrinkage of over 50 percent in demand for fuller's earth, whereas the petroleum-refining index, which formerly served as a reliable barometer of demand for this material, has expanded about 35 percent.

The Census figures exceed those compiled by the Bureau of Mines chiefly in respect to the output in Texas, where a substantial quantity of material used for oil refining has been reported to the Bureau of

Mines as "miscellaneous clay" or "bentonite," rather than as "fuller's earth." The distinction between fuller's earth and other clays having more or less bleaching power is not sharply drawn, and the proper classification of 20,000 to 30,000 tons a year of this borderline material is largely a matter of opinion; in fact, producers in their reports to the Bureau of Mines have altered the classification of their respective products from one year to the next.

Fuller's earth sold or used by producers in the United States, 1938–40, by States

State	1938		1939		1940	
	Short tons	Value	Short tons	Value	Short tons	Value
Florida and Georgia	91,031	$987,391	91,947	$1,035,066	79,898	$917,365
Nevada	5,984	57,499	(1)	(1)	(1)	(1)
Texas	37,998	358,980	38,338	359,058	34,039	277,229
Other States [2]	35,839	303,999	36,785	297,731	32,631	276,489
	170,852	1,707,869	167,070	1,691,855	146,568	1,471,083

[1] Included under "Other States."
[2] 1938: California, Colorado, Illinois, Mississippi, and Tennessee; 1939: California, Colorado, Illinois, Nevada, and Tennessee; 1940: Colorado, Illinois, Nevada, New Mexico, and Tennessee.

Imports of fuller's earth declined further in 1940 to only 474 short tons valued at $6,105 compared with 1,818 tons valued at $22,215 in 1939. Exports are not recorded separately by the Department of Commerce, but reports to the Bureau of Mines by producers show shipments to foreign countries aggregating 6,290 short tons valued at $53,886 compared with 11,090 tons valued at $90,117 in 1939.

The decline in use of fuller's earth, as noted in previous annual chapters of this series, has been due partly to new methods of oil refining and partly to substitution of other oil-bleaching and clarifying agents. In Minerals Yearbook 1940 (p. 1263) reference was made to Magnesol, a synthetic magnesium silicate used in refining petroleum and for clarifying solvents used by dry-cleaning establishments. Reference was also made to United States Patent 2,183,590 issued to Ernest Wayne Rembert on December 19, 1939, but it seems that this patent is not owned by the manufacturers of the product known as Magnesol, the manufacture and use of which are covered by Patents 2,163,525, 2,163,526, and 2,163,527 issued to Lyle Caldwell on June 20, 1939. Acid-activated bentonite and, to a smaller extent, bauxite have invaded heavily the field for fuller's earth in oil refining. Still another factor in the reduced requirement for fuller's earth is the relative decrease in the production of lubricating oils compared with gasoline and other petroleum products that require less or no bleaching.

MISCELLANEOUS CLAY

Hitherto no figures have been available on the total quantity of clay dug and used in the manufacture of brick, title, sewer pipe, and other heavy-clay products. Bureau of Mines figures for "miscellaneous clay" include a substantial tonnage used in making these products, but only when it is sold to another company or shipped by the mining company to a plant some distance from the pit. For 1939 the Census of Mines and Quarries has collected figures for all clay dug, including material produced at integrated plants adjacent to clay pits and representing a tonnage probably six to nine times as large as the total for all kinds of merchant clay.

Miscellaneous clay, including slip clay[1] and shale, sold or used by producers in the United States, 1937–40, by States

State	1937		1938		1939		1940	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(2)	(2)	(2)	(2)	(2)	(2)	100,522	$60,583
Arkansas	(2)	(2)	(2)	(2)	(2)	(2)	24,421	10,533
California	153,315	$217,938	135,923	$374,166	117,286	$250,328	127,539	248,632
Colorado	65,190	58,916	54,115	49,249	76,081	78,159	62,803	64,842
Indiana	10,024	6,405	3,089	1,692	17,402	12,024	20,086	9,750
Iowa	(2)	(2)	6,055	36,725	4,655	40,081	9,548	47,566
Louisiana	------	------	(2)	(2)	(2)	(2)	10,189	96,314
Nebraska	(2)	(2)	16,009	7,532	19,567	8,910	10,406	5,516
Ohio	5,259	12,380	47,226	28,751	23,542	14,351	44,156	18,788
Pennsylvania	50,208	53,481	39,196	23,136	45.292	31,728	54,930	35,256
Texas	(2)	(2)	(2)	(2)	(2)	(2)	65,822	257,238
Washington	21,071	45,118	11,901	10,638	8,272	5,744	14,807	11,256
Other States[3]	98,455	391,789	76,201	329,770	97,177	272,880	165,286	270,466
	403,522	786,027	389,715	861,659	409,274	714,205	710,515	1,136,740

[1] Includes slip clay as follows: From Michigan and New York, in 1937, 6,087 short tons valued at $39,889; 1938, 2,227 tons, $13,955; 1939, 2.564 tons, $17,654; and from Michigan, New York, and Ohio, in 1940, 4,365 tons, $29,268.

[2] Included under "Other States."

[3] Includes States indicated by "(2)" above, and Connecticut, Georgia, Illinois, Kansas (1939-40 only), Kentucky (1937 and 1939 only), Maine (1937 and 1939 only), Maryland, Massachusetts, Michigan, Minnesota, Mississippi (1938-40, inclusive), Missouri (1940 only), Montana, Nevada (1937, 1939, and 1940 only), New Jersey, New Mexico (1938-40, inclusive), New York, Oklahoma, Tennessee (1937 and 1940 only), and Utah.

The second largest use of miscellaneous clay is for rotary-drilling mud. Additional tonnages of unclassified clays are employed in cement manufacture, in foundries and steel works, in flowerpots and other earthenware, in oil refining, and for a variety of minor uses.

HEAVY-CLAY PRODUCTS

Preliminary figures for shipments and employment at brick, tile, and terra-cotta works indicate that production and sales lagged far behind the corresponding figures in 1939 during the first half of 1940 but ran well ahead during the latter half. The net result was that, although the industry did not do so well for the 12-month period, it ended the year with a strong rising trend in contrast to the marked slump that developed before the beginning of the year.

Production trends for many heavy-clay products from 1920 to 1938 were plotted in Minerals Yearbook, 1940 (p. 1266).

POTTERY

Census figures for specified pottery products for 1939 (1937 figures in parentheses) follow: Vitreous china plumbing fixtures $21,978,821 ($20,392,532); hotel china $9,359,660 ($10,415,249); whiteware $27,800,677 ($25,688,838); pottery products not elsewhere classified $16,593,344 ($14,569,850). Earthenware, household, table, and kitchenware articles—the largest item in domestic production of pottery—compete intensively with cheap grades of Japanese pottery and probably will show a marked increase in 1940, probably to an all-time record.

Value of production, imports, and exports of pottery in the United States, 1929–40 [1]

Year	Production	Imports [2] (foreign value)	Exports
1929	$112,019,000	$18,538,000	$5,036,000
1931	66,582,000	7,853,000	2,150,000
1932	40,373,000	4,539,000	859,000
1933	44,024,000	5,449,000	955,000
1937	97,365,000	9,911,000	2,704,000
1938	82,662,000	6,511,000	2,488,000
1939	97,861,000	6,736,000	2,668,000
1940	[3] 100,000,000	6,790,000	3,916,000

[1] Compiled by U. S. Tariff Commission from reports of the Bureau of the Census and the Bureau of Foreign and Domestic Commerce.
[2] Class or kind provided for in pars. 210, 211, and 212 of Tariff Act of 1930.
[3] Estimated.

REFRACTORIES

According to Ramsay,[2] plant capacity for making silica brick and fire-clay brick in the United States has been reduced from a maximum of 1,725,000,000 in 1931 to approximately 1,525,000,000 in 1940, and even the latter figure is roughly twice as large as the quantity needed for filling the requirements of consuming industries. Further evidence of overcapacity is the great number of concerns that have gone through receivership or bankruptcy. Clay-brick capacity represents about three-fourths and silica-brick capacity about one-fourth of the combined capacity as estimated above.

Ramsay affirms that the steel industry does not consume more than half the number of refractory units per ton of iron or steel that it did even 10 years ago, and the reduction in requirements of the oil industry is still greater. The following quotations from his informative analysis are especially interesting:

> In going back over the last 70 years I find that the combined shipments of silica brick and fire-clay brick in 1870 were, roughly, 60,000,000 9-inch equivalent; in 1880 they had reached to 163,000,000; in 1890 to 391,000,000; while in 1899 the shipments were probably 800,000,000 brick. Twenty years later—1919, the shipments were 1,174,000,000 brick, while in 1926 the shipments were 1,300,000,000. From 1926 on, the average shipments were very much less than they were in the period from 1909 to 1926. We all know that 1929 was a good year in nearly all lines, and yet the shipments in that year were not much in excess of 1,000,000,000 9-inch equivalent. The nearest approach to those shipments was in 1928, when they were approximately 900,000,000. Nineteen thirty-six and 1937 were both rather active years, and yet the shipments in each of those years were less than 800,000,000—or, not as much as they were in 1899. In 1932 they fell below 300,000,000. A survey of the average shipments of the 12-year period from 1928 to 1939, both inclusive, indicates that the shipments were probably not much, if any, in excess of 600,000,000. Prior to 1926 the industry probably operated at close to capacity, and in the year 1926 it is my belief that the shipments were at least 90 percent of the capacity of the industry. . .
>
> One of the outstanding points where the consumption is reduced is in the larger units of furnaces or kilns being built by the consumer. Many blast furnaces are now built to produce 1,000 tons of pig iron per day. The linings in these larger furnaces often last for years and produce anywhere from 1 million tons of pig iron to 2 million tons out of a single lining. This means that the life of blast-furnace linings has been probably doubled in the last 10 years. It does not take many more brick to line the large furnace than the small one. Open-hearth furnaces have been enlarged from 100 tons to 150 tons. Glass tanks have been enlarged, and the life in many instances has been doubled as a result of a better product on the part of the producer and better engineering and care on the part of the con-

[2] Ramsay, John D., Backbone of Industry; chap. 9, Economics of the Refractories Industry: Brick and Clay Record, vol. 97, No. 5, November 1940, pp. 58, 60, 62.

sumer. Of course we must not overlook the fact that many consumers today have pyrometric control over their equipment where refractories are used and, obviously, this prevents premature failure. Large, high-pressure boilers take the place of a number of small ones. The high-pressure stills in the oil industry take the place of rows of small units. The central power stations have eliminated thousands of small power plants. The use of tunnel kilns in the ceramic industry, thus displacing the periodic kiln, has made the consumption of refractories an insignificant amount as compared with those required to build and maintain the periodic kilns. During this century, and particularly during the last 30 years, the introduction and construction of byproduct coke ovens require a great many fire brick and silica brick for the original installation, but the maintenance following that is practically nil for 10 or 15 years, and in many cases for 20 years. This has made a great change in the consumption of refractories for the production of coke because the old beehive ovens required continuous repairs, all requiring refractories. One of the greatest losses we have sustained in the consumption of refractories is the byproduct coke-oven installations. I could go on and enumerate and give similar cases in nearly every industry, but the net result of these larger units and better engineering is that the consumption of refractories per unit of production, whether it be steel ingots or glass or electric current, is probably not over 50 percent of what it was 10 years ago.

TECHNOLOGY

Paralleling the marked improvement in commercial clays of domestic origin, laboratory studies are probing deeper into clay molecules and finding sound technologic reasons and replacing rule-of-thumb traditions to explain and predict the behavior of clays in ceramic and other applications. New techniques for speeding identification of the constituents of clays by staining have been perfected in the Bureau of Mines laboratories.[3] At Urbana, Ill., R. E. Grim has been finding that certain behaviors commonly attributed to *p*H alone must be viewed in the light of adsorbed water and the nature of the cation. In the potteries is noted a growing trend toward dry-mixing raw materials, particularly for manufacturing chemical stoneware, electrical porcelain, and certain whitewares. Other recent trends have been summarized as follows:[4]

To simulate the casting properties of standard English clays, synthetic domestic clays or blends, in which grain size is controlled, have been produced. All of them are more refractory than English clay but suit the purpose well when used with additional or more active flux. Even in the enameling industry, one of the few remaining strongholds of continental clays in this country, blended domestic clays have been used successfully and may permanently displace even the highly reputed Vallendar clay.

A new automatic molding (jiggering) machine for plates and other simple shapes, an outstanding advance in pottery making, was developed by Homer Laughlin China Co. Electric firing studies for ceramics were continued at Norris, Tenn., as research continued on all-American bodies. New organic flocculants for sanitary-body casting slips were developed. Lignin and papermakers' byproducts are being used as plasticizers for even cheap structural products. The Overstrom mud screen, previously employed for thick, oil-well drilling muds, has been suggested for heavy ceramic slips. Automatic stokers are being tested at brick plants in various States, not so much to save labor as to assure more uniform firing.

The fire-clay resources of northern Ontario are being studied as a means of relieving Canada's dependence on imports. Those of the United States are discussed in a new book by A. F. Greaves-Walker.[5]

T. V. A. announces the discovery of a new process which it claims will yield alumina commercially for aluminum production from clay; technical details are withheld.

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[3] Faust, G. T., Staining of Clay Minerals as a Rapid Means of Identification in Natural and Beneficiated Products: Bureau of Mines Rept. of Investigations 3522, 1940, 22 pp.

[4] Tyler, Paul M., and Bowles, Oliver, Industrial Minerals: Min. and Met., vol. 22, No. 410, February 1941, p. 99.

[5] Greaves-Walker, A. F., Origin, Mineralogy, and Distribution of the Refractory Clays of the United States: North Carolina State Coll. Eng. Exp. Sta., Bull. 19, 1939, 87 pp.

THE INDUSTRY IN FOREIGN COUNTRIES

Germany.—Germany has huge kaolin resources that were increased greatly by the annexation of Czechoslovakia. Before occupation of the Sudeten area in October 1938 Germany's production of kaolin from plants subject to statistical control rose from about 390,000 metric tons in 1932 to 730,000 in 1936, most of which came from deposits in Bavaria. Czechoslovakia's output meanwhile rose from 356,000 tons in 1932 to 407,000 in 1936. Virtually all the famous china and porcelain plants of western Bohemia and the associated clay deposits were acquired by the 1938 coup, which is the more significant in view of the fact that (in 1937) 76 percent of the 236,898 metric tons of china clay that Germany imported came from Czechoslovakia. In 1938 Germany's imports of china clay totaled 189,310 tons, of which Czechoslovakia supplied 140,689, the United Kingdom 45,304, Denmark 3,228, and other countries 89. Czechoslovak imports of china clay on the other hand were negligible—only 4,357 tons in 1937, of which 3,890 were from Germany.

The United States has imported a variety of specialty clays from central Europe, chiefly for enameling, special refractories, and pencil leads. For many years the famous Zettlitz kaolins were considered the highest type of clay for porcelain manufacture. Imports of German and Czechoslovak clay into the United States in recent years have not been very large, but when they were finally cut off by the British blockade certain minor readjustments were necessitated. The transition to blends of American or of American and English clays was made easier by reason of fairly large stocks in the hands of consumers. Most of the crucible manufacturers, for example, still have stocks of Klingenberg clay, which hitherto was considered essential for this purpose—probably because it becomes dense at a comparatively low temperature, thus sealing the carbon grains and protecting them from oxidation. Gross-Almerode glass-pot clay is a German clay that formerly was used extensively in the United States in making pots and tanks in which glass was melted; imports of this clay aggregated 2,145 tons in 1936 but dwindled to insignificant proportions even before the outbreak of the European war. Other special German clays were used in making tobacco pipes, emery wheels, and a variety of other ceramic products. In the enameling field the complete answer to the clay problem only a quarter century ago was Vallendar clay, which was produced in Germany northeast of Koblenz. During the World War of 1914–18 the American hollow-ware industry began to use domestic clays, usually with admixtures of English clay; and after 1918 some use of domestic clays persisted, especially in grey-ware enameling. Long before the outbreak of the present war American enamelers had escaped dependence on Vallendar clay. Some quantities of this clay were still imported, but it was perfectly possible to get along without it. One effect of the present conflict may be to establish American clay in the enameling industry as well as in other industries to such an extent that German clays will not be needed in the United States.[6]

India.—Illustrating further the world-wide trend toward self-sufficiency in clays as well as other materials and products was the

[6] Irwin, J. T., What Have We Learned About Clay Since World War I: Enamelist, vol. 17, No. 8, May 1940, pp. 5–12.

establishment of a Government porcelain factory in the State of Mysore, India, in 1931. China clay, quartz, and feldspar are found in abundance near Bangalore. It is reported [7] that the factory supplies not only the requirements of the electrical department of the State (which is probably the largest consumer of electrical goods in India) but even sells its products elsewhere in India. The manufacture of stoneware is being considered.

Italy.—Before the present war the production of china clay in Italy more than trebled in 4 years or from 37,830 metric tons in 1934 to 119,286 in 1938. Imports meanwhile dwindled from 52,594 tons in 1934 to 28,446 tons in 1938. The following résumé is based upon reports from United States Vice Consul Charles T. Terry, Venice:[8]

Up to the period of the sanctions (1936) Italy depended entirely on foreign nations for high-grade clays both for porcelain and rubber making. Today the situation is greatly changed. Kaolins of a low purity and plasticity, of which Italy has abundant supplies, are being pulverized, washed, and decanted to furnish material suitable for many purposes in the ceramics industry, for the manufacture of paints, mastic, and, for the present in lesser degree, paper. If subjected to an adequate mechanical, chemical, or electrical-osmotic treatment, it is believed Italy's kaolin might be adapted to still other uses for which it cannot be employed at present. Plants for purifying kaolin already exist at Torniella in the Province of Grosseto and at Tretto in the Province of Vicenza.

National production of kaolin in 1936 was 73 percent more than in 1935. All Italian kaolin mines contributed to the 73-percent jump in national output in 1936, but more especially those at Furtei Serrenti in Sardinia, those in the mining district of Vercelli in the Piedmont Province, and those at Tornella and Valle Pozzatello in Tuscany Province. The mines at Tretto in Vicenza (Venice consular district) and those opened in 1935 on the island of Ponza in the Naples mining district contributed substantially to the total production.

Italy is fairly rich in kaolinic strata, but much of the domestic product, after washing, is not suitable for use in porcelain. To approximate that which is being imported from abroad, the raw kaolin must undergo a process of enrichment and purification. The raw kaolin produced at Furtei, which is well-adapted also to the manufacture of refractories, is the variety that lends itself best to this process. It yields a product with 35 percent alumina or 95 percent kaolinite. The spectrum of this variety of kaolin, known as "Bex di Monte Porceddu," more nearly approximates that of the best English kaolin. Clays mined at Tretto in Vicenza, Roccastrada in Grosseto, Pozzatello in Pisa, and Ponza in Naples, do not lend themselves to this process because they are not rich enough in Al_2O_3.

It may be said that even yet only a very limited quantity of kaolin has been produced in Italy for porcelain and hard white crockery. On the whole, the known Italian strata of kaolin yield kaolinic earth only for pottery and refractories. Impure kaolin, after having been ground, is used in the manufacture of refractories, and part, after it has been washed (the so-called refined kaolin, in the form of loaves and powder), is extracted for use in pottery, paint, mastic, and paper.

United Kingdom.—Because of the war official statistics for china clay, ball clay, and china stone in the United Kingdom were discontinued in November 1940. The output of china clay during the first 10 months of the year totaled 423,016 long tons compared with 748,402 tons during the 12 months of 1939 and a record of 830,946 tons during 1937. For ball clay the 10-month output was 17,522 long tons compared with the 1937 record of 31,812 tons for a full year. The china-clay works in Devon and Cornwall were operated at only a slightly lower rate during the first 4 months of 1940 than during the corresponding 1939 period—before the war. However, when the Scandinavian market was cut off stocks began to grow; and later when Italy

[7] Bureau of Foreign and Domestic Commerce, Foreign Commerce Weekly, vol. 2, No. 13, March 29, 1941, p. 539.

[8] Terry, Charles T. (United States vice consul, Venice), Consular Repts., July 14 and July 21, 1939; abs. Bureau of Mines Mineral Trade Notes, vol. 9, No. 3, September 20, 1939, pp. 29-31.

and the rest of the continental market, except Spain, stopped buying English clay hundreds of workers had to be laid off. During the latter half of the year trade was virtually confined to home consumption and exports to the United States, and even these outlets were restricted.

A comprehensive report on the English china-clay industry was submitted in August 1938 to the Bureau of Mines by Rollin R. Winslow, United States consul, Plymouth, England, and was abstracted in Mineral Trade Notes (vol. 7, No. 4, October 20, 1938, pp. 23–26, and No. 5, November 20, 1938, pp. 13–14), from which many of the data in the following paragraph are taken:

Kaolin, or china clay, is the most important natural material produced in Great Britain, next to coal, and virtually all of it comes from an area 10 miles square in Cornwall. In 1913, the St. Stephens district provided more than 50 percent of the estimated world production; for many decades before that English production was rivaled only by that of China. In later years, it has constituted only about 15 percent of the world total—not because production has declined in England (it was even larger in 1937 than in 1913) but because production elsewhere, notably in the United States, has increased. Cornish clays have held a high reputation for uniformity, high average quality, and good color, and the development of international markets has been facilitated by the existence of large deposits close to seaports. Taking normal production of English china clay as 800,000 long tons a year, it has been estimated that its uses, foreign and domestic, are distributed as follows: 450,000 tons in paper, 250,000 in pottery, 50,000 in textiles, and 50,000 in other products. In respect to sales in the United States, the uses of English clay are divided approximately as follows: Paper filler, 40; paper coating, 19; pottery, 33; textiles, paints, etc., 5; and oilcloth and linoleum, 3 percent. In 1913, American imports of English kaolin were more than 10 times American production, but by 1919 American production exceeded imports, and in 1940 it was almost 8 times as great. Between 1920 and 1930, 56 percent of all English china clay exported went to the United States but in recent years scarcely 15 percent. Normally, about two-thirds of the English output is marketed overseas. Before the outbreak of hostilities in 1939 Germany had become the largest buyer next to the United States. France was third, Netherlands ranked fourth, and other European countries were consistent consumers.

Scottish fire clays[9] are almost as famous in their field as the china clays of Southwest England. About 600,000 tons of fire clay of various classes are mined annually in Scotland, roughly 30 percent of the entire output of the United Kingdom. Much of the output is used in the local steel works and Tyneside shipyards. It is also used in making various articles ranging from fire brick to sanitary ware and in chemical plants. Roughly, 25 percent is exported. Ordinary fire clay is distributed widely along coal seams, but the more refractory clays seldom occur near workable coal. These clays appear in the two principal areas in Scotland—the Saltcoats-Mauchline deposits in Ayrshire and the Cardowan-Bonnybridge deposits in the Counties of Lanark, Dumbarton, and Stirling. The industry is centered between Bonnybridge and Cumbernauld, where there are nine mines, and between Glenboig and Cardowan, where six mines are operating. There are four other mines in North Ayrshire, with others near Polmont, Bathgate, Fauldhouse, and Morningside. This producing area is within a radius of 25 miles of Glasgow.

[9] Bowman, Howard A. (United States consul, Glasgow, Scotland), Fire-clay Trade in Scotland: Consular Rept., January 26, 1939, 3 pp.; abs. Bureau of Mines Mineral Trade Notes, vol. 8, No. 3, March 20, 1939, pp. 22–24.

ABRASIVE MATERIALS

By Robert W. Metcalf

SUMMARY OUTLINE

The total value of products of the industries comprising the natural abrasives group showed a small increase in 1940 compared with 1939. Offsetting decreases in the value of sales of tripoli, millstones, and garnet, were healthy advances for quartz, ground sand and sandstone, grindstones and pulpstones, pumice and pumicite (a new record), and emery. The reported tonnage of pumice and pumicite, however, was somewhat less than the record output of 1939, and the quantity of garnet sold increased 16 percent in 1940 compared with 1939.

Salient statistics of the abrasives industries in the United States, 1939–40

	1939	1940	Percent of change in 1940
Domestic production (sold or used by producers):			
Natural silica abrasives:			
Diatomite	(1)	(1)	
Tripoli	$466,380	$366,569	−21
Quartz	153,038	176,390	+15
Ground sand and sandstone	1,930,301	2,088,314	+8
Special silica-stone products:			
Grindstones and pulpstones	426,375	496,448	+16
Oilstones and related products	115,805	(1)	
Millstones	11,084	6,558	−41
Flint lining and grinding pebbles	(1)	(1)	
Natural silicate abrasives:			
Pumice and pumicite	424,780	449,914	+6
Garnet	278,534	259,345	−7
Natural alumina abrasives:			
Emery	6,828	9,349	+37
Total natural abrasives	[2] 3,813,125	[2] 3,852,887	+1
Total artificial abrasives [3]	6,504,403	10,142,691	+56
Foreign trade:			
Imports	10,246,945	11,517,117	+12
Exports	1,415,589	1,605,961	+13

[1] Bureau of Mines not at liberty to publish figures. Average for diatomite for 1936–38 was $1,459,118.
[2] Excludes in 1939 value of diatomite and of flint lining and grinding pebbles and in 1940 value of diatomite, flint lining and grinding pebbles, and oilstones and related products, which the Bureau of Mines is not at liberty to publish.
[3] Includes some material produced in Canada; Bureau of Mines not at liberty to publish United States data separately.

Output of crude manufactured abrasives established an all-time record in 1940, and the total value of products was only 6 percent under the 1929 figure—the highest yet recorded. All three classes of artificial abrasives—silicon carbide, aluminum oxide, and metallic abrasives—reached new highs in 1940, silicon carbide and aluminum oxide far outstripping the 13-percent increase in general industrial activity over 1939 and the 25-percent gain in durable goods manufacture. Continued heavy imports of smaller industrial diamonds, large increases in receipts of corundum and emery ores, radical decreases in imports of Italian pumice and of flint, flint stones, etc., for grinding and ceramic use, and a sizable increase in value of exports featured the foreign trade of the United States in abrasive materials during 1940.

This chapter includes data for most of the materials used chiefly as abrasives, although certain clays, oxides, and substances mentioned later under "Miscellaneous abrasive materials" are not included in the statistics presented herein. On the other hand, some commodities listed as abrasives for which data are given also have important nonabrasive uses.

President Roosevelt on July 2, 1940, designated industrial diamonds as one of a large group of commodities subject to export by license only,[1] such license to be issued by the Division of Controls of the State Department. On recommendation of the Administrator of Export Control the President placed some 15 additional articles in this category on December 20, 1940. Included in this later group subject to restrictive export were: Abrasives and products containing emery, corundum, or garnet, as well as abrasive paper and cloth; and tools incorporating industrial diamonds.[2]

The general trends in the natural and artificial abrasives industry, including reference to coated products and grinding wheels, were described in one of a series of studies, by the Bureau of Mines, of nonmetallic minerals necessary to the defense program.[3] A brief history and description of the uses of each of the principal types of abrasives were given, with tables for imports and domestic production in selected years and a compilation of Census data since 1880. Unprecedented demands for abrasives are forecast in the rapidly growing airplane output, in the mechanization of armed forces, and in the resultant activity of steel mills and other factories using large quantities of abrasives in the manufacture of finished munitions and other articles needed for defense.

A general discussion of the vital necessity for long grinding and polishing in the production of the highly efficient engines, machinery, and instruments with precision-ground tolerances essential for modern war and peace requirements is presented in an article in Priorities, a chemical-firm house organ.[4] A recent book by Swigert [5] devotes a chapter to abrasives, tracing their history from early development to the present-day use of bonded abrasives. British specifications for abrasive papers and cloths were published recently.[6]

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[1] Federal Register, vol. 5, No. 130, July 4, 1940, pp. 2467–2468.

[2] Federal Register, vol 5, No. 249, December 24, 1940, pp. 5229–5230.

[3] O'Neill, Leo J., Nonmetallic Minerals Needed for National Defense. 2. Abrasives: Bureau of Mines Inf. Circ. 7168, 1941, 17 pp.

[4] Prior Chemical Corporation (420 Lexington Ave., New York), Abrasives: Priorities, February 1941, pp. 1–2, 4; abs., Oil, Paint, and Drug Reporter, vol. 139, No. 8, February 24, 1941, p. 53.

[5] Swigert, Arthur M., Jr., The Story of Superfinish: Lynn Publishing Co., Detroit, 1940, 675 pp.; rev. Mech. Eng., vol. 62, No. 12, December 1940, p. 922.

[6] British Standards Institute, Abrasive Papers and Cloth (Technical Products): British Standard Specifications 871 and 872, London, 1939.

An improved polishing method utilizes an abrasive film on metal laps, thereby providing a greater number of active cutting particles than a fixed abrasive and avoiding scratches and waviness such as are produced by a freely rolling abrasive.[7] Greater speed also is obtained through the use of the special technique recommended, as a mounted surface can be ground and polished in 10 to 60 minutes compared with 3 to 12 hours using standard methods.

A detailed discussion of the complicated nature of the factors involved in abrasives and grinding was presented by Milligan,[8] under the four following headings: (1) Characteristics of abrasive grains, including consideration of hardness characteristics and testing methods, toughness, refractoriness, and a listing and classification of the different abrasive materials; (2) bonding characteristics, including consideration of the various kinds of bonds employed commercially for grinding wheels, coated goods, polishing, and buffing and lapping wheels, the structural relationship in bonded abrasive products, and grading of abrasive products; (3) characteristics of the substance or work undergoing the abrasive process; and (4) conditions under which the abrasive is used.

Following the success of the electrostatic method in coating sandpaper its possible usefulness in textiles was indicated. One such application has been in the manufacture of pile fabrics,[9] such as women's dress goods decorated with a pile design and all-over covered pile products for such service as car interiors and upholstery. The wearing properties of an electrocoated pile fabric are increased as a result of the density of pile attainable—as high as 275,000 fibers per square inch.

NATURAL SILICA ABRASIVES

Diatomite.—The Bureau of Mines has not been at liberty to publish annual production figures on diatomite since 1926. Total output (sales) for 3-year periods, however, may be shown, and the annual fluctuation up to 1926 and 3-year averages since that date are plotted in figure 1. Total sales during the period 1936–38 totaled 279,645 short tons valued at $4,377,353 compared with 244,342 tons valued at $3,618,428 in the period 1933–35. Sales in 1940 were slightly higher than in 1939, continuing this gradual upward trend.

California and Oregon remained the chief producing States in 1940; other States that produced diatomite were Florida, Idaho, Nevada, New Mexico, New York, and Washington.

The principal uses for diatomaceous earth are for polishes, in insulation board and similar products, and as fillers, admixtures, and filter aids. Precoating the papers in plate and frame presses with diatomaceous earth, in which a special technique developed by Bitzer [10] is employed, has proved of value in filtering cyanide precipitate.

Tripoli.—Sales of tripoli (including Pennsylvania rottenstone) decreased in 1940 to 30,212 short tons valued at $366,569—10 percent in tonnage and 21 percent in value less than in 1939. Except for 1937

[7] Fuller, J. Osborn, Mechanical Polishing with a Film of Abrasive: Econ. Geol., vol. 36, No. 2, March-April 1941, pp. 199–211.
[8] Milligan, Lowell H., Abrasives and Grinding: Bull. Am. Ceram. Soc., vol. 20, No. 2, February 1941, pp. 39–47.
[9] Oglesby, N E. and Hoogstoel, L. E., Electrocoated Pile Fabrics: Ind. Eng. Chem., vol. 32, No. 12, December 1940, pp. 1552–1554.
[10] Bitzer, E. C., Diatomite an Aid in Filtering Cyanide Precipitate: Eng. and Min. Jour., October 1940, pp. 52–53.

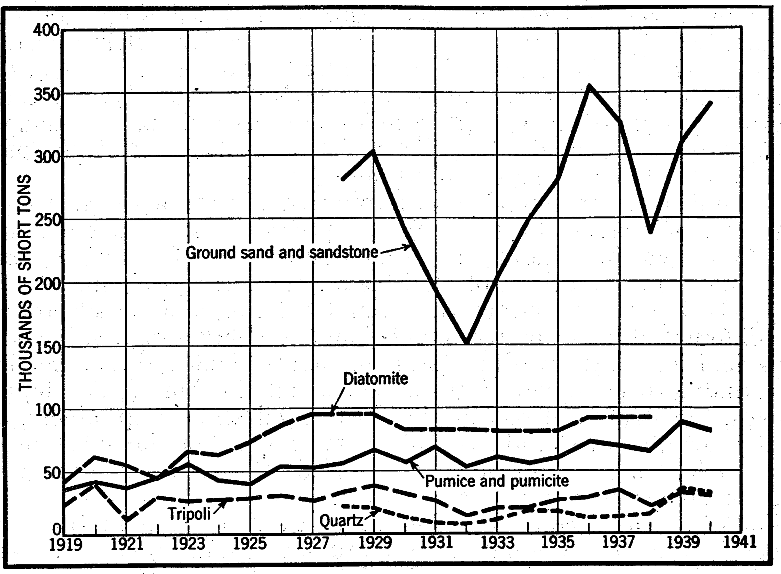

FIGURE 1.—Trends in production of diatomite, tripoli, pumice and pumicite, quartz, and ground sand and sandstone, 1919–40.

and 1939 the quantity sold was larger than in any year since 1930. In 1940 tripoli or amorphous silica was mined in Arkansas, California, Illinois, Missouri, Oklahoma, and Texas. Production is largely from the Seneca (Mo.), and Gate (Okla.) areas and from southern Illinois. Rottenstone was produced in Pennsylvania only.

Tripoli (including Pennsylvania rottenstone) sold or used by producers in the United States, 1936–40

Year	Illinois		Other States [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1936	10,981	$138,063	17,506	$253,815	28,487	$391,878
1937	11,647	151,154	23,289	299,416	34,936	450,570
1938	8,141	117,107	14,047	211,974	22,188	329,081
1939	11,134	148,310	22,340	318,070	33,474	466,380
1940	11,521	155,576	18,691	210,993	30,212	366,569

[1] 1936: Arkansas, California, Missouri, Oklahoma, and Pennsylvania; 1937–38: Arkansas, California, Missouri, Oklahoma, Pennsylvania, and Tennessee; 1939: Arkansas, California, Missouri, Oklahoma, Pennsylvania, Tennessee, and Texas; 1940: Arkansas, California, Missouri, Oklahoma, Pennsylvania, and Texas.

Abrasives remained the largest outlet for tripoli, followed by sales for fillers of various kinds. These two uses combined represented 62 percent of the total sales. Sales for concrete admixture and for oil-well drilling mud in 1940 were 1,683 and 1,840 short tons, respectively.

Quartz.—Production of quartz from pegmatite veins or dikes and from quartzite totaled 31,865 short tons valued at $176,390 in 1940—a 9 percent decrease in tonnage, but a 15-percent increase in value compared with 1939. Except for 1939 sales were larger than in any year since 1920. The decrease in tonnage was due entirely to the drop in sales of crude material, as sales of both crushed and ground quartz rose substantially.

Tripoli (including Pennsylvania rottenstone) sold or used by producers in the United States, 1938–40, by uses

Use	1938		1939		1940	
	Short tons	Value	Short tons	Value	Short tons	Value
Abrasives	8,097	$138,807	10,953	$169,370	10,279	$119,609
Concrete admixture	2,170	12,634	1,653	24,580	1,683	15,895
Filler	5,584	78,900	9,016	120,284	8,451	113,862
Oil-well drilling			(1)	(1)	1,840	16,949
Other uses [2]	6,337	98,740	11,852	152,146	7,959	100,254
	22,188	329,081	33,474	466,380	30,212	366,569

[1] Included under "other uses."
[2] 1938: Filter block, foundry facing, and unspecified; 1939: Foundry facing, oil-well drilling mud, and unspecified; 1940: Filter block, foundry facing, and unspecified.

Quartz (crude, crushed, and ground)[1] sold or used by producers in the United States, 1936–40

Year	Crude		Crushed		Ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1936	[2] 6,281	[2] $24,971	(2)	(2)	6,705	$71,621	12,986	$96,592
1937	3,252	10,096	5,891	$24,652	3,869	31,293	13,012	66,041
1938	4,493	17,023	9,930	27,941	4,188	43,233	18,611	88,197
1939	13,739	45,785	15,504	49,186	5,716	58,067	34,959	153,038
1940	3,606	17,099	17,652	58,897	10,607	100,394	31,865	176,390

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

Output of crude quartz in 1940 was reported from 13 States compared with 12 in 1939. No sales in 1940 were reported from Ohio, and New Jersey and Pennsylvania reappeared in the list of producing States. Otherwise quartz was mined in the same States in 1940 as in 1939.

Quartz (crude, crushed, and ground)[1] sold or used by producers in the United States, 1938–40, by States

State	1938		1939		1940	
	Short tons	Value	Short tons	Value	Short tons	Value
Arizona	(2)	(2)	8,442	$37,410	2,141	$25,548
California	1,494	$20,809				
Maine	243	663	644	1,725	160	538
New Hampshire						
Maryland	377	6,000	515	8,010	(2)	(2)
Massachusetts	140	840	442	2,652	786	4,716
North Carolina and Virginia	763	9,390	3,702	22,824	3,842	25,063
Oregon	(2)	(2)	910	5,600	1,600	10,000
Other States [3]	15,594	50,495	20,304	74,817	23,336	110,525
	18,611	88,197	34,959	153,038	31,865	176,390

[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 "Other States."
[3] 1938: Arizona, New York, Ohio, Oregon, Tennessee, and Wisconsin; 1939: New York, Ohio, Tennessee, and Wisconsin; 1940: Maryland, New Jersey, New York, Pennsylvania, Tennessee, and Wisconsin.

Ground sand and sandstone.—Except for 1936, sales of ground sand and sandstone in 1940 were the largest since 1917 and totaled 342,218 short tons valued at $2,088,314—10 percent in tonnage and 8 percent in value higher than in 1939. Important producing States were Illinois, New Jersey, Ohio, and Pennsylvania.

Ground sand and sandstone sold or used by producers in the United States, 1936–40

Year	Short tons	Value	Year	Short tons	Value
1936	356,423	$2,146,464	1939	310,512	$1,930,301
1937	328,156	1,996,528	1940	342,218	2,088,314
1938	237,167	1,425,445			

Ground sand and sandstone sold or used by producers in the United States, 1939–40, by States

State	1939		1940	
	Short tons	Value	Short tons	Value
California	(1)	(1)	5,505	$39,080
Illinois	91,645	$543,761	106,397	628,488
Massachusetts	1,374	6,220	1,425	6,240
New Jersey	88,946	577,811	122,304	641,021
Pennsylvania	(1)	(1)		
Ohio	36,950	223,965	96,133	688,321
Virginia and West Virginia	(1)	(1)		
Other States [2]	91,597	578,544	10,454	85,164
	310,512	1,930,301	342,218	2,088,314

[1] Included under "Other States."
[2] 1939: California, Missouri, Pennsylvania, Virginia, West Virginia, and Wisconsin; 1940: Missouri, North Carolina, and Wisconsin.

Sales of ground sand and sandstone for pottery, porcelain, and tile in 1940 totaled 137,228 short tons—40 percent of the total. Sales for abrasive use and for foundries were the next most important. These three markets combined comprised 83 percent of the total in 1940.

Ground sand and sandstone sold or used by producers in the United States in 1940, by uses

Use	Short tons	Value	
		Total	Average per ton
Abrasive:			
Cleansing and scouring compound	77,734	$396,594	$5.10
Other	10,718	53,677	5.01
Enamel	22,978	141,334	6.15
Filler	6,109	68,004	11.13
Foundry	58,306	324,659	5.57
Glass	9,883	51,327	5.19
Pottery, porcelain, and tile	137,228	942,996	6.87
Other uses	19,262	109,723	5.70
Total reported, by uses	342,218	2,088,314	6.10

Abrasive sand.—Natural sands with a high silica content, employed for sand blasting, scouring stone, grinding glass, sandpaper, and other abrasive use, increased in 1940 to 856,309 short tons valued at $915,925 compared with 668,027 tons valued at $895,989 in 1939—a rise of 28 percent in tonnage and 2 percent in value, although still considerably under the 1937 level. The 1940 total included 256,104 tons of blast sand valued at $597,198, or 16 percent in quantity and 10 percent in value higher than the 220,240 tons valued at $542,915 reported for this use in 1939. More detailed data on abrasive sands are shown under the classification "Grinding and polishing sand" in the chapter on Sand and Gravel.

SPECIAL SILICA-STONE PRODUCTS

Grindstones and pulpstones.—The total sales value of grindstones and pulpstones made from quarried stone increased in 1940 to $496,448—a 16-percent gain over 1939. Sales of grindstones in 1940 were 11 percent higher in both tonnage and value and pulpstones 80 percent larger in tonnage and 25 percent in value than in 1939. The value of pulpstones sold in 1940 was the highest since 1937 and the reported tonnage larger than in any year since 1929. As in other recent years, grindstones were quarried in Ohio and West Virginia and pulpstones in Washington and West Virginia.

Grindstones and pulpstones sold by producers in the United States, 1936–40

Year	Grindstones		Pulpstones		
			Quantity		Value
	Short tons	Value	Pieces	Equivalent short tons	
1936	10,703	$334,363	685	2,472	$163,643
1937	11,617	352,377	761	2,924	220,331
1938	4,653	149,019	417	1,553	90,987
1939	7,917	257,350	672	2,517	169,025
1940	8,790	284,809	901	4,533	211,639

The development of wood grinders and the relation of the size, texture, and hardness of pulpstones used in the pulp and paper industry were described by Shipman and Stephenson.[11] Different stones produced differing grades of pulp and reacted differently to dressing. Grading of the stones according to the predominant size of grit and texture became necessary, as stones, even from the same quarry, varied somewhat and those from other localities had distinct characteristics. Thus, English pulpstones, long considered best in quality, differed from those quarried in Ohio, West Virginia, or New Brunswick. As the pulp grinders increased in width, larger stones were required—sizes up to 54 inches in width and 62 and then 72 inches in diameter, instead of the 27-inch-width by 54-inch-diameter size largely used in earlier years. The difficulty of finding quarries with suitable sandstone beds thick enough to produce these large stones led to the cementing together of two thin stones or the use of bonding material to improve the natural qualities of the stone. Artificial stones made from aluminum oxide and silicon carbide also have been adapted for use as pulpstones in recent years.

[11] Shipman, George, and Stephenson, J. N., Advances in Grinding Wood: Pulp and Paper Mag. Canada, vol. 41, No. 9, August 1940, pp. 568–569.

Oilstones and related products.—Sales of natural sharpening stones—including oilstones, whetstones, scythestones, and rubbing stones—were higher in 1940 than in 1939. The Bureau of Mines, however, is not at liberty to publish the 1940 data. States contributing to the total were as follows: Arkansas, oilstones and whetstones; Indiana, rubbing stones; New Hampshire, scythestones; and Ohio, whetstones, scythestones, lathestones, and holystones.

Oilstones and other whetstones, hones, scythestones, and rubbing stones sold by producers in the United States, 1936–40

Year	Short tons	Value	Year	Short tons	Value
1936	752	$121,196	1939	620	$115,805
1937	810	112,841	1940	(1)	(1)
1938	511	130,277			

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

Millstones.—The value of sales of millstones in 1940 dropped to $6,558—41 percent lower than in 1939 and 21 percent less than in 1937. Millstones in 1940 were produced from Ulster County, N. Y. ("Esopus" stone); Rowan County, N. C. (granite); and Montgomery County, Va. (quartzite). The diameter of the millstones produced in Virginia ranges from about 12 to 72 inches; they are quarried by hand from underground operations, as the surface rock has been found unsatisfactory on account of its objectionable lining and lamination.

Value of millstones, chasers, and dragstones sold by producers in the United States, 1936–40

Year	New York		Other States [1]		Total	
	Producers	Value	Producers	Value	Producers	Value
1936	6	$5,458	3	$5,151	9	$10,609
1937	6	(2)	2	(2)	8	8,305
1938	4	(2)	2	(2)	6	3,743
1939	6	2,584	3	8,500	9	11,084
1940	3	(2)	2	(2)	5	6,558

[1] 1936–38: Virginia; 1939–40: North Carolina and Virginia.
[2] Bureau of Mines not at liberty to publish figures.

Tube-mill lining and grinding pebbles.—Stimulated by the threatened curtailment of supplies of foreign mill liners and grinding pebbles, an intensive search for possible new sources and likely substitutes for grinding pebbles formerly imported chiefly from Denmark and France and for silex liners from Belgium was undertaken during the year. The sharp drop in imports of "Flint, flints, and flintstones, unground" in 1940 to 2,840 short tons from 11,987 in 1939 confirmed the likelihood of a curtailed supply from abroad.

Fortunately, fairly large stocks had been built up at plants, and the partial stoppage of imports already has been offset by increased production of artificial pebbles in the United States and by various substitutes (including selected pegmatite quartz) from certain feldspar mines. One company found that granite liners gave better service than Belgian silex. Some operators also have discovered that steel balls and liners caused less serious contamination by iron than had hitherto been supposed. The Board of Directors of the National Industrial Sand Association in the fall of 1940 recognized the need for looking ahead for a future supply of grinding pebbles for making silica flour. At the semiannual meeting in November it discussed the desirability of an interchange among member companies of information and experience with substitute materials. At that time one of these members was using porcelain and another testing corundum pebbles.

The Canadian Mining and Metallurgical Bulletin for September 1940 reported that large consumers in the United States were becoming interested in several southwestern Saskatchewan deposits containing hard, dense quartzite pebbles whose performance is said to compare favorably with European material formerly imported. Deposits in the best locations already had been taken up, and the Canadian Flint & Spar Co. was beginning production at Gouverneur and Knollys immediately.[12] The Clinchfield Sand & Feldspar Corporation, Baltimore, Md., producer of feldspar and other ceramic raw materials, imported about 2,000 tons of beach pebbles from Newfoundland in 1940. These pebbles were reported to be high in flint and fairly low in iron. As many of them, however, were quite soft, it was found necessary to sort them carefully. The sorted product was quoted at $35 a short ton, f. o. b. New York.

The Jasper Stone Co., Sioux City, Iowa, marketing liners and artificially rounded pebbles of quartzite from its Jasper (Minn.) quarries, was again the principal commercial producer of mill lining and grinding pebbles, but at least two others reported small sales in 1940—Southern Products & Silica Co., Lilesville, N. C. (granite cubes and liners, also some large quartz pebbles), and John T. Momand, Carlsbad, Calif. (beach pebbles). J. Howard Swaim, Nashville, Tenn., has taken over the property near Iron City, Tenn., formerly operated by the American Flint Co. and is expecting to begin shipments during 1941. Although the Harris Granite Quarries Co., Salisbury, N. C., shipped practically only sample lots in 1940, it is making both liners and pebbles "in considerable quantities" in 1941. The Crystal Silica Co., Los Angeles, Calif., is said to be producing several grades of pebbles at its plant, Oceanside, Calif. In addition to handling Newfoundland pebbles the Clinchfield Sand & Feldspar Corporation is reported to have tested various quartzite pebbles. Experimental work on topaz as a grinding medium was undertaken by the United Feldspar & Minerals Corporation, Spruce Pine, N. C. Porcelain balls have been used by a silica firm. Use of "self-material" or lumps of the same material being ground, silica flour compressed into balls under pressure with sodium silicate as a binder, white-iron grinding mediums, and hard-iron liners of special composition in place of silex have been suggested as possible substitutes for imported material.[13] A general review of the silex and grinding-pebble industry appeared in 1940.[14]

NATURAL SILICATE ABRASIVES

Pumice and pumicite.—Sales of pumice and pumicite in 1940 decreased to 82,407 short tons—8 percent under the record output of 1939 (89,159 tons), although they were considerably higher than in other years. The value of sales in 1940, however, totaled $449,914, and was a new high—6 percent greater than that reported in 1939.

[12] Canadian Mineral and Metallurgical Bulletin 341: September 1940, p. 362.
[13] Rock Products, Grinding Pebbles: Vol. 44, No. 1, January 1941, pp. 87–88.
[14] Metcalf, Robert W., Grinding Pebbles and Tube-mill Liners: Bureau of Mines Inf. Circ. 7139, 1940, 5 pp.

Pumice and pumicide sold or used by producers in the United States, 1936–40

Year	Short tons	Value	Year	Short tons	Value
1936	72,915	$328,406	1939	89,159	$424,780
1937	71,007	301,936	1940	82,407	449,914
1938	65,742	312,886			

Pumice and pumicite sold or used by producers in the United States, 1938–40, by uses

Use	1938		1939		1940	
	Short tons	Value	Short tons	Value	Short tons	Value
Abrasive:						
Cleansing and scouring compounds and hand soaps	47,013	$188,807	52,521	$227,447	49,359	$234,768
Other abrasive uses	938	8,499	(1)	(1)	836	7,563
Acoustic plaster	3,080	54,055	5,444	97,181	3,712	67,906
Concrete admixture and concrete aggregate	7,596	18,297	20,719	24,852	22,045	48,204
Other uses [2]	7,115	43,228	10,475	75,300	6,455	91,473
	65,742	312,886	89,159	424,780	82,407	449,914

[1] Included under "Other uses."
[2] 1938: Asphalt, filtering, rock gardens and landscaping, building tiles, and some unspecified uses; 1939: Asphalt, heat or cold insulation, or other abrasive use, insecticide, building tile and blocks, roofing, stucco, and unspecified uses; 1940: Asphalt, heat or cold insulation, insecticide, stucco, lime mortar, and unspecified uses.

Production of pumice in 1940 was reported in California, Kansas, Nebraska, Oklahoma, and Oregon and output of pumicite or volcanic ash in Colorado, Kansas, Nebraska, and Oklahoma.

Sales of pumice and pumicite in 1940 for use in concrete (as admixture and aggregate) increased 6 percent to 22,045 short tons compared with 20,719 tons in 1939. Consumption in other uses for which comparisons are available, however, was less than in 1939—cleansing and scouring compounds and hand soaps, 49,359 tons in 1940 compared with 52,521 tons in 1939, a decrease of 6 percent; and acoustic plaster, 3,712 tons in 1940 compared with 5,444 tons in 1939, a decrease of 32 percent (see figure 2).

The American Pumice Co., Los Angeles, Calif., with a plant 30 miles north of Bishop was incorporated [15] and started production. The Pumice Processing Co., 556 San Fernando Road, Los Angeles, Calif., also obtained a certificate to go into business.[16] Owing to the increased demand for its lightweight concrete block and roofing tile utilizing ground pumice the Basalt Rock Co., Napa, Calif., installed a second tamper-type machine and a new Besser Vibrapac during 1940.[17] Pumice and volcanic ash deposits in Mono County, Calif., were described.[18] Pumicite is being used in the concrete mix for the Friant (Calif.) dam.[19] Pence [20] has studied the behavior of a white-firing volcanic ash as a ceramic body constituent. The alteration of volcanic ash and its relation to the silicification of wood were discussed by Murata.[21]

[15] Oil, Paint, and Drug Reporter, vol. 138, No. 24, December 9, 1940, p. 39.
[16] Oil, Paint, and Drug Reporter, vol. 139, No. 1, January 6, 1941, p. 55.
[17] Pit and Quarry, January 1941, p. 140.
[18] California Journal of Mines and Geology, vol. 36, No. 2, April 1940, pp. 151–153.
[19] Rock Products, vol. 43, No. 8, August 1940, p. 59.
[20] Pence, F. K., White-firing Volcanic Ash in Texas as a Body Ingredient: Paper presented at 43d ann. meeting, Am. Ceram. Soc., April 3, 1941; Bull. Am. Ceram. Soc., vol. 20, No. 3, March 1941, p. 108.
[21] Murata, K. J., Volcanic Ash as a Source of Silica for the Silicification of Wood: Am. Jour. Sci., vol. 236, No. 8, August 1940, pp. 586–596.

French pumice deposits were described in 1940.[22] Italian tests of pumice used for lightweight concrete were reported.[23] Experiments to determine physical and chemical properties of the volcanic ash near the village of Gorenki, Voronezh Oblast, U. S. S. R., indicated suitability of the material for portland, lime-porcelain, or acid-resisting cements.[24] A projected revival of pumice production in the Canary Islands, financed by Spanish capital, has been reported. A profitable export trade with the British Isles and continental ports was carried on many years ago.[25]

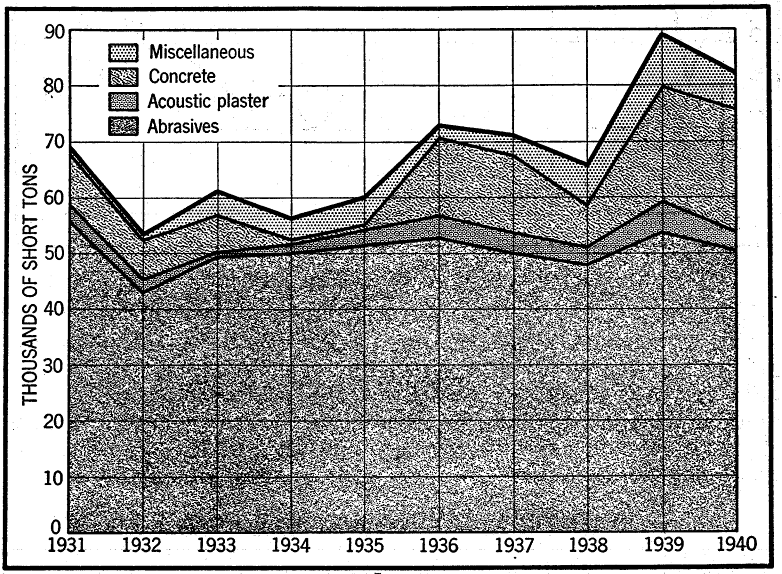

FIGURE 2.—Trend, by uses, of pumice and pumicite sold or used by producers in the United States, 1931–40.

Garnet.—Sales of garnet in 1940 increased to 4,716 short tons, or slightly under the 1937 level and 16 percent higher than in 1939 (see fig. 3). The total sales value in 1940, however, decreased 7 percent compared with 1939. In 1940 garnet was produced for sale in New York, North Carolina, Vermont, and Idaho. A small screening and classifying plant was built in Benewah County, Idaho, by Garnet Mines, Inc., Paulson Building, Spokane, Wash., and put in operation during 1940.[26] As in 1939, no imports of garnet were reported.

Abrasive garnet sold or used by producers in the United States, 1936–40

Year	Short tons	Value	Year	Short tons	Value
1936	3,820	$315,913	1939	4,056	$278,534
1937	4,863	382,535	1940	4,716	259,345
1938	2,669	191,658			

[22] Génie civil, Le Gisement du pierre ponce de Rochefort-Montagne (Puy-de-Dôme): Vol. 116, June 1, 1940, p. 364.
[23] Perfetti, A., (Pumice for Light Concrete Construction): Riv. tec. ferrovie ital., vol. 54, 1938, pp. 217–232; Chem. Zentralb., 1939, pt. I, p. 1827 (*see* Chem. Abs., vol. 32, No. 13, July 10, 1938, p. 5178); Chem. Abs., vol. 34, No. 21, November 10, 1940, p. 7565.
[24] Industriya, June 10, 1940; reported in Bureau of Foreign and Domestic Commerce Russian Econ. Notes, vol. 2 (N. S.), No. 15, August 15, 1940, pp. 11–12.
[25] Winfield H. Scott (United States consul, Teneriffe), February 12, 1940; reported in Bureau of Mines Mineral Trade Notes: Vol. 10, No. 5, May 20, 1940, p. 21.
[26] Idaho Inspector of Mines, Annual Report of the Mining Industry of Idaho for 1940: Bureau of Mines and Geology, p. 97.

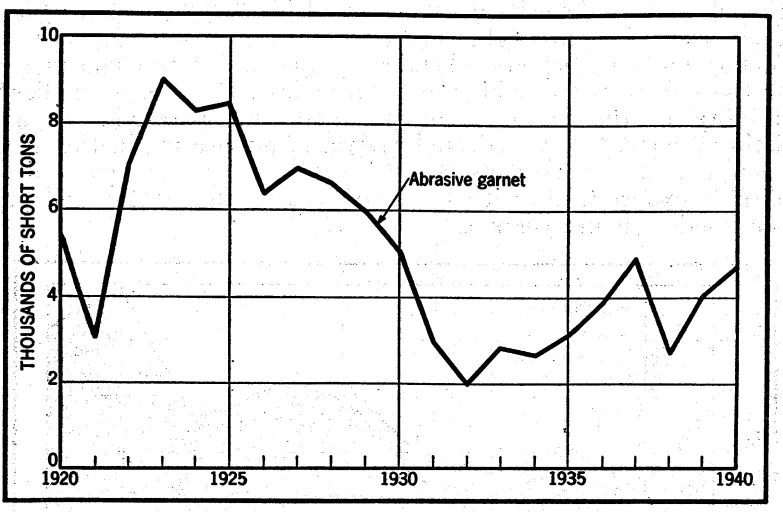

FIGURE 3.—Marketed production of abrasive garnet in the United States, 1920–40.

In certain localities in the State of Mysore, India, garnets occur in crystalline schists and to a small extent in some river sands in sufficient quantities (it is alleged) to justify commercial exploitation.[27] Levin [28] discussed the properties of South African garnets, comparing them with foreign garnets as to size, color, appearance, fracture, inclusions, and impurities. Results of the magnetic treatment of the South African product also were given.

NATURAL ALUMINA ABRASIVES

Corundum.—Corundum has not been mined in the United States in recent years. Imports of corundum ore in 1940, however, increased sharply to 5,718 short tons valued at $73,935—more than two and one-half times that imported in 1939. Most of the corundum and emery is imported crude and is crushed and graded in this country for domestic consumption. Corundum is reported to be widely distributed in the State of Mysore, India.[29] Varieties range in color from deep red to pink and light gray. No sustained effort has yet been made to market a clean concentrate.

Emery.—Sales of emery in 1940 rose to 1,046 short tons valued at $9,349—37 percent greater in both tonnage and value than in 1939, and practically equaling the quantity sold in 1933—when sales were higher than in any recent year—although much smaller in total value. As in recent years, production of emery was reported only from the Peekskill district, Westchester County, N. Y. Shipments in 1940 were reported by three producers—DiRubbo & Ellis, Joe DeLuca, and the Howard Emery Corporation, all of Peekskill.

Figure 4 shows trends in sales of domestic emery and imports of emery and corundum from 1924 through 1940.

[27] Curtis C. Jordan (United States consul, Madras), November 15, 1940, reported in Bureau of Mines Mineral Trade Notes: Vol. 12, No. 2, February 20, 1941, p. 18.
[28] Levin, J., Garnets in South Africa: Minerals Research Lab. South Africa Bull. 3 (year not given), pp. 35–37; Jour. Am. Ceram. Soc., Ceram. Abs., vol. 19, No. 9, September 1940, p. 207.
[29] Curtis C. Jordan (United States consul, Madras), November 15, 1940, reported in Bureau of Mines Mineral Trade Notes; Vol. 12, No. 2, February 20, 1941, p. 20.

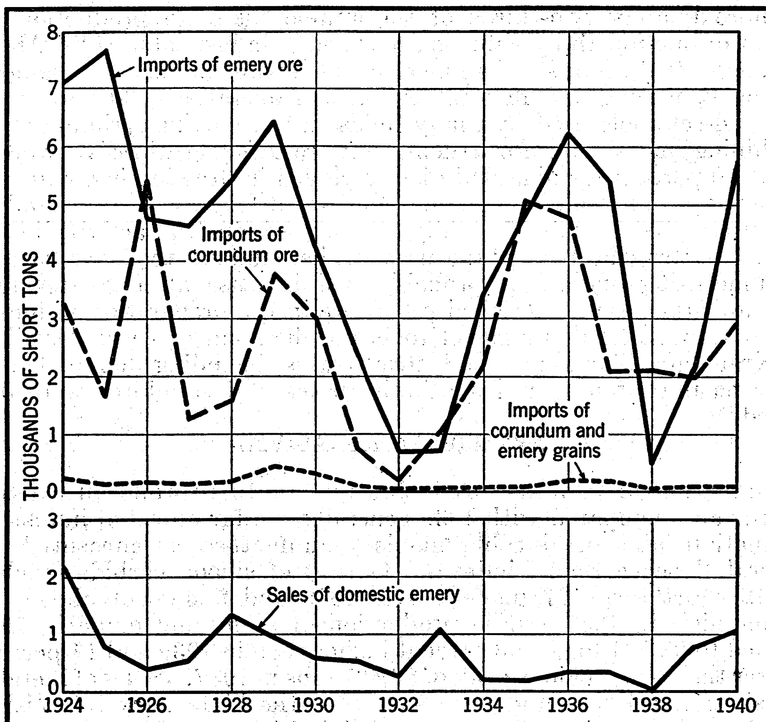

FIGURE 4.—Comparison of sales of domestic emery with imports of emery and corundum into the United States, 1924–40.

Emery sold or used by producers in the United States, 1936–40

Year	Short tons	Value	Year	Short tons	Value
1936	325	$2,900	1939	765	$6,828
1937	320	2,780	1940	1,046	9,349
1938	------------	------------			

NATURAL CARBON ABRASIVES

Abrasive or industrial diamonds.—The demand for abrasive or industrial diamonds in the United States is met through the importation of black diamonds or carbonados (largely from Brazil) and bort (chiefly from the Union of South Africa). Some diamond dust also is imported. However, both the value of diamond dust and the quantity of bort entering this country in recent years have tended to decline. On the other hand, imports of "Glaziers' and engravers', unset, and miners' " diamonds (a classification that comprises largely if not entirely diamonds for industrial use) have shown an upward trend and an almost phenomenal growth within the last year or two. In 1940 imports under this heading increased to 3,809,071 carats valued at $11,026,563—240,341 carats and $1,300,880 more than in 1939. The average value rose to $2.89 a carat in 1940 compared with $2.73 in 1939, $3.02 in 1938, and $3.47 in 1937.

Approximately two-thirds of the annual diamond production by weight or one-fourth by value is consumed in industrial uses.[30] About 45 percent of the industrial application, on a value basis, is for diamond drilling in mining and mineral-exploration operations, 30 percent in diamond-set tools used by many industries in cutting, grinding, and machining metal and for trueing and resurfacing abrasive wheels, about 10 percent for diamond dies employed in drawing fine wire and filaments of uniform diameter, and 15 percent for miscellaneous industrial uses. As a result of rapidly expanding industrial activity in the United States, the percentage used in diamond-set tools for various manufacturing operations probably will increase at a greater rate than for other uses. Detailed procedure in the preparation of industrial diamonds for diamond-set tools and diamond dies was described by Kraus and Slawson.[31] Industrial jewels, including diamonds and other natural stones, and synthetic rubies and sapphires were discussed.[32]

ARTIFICIAL ABRASIVES

Production of manufactured abrasives in 1940 broke all existing records and compared with 1939 generally ran far ahead of industrial production and of durable goods manufacture as measured by Federal Reserve Board indexes. Output of silicon carbide reached 33,042 short tons—37 percent over 1939 and 9 percent above the former high in 1937—while production of aluminum oxide in 1940 jumped to 98,531 tons—95 percent higher than in 1939 and 14 percent greater than the previous peak of 86,401 tons in 1937. Sales of metallic abrasives (steel shot and grit) surpassed the high mark established in 1939 and rose to the new record of 50,016 tons.

Crude artificial abrasives sold, shipped, or used, from manufacturing plants in the United States and Canada, 1936–40 [1]

Year	Silicon carbide [2]		Aluminum oxide [2]		Metallic abrasives		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1936	29,342	$2,139,919	69,825	$3,913,155	24,667	$1,221,912	123,834	$7,274,986
1937	[3] 30,365	[3] 2,215,318	[3] 86,401	[3] 4,749,497	28,031	1,399,772	144,797	8,364,587
1938	[3] 25,346	[3] 1,904,925	[3] 53,220	[3] 3,098,132	25,771	1,234,977	104,337	6,238,034
1939	[3] 24,206	[3] 1,713,207	[3] 50,468	[3] 3,047,337	42,015	1,743,859	116,689	6,504,403
1940	[3] 33,042	[3] 2,359,876	[3] 98,531	[3] 5,464,986	50,016	2,317,829	181,589	10,142,691

[1] Bureau of Mines not at liberty to publish data for United States separately.
[2] Includes also material used for refractories and other nonabrasive uses.
[3] Production.

The production of silicon carbide and aluminum oxide is concentrated chiefly in the Niagara Falls region of the United States and Canada, with some output of aluminum oxide from Alabama. The manufacture of steel shot and grit is centered largely in northern Ohio and Pittsburgh, Pa., with some output from Michigan and New Hampshire.

Since 1937 producers of silicon carbide and aluminum oxide have been requested to indicate the approximate percentages of their

[30] Ball, Sydney H., The Diamond Industry in 1939: Jewelers Circ.—Keystone, vol. 110, No. 11, August 1940, pp. 1–16.
[31] Kraus, Edward H., and Slawson, Chester B., Cutting of Diamonds for Industrial Purposes: Am. Mineral., vol. 26, 1941, pp. 153–160.
[32] Rocks and Minerals, United States Well Supplied with Industrial Jewels; March 1941, p. 91.

products consumed for refractory or other nonabrasive uses. Estimates based upon these percentages show an increase to 32 percent in the nonabrasive uses of silicon carbide compared with 29 percent in 1939, 26 percent in 1938, and 29 percent in 1937. The relative importance of the nonabrasive uses of aluminum oxides, however, dropped to 2 percent of the total output compared with 4 percent in each of the 3 preceeding years for which comparisons are available.

An excellent summary of the history and development of artificial abrasives from Dr. Acheson's discovery of carborundum or silicon carbide in 1891 to the present appeared at the beginning of 1941.[33] Natural abrasives only were used until 1891. Gem cutters employed diamond dust for cutting, forming, and polishing precious stones. Sandstone "wheels" were the principal means of sharpening tools until about the middle of the nineteenth century, when the natural abrasives emery and corundum were bonded into wheels. Because of their flexibility and the exact control of desired characteristics possible with their use, the manufactured abrasives aluminum oxide and silicon carbide soon were widely adopted by industry and have contributed largely to modern large-scale operations, especially in accurate precision grinding. Cut-off operations using aluminum oxide and silicon carbide bonded into wheels were described by Wiese.[34] General recommendations for types of cutting wheel, bond, and grain for cutting various kinds of materials are presented. Aluminum oxide wheels are utilized most commonly for cutting off metal, and in different grain sizes are employed for almost everything from aluminum to tungsten. The cutting of cast iron, copper tubing, and pure copper slabs is effected best with silicon carbide, which also is used for hard rubber, for plastics, and for nicking porcelain. For cutting very hard materials, such as cemented carbides, diamond grains bonded into thin wheels are employed.

Nöganäs-Billesholm, manufacturer of abrasive and refractory materials, has achieved a virtual monopoly of the Swedish abrasives industry through acquisition of all the shares of Svenska Naxos and of a majority interest in Slipmateriel at Västervik.[35] For many years Nöganäs-Billesholm has been manufacturing silicon carbide for use in special-type firebrick and for abrasives and also makes aluminum from bauxite or if necessary from a special type of clay found in Skåne. The combined value of output of the two recently acquired firms approximated 6,000,000 crowns, and together they supplied about 25 percent of the Swedish demand for abrasives.

MISCELLANEOUS ABRASIVE MATERIALS

In addition to the manufactured and natural abrasives material discussed above, many other mineral substances have abrasive uses. Various oxides, including tin oxide, rouge and crocus, chromium oxide, magnesium oxide, and manganese oxide, are utilized as polishing agents. Finely ground as well as calcined clays, high-grade lime, talc, river silt, whiting, feldspar, and other substances also are used for abrasive purposes.

[33] Manufacturers Record: Fifty Years of Manufactured Abrasives. Vol. 110, No. 3, March 1941, pp. 20–21, 60.

[34] Wiese, R. R., Cutting With Abrasives: Am. Machinist, vol. 85, No. 4, February 19, 1941, pp. 97–100.

[35] Alfsen, F. A. M. (United States assistant trade commissioner, Stockholm, Sweden), June 12, 1940; reported in Bureau of Mines Mineral Trade Notes: vol. 11, No. 2, August 20, 1940, p. 11.

FOREIGN TRADE [36]

Imports of "Glaziers' and engravers', unset, and miners'" diamonds in 1940 rose above 1939 by a substantial margin, contributing largely to the 12-percent increase in value of imports of all classes of abrasive materials. Imports of tripoli and rottenstone remained at a low level, while imports of crude or unmanufactured pumice dropped 44 percent. Receipts of both emery ore and corundum ore, however, increased sharply.

Abrasive materials imported for consumption in the United States, 1938–40, by kinds

Kind	1938		1939		1940	
	Quantity	Value	Quantity	Value	Quantity	Value
Millstones and burrstones:						
Rough or unmanufactured short tons	11	$894	(1)	$52		
Bound up into millstones do	15	1,318	31	1,678	40	$2,167
Grindstones, finished or unfinished do	657	22,431	838	26,059	634	18,275
Hones, oilstones, and whetstones do	101	44,142	68	48,261	37	42,482
Emery:						
Ore do	477	7,796	2,191	29,318	5,718	73,935
Grains, ground, pulverized, or refined pounds	(2)	(2)	(2)	(2)	(2)	(2)
Paper and cloth of emery or corundum	(3)	67,062	(3)	72,966	(3)	91,112
Wheels, files, and other manufactures of emery or corundum or garnet pounds	6,503	3,221	10,604	5,043	4,348	2,473
Corundum (see also "Emery"):						
Ore short tons	2,098	138,629	1,964	104,724	2,922	165,270
Grains, ground, pulverized, or refined pounds	[2] 65,608	[2] 6,155	[2] 129,237	[2] 9,793	[2] 134,606	[2] 9,262
Garnet in grains, or ground, pulverized, etc. pounds	3,696	193				
Tripoli and rottenstone short tons	498	9,826	218	2,769	227	3,767
Pumice:						
Crude or unmanufactured do	5,943	34,486	6,656	36,463	3,758	20,771
Manufactures of, or of which pumice is the component material of chief value	(4)	20,809	(4)	29,221	(4)	6,468
Diamond:						
Bort carats	1,151	19,187	1,381	34,618	785	19,660
Dust	(4)	63,105	(4)	4,278	(4)	2,515
Glaziers' and engravers', unset, and miners' carats	1,396,247	4,213,412	3,568,730	9,725,683	3,809,071	11,026,563
Flint, flints, and flint stones, unground short tons	8,169	74,338	11,987	116,019	2,840	32,397
		4,727,004		10,246,945		11,517,117

[1] Less than 1 ton.
[2] Emery included with corundum; not separately classified.
[3] 2,205 reams in 1938, 2,479 reams in 1939, 1,562 reams in 1940, weight not recorded.
[4] Quantity not recorded.

The value of all exports of natural abrasive materials in 1940 was 13 percent higher than in 1939. The value of exports of grindstones and of emery and corundum abrasive wheels rose to $215,156 and $179,514, respectively—the highest figures since 1930. The classification "All other natural abrasives, hones, whetstones, etc.," increased in 1940 to $1,211,291—the largest value reported for this item since 1921.

Value of domestic abrasive materials exported from the United States, 1936–40

Material	1936	1937	1938	1939	1940
Grindstones	$140,614	$193,112	$122,720	$173,575	$215,156
Abrasive wheels, emery and corundum	124,471	140,022	116,456	125,303	179,514
All other natural abrasives, whetstones, hones, etc.	277,463	826,955	835,894	1,116,711	1,211,291

[36] 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.

SULFUR AND PYRITES

By Robert H. Ridgway, Allan F. Matthews, and A. W. Mitchell [1]

SUMMARY OUTLINE

World production of sulfur advanced appreciably in 1940, chiefly as a result of increased shipments from mines in the United States to its own defense industries and to those of the British Empire. World markets are supplied largely by the United States and Italy; the fairly large Japanese output is consumed at home. How the war affected the Italian sulfur industry during 1940 is not known, but the prices guaranteed to producers in Italy by the official Italian Sulfur Board were raised 20 percent in the middle of 1940. The United Kingdom doubled its takings of American sulfur in 1940. The largest producers of pyrites in 1940 doubtless continued to be Spain, Japan, Norway, and Italy, but the war has prevented publication of specific data. Spanish pyrites, the source of most of our imports and the only foreign pyrites quoted in American trade journals, ceased to be quoted after January 1941, and deliveries from Spain to the United States slumped heavily during the first quarter of 1941.

In the United States during 1940 shipments of sulfur reached an all-time record, and production fell just short of equaling the 1937 peak. Most of the sulfur shipped in 1940 was used at home in making sulfuric acid, for which there was increased demand in defense industries, but 21 percent was exported, mainly to the British Empire. The price of sulfur remained steady throughout 1940, and early in 1941 one of the largest American sulfur producers informed the Advisory Commission to the Council of National Defense that there would be "no increase in the base price of its product with respect to an amount of sulfur sufficient to meet demands of customers for 1 year at the current rate of sales." [2]

The position of the American sulfur industry in the present national defense effort as compared with that during the World War of 1914–18 is one of plenty instead of want. In 1914 less than 3 percent of the domestic sulfuric acid production came from native sulfur, and 50

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.
[2] Steel, vol. 108, No. 2, January 13, 1941, p. 96.

percent of it was derived from imported Spanish pyrites. An acute shortage of sulfuric acid had developed by the summer of 1915, but the building of new plants and the stepping up of imports relieved the situation somewhat. After the unrestricted submarine campaign was begun in January 1917, however, it became difficult to obtain Spanish pyrites, and the problem of sulfur and pyrites supplies became increasingly grave. By Presidential proclamation in March 1918 sulfur, pyrites, and sulfuric acid were placed under a license system, and in July 1918 the War Industries Board assumed complete control of both production and allocation of sulfur and pyrites. Construction was commenced on a plant in Texas for large-scale production of sulfur, but 4 months later the Armistice was signed.

Salient statistics of the sulfur industry in the United States, 1925–29 (average) and 1937–40

	1925–29 (average)	1937	1938	1939	1940
Sulfur:					
Production of crude sulfur..long tons..	1,951,034	2,741,970	2,393,408	2,090,979	2,732,088
Shipments of crude sulfur:					
For domestic consumption..do....	1,397,411	1,791,215	1,049,740	1,605,998	1,812,274
For export..do....	707,175	675,297	579,107	627,819	746,468
Total shipments..do....	2,104,586	2,466,512	1,628,847	2,233,817	2,558,742
Imports:					
Ore..do....	1,896	398	51	35	(1)
Other..do....	295	230	2,552	13,941	27,845
Exports of treated sulfur..do....	11,956	13,533	12,707	25,005	19,745
Producers' stocks at end of year..do....	2,413,000	3,400,000	4,200,000	4,000,000	4,200,000
Price of crude sulfur f. o. b. mines, per long ton..	$17.50	$18	$16–$18	$16	$16
Pyrites:					
Production..long tons..	273,936	584,166	555,629	516,408	617,513
Imports..do....	372,958	524,430	334,234	482,336	407,004
Price of imported pyrites c. i. f. Atlantic ports...cents per long-ton unit.	12–13	12–13	12–13	12–13	12–13
Sulfuric acid: Production of byproduct sulfuric acid (60° B.) at copper and zinc plants..short tons..	1,118,453	833,994	687,176	778,441	(2)

1 Less than 1 ton.
2 Figures not yet available.

Since 1918 large sulfur deposits have been discovered in Texas and Louisiana, and the growth of American industry has created a demand for increasing tonnages of sulfur that has been ample to sustain large-scale production facilities both of sulfur and its principal product, sulfuric acid. Known reserves of unmined sulfur in the United States were expanded in 1940, and stocks of sulfur above ground at the mines on December 31, 1940, totaled 4,200,000 long tons—enough to last 1⅔ years, even at the increased current rate of consumption. Production of pyrites in the United States in1940 established a new record. New sulfuric acid plant capacity totaling more than 200 tons a day of contact acid (100-percent basis) went into operation in 1940, and new capacity planned for 1941 amounts to some 900 tons a day.[3] Sulfuric acid is important as a war material because it is a fundamental heavy chemical in the manufacture of fertilizers, refining of petroleum, preparation of other chemicals, pickling of steel, pro-

3 Chemical and Metallurgical Engineering, Mineral Acids and Sulfur: Vol. 48, No. 2, February 1941, pp. 90–92.

cessing of textiles, and—more directly strategic—the making of explosives. From the standpoint of munitions more can now be accomplished with fewer pounds of sulfur than during the earlier World War, according to Duecker.[4] At that time every 1,000 pounds of either smokeless powder or TNT made took 800 pounds of sulfur; but today 200 pounds of sulfur will produce 1,000 pounds of smokeless powder and 30 to 40 pounds of sulfur will yield 1,000 pounds of TNT.

An important publication issued in 1940 described the effects of sulfur dioxide fumes on vegetation.[5] It is the result of a 10-year research program by Canadian experts with the cooperation of United States Government specialists.

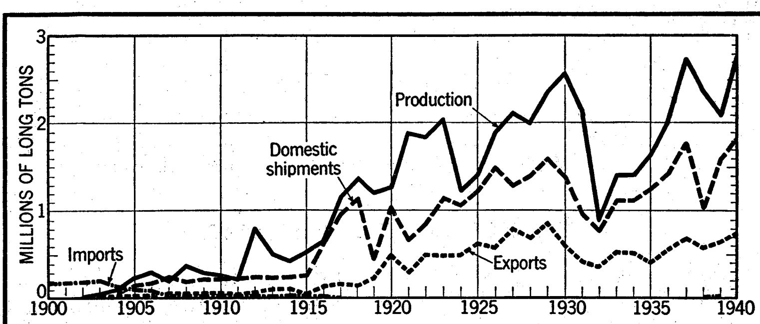

FIGURE 1.—Domestic production, domestic shipments, exports, and imports of crude sulfur, 1900–1940.

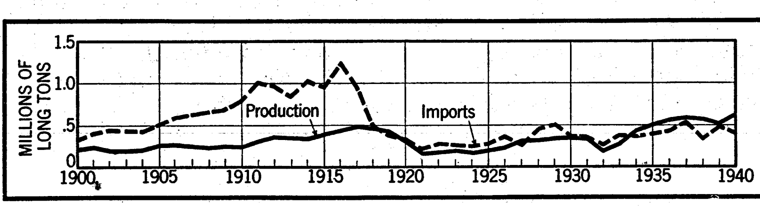

FIGURE 2.—Domestic production and imports of pyrites, 1900–1940.

SULFUR

Domestic production.—Production of crude sulfur in the United States in 1940 increased 31 percent over 1939, came within one-half percent of the 1937 peak, and was the second largest on record. Shipments from the mines in 1940 exceeded those of 1939 by 15 percent and those of 1937 (the previous high) by 4 percent to establish a new all-time record.

Sulfur produced and shipped in the United States, 1936–40

Year	Produced (long tons)	Shipped		Year	Produced (long tons)	Shipped	
		Long tons	Approximate value			Long tons	Approximate value
1936	2,016,338	1,968,820	$35,400,000	1939	2,090,979	2,233,817	$35,500,000
1937	2,741,970	2,466,512	44,300,000	1940	2,732,088	2,558,742	40,900,000
1938	2,393,408	1,628,847	27,300,000				

[4] Duecker, W. W., Sulfur and National Defense: Chem. and Met. Eng., vol. 48, No. 3, March 1941, pp. 70–74.
[5] National Research Council of Canada, Effect of Sulfur Dioxide on Vegetation: Report 815, 1940, 447 pp.

Of the domestic output of sulfur reported for 1940, 81 percent came from Texas, nearly 19 percent from Louisiana, and less than 1 percent from California and Utah. The production of these last two States totaled 6,314 long tons in 1940 compared with 2,979 tons in 1939. The Bureau of Mines is not at liberty to publish figures for California and Utah separately. Active mines in 1940 are listed in the following table.

Mines that produced sulfur in the United States in 1940

Operating company	Name of mine	Location of mine
California:		
Big Pine Sulphur Co.	Crater Group	Bigpine, Inyo County.
Pacific Sulphur Co.	do	Do.
Louisiana: Freeport Sulphur Co.	Grande Ecaille	Port Sulphur, Plaquemines Parish.
Texas:		
Duval Texas Sulphur Co.	Boling Dome	Boling, Wharton County.
Do	Orchard Dome	Orchard, Fort Bend County.
Freeport Sulphur Co.	Hoskins Mound	Freeport, Brazoria County.
Jefferson Lake Sulphur Co., Inc.	Clemens Dome	Brazoria, Brazoria County.
Texas Gulf Sulphur Co.	Boling Dome	Newgulf, Wharton County.
Utah: Utah Sulphur Industries	Utah Sulphur Industries	Beaver, Beaver County.

THE INDUSTRY IN 1940 BY STATES

California.—Big Pine Sulfur Co. and Pacific Sulfur Co. reported production in 1940 from the Crater group of claims at Bigpine, Inyo County. The literature dealing with California sulfur deposits has been abstracted by the Works Projects Administration under the supervision of the California State Division of Mines.[6]

Louisiana.—Production of sulfur in Louisiana in 1940 totaled 512,935 long tons and was made by the Freeport Sulphur Co. from its operations at Grande Ecaille, Plaquemines Parish. The Jefferson Lake Sulphur Co., Inc., Brazoria, Tex., explored by drilling the Bay St. Elaine Dome, Terrebonne Parish, La., but the results of the work have not yet been ascertained.

Texas.—Texas supplied 81 percent of the domestic sulfur output in 1940. Five operations contributed to the total, but by far the largest output came from the Boling Dome property of the Texas Gulf Sulphur Co. at Newgulf, Wharton County. The following table, compiled from information issued by the Texas State Comptroller's Office, shows the quarterly production of sulfur in Texas for 1940.

Sulfur produced in Texas in 1940, by companies, in long tons

Company	First quarter	Second quarter	Third quarter	Fourth quarter	Total
Texas Gulf Sulphur Co.	334,113	340,224	375,299	378,571	1,428,207
Freeport Sulphur Co.	93,645	88,840	81,420	83,595	347,500
Jefferson Lake Sulphur Co., Inc.	58,102	50,809	59,044	51,714	219,669
Duval Texas Sulphur Co.	60,698	45,284	57,657	53,819	217,458
	546,558	525,157	573,420	567,699	2,212,834

The Freeport Sulphur Co. continued operations at Hoskins Mound, Freeport, Brazoria County; the Jefferson Lake Sulphur Co., Inc., at Clemens Dome, Brazoria, Brazoria County; and the Duval Texas

[6] California State Division of Mines, Sulfur: Mineral Abstracts, 1940, 22 pp.

Sulphur Co. at Boling Dome, Boling, Wharton County, and at Orchard Dome, Orchard, Fort Bend County.

Utah.—Sulfur production in Utah in 1940 came from the Utah Sulphur Industries plant at Beaver, Beaver County.

Recovery as byproduct.—The treatment of copper and zinc ores yields large quantities of sulfur, which is recovered at the mills as pyrites concentrate or at the smelters as sulfuric acid. The production of pyrites concentrate is discussed in the pyrites section of this report. In smelting copper and zinc concentrates sulfur is driven off as sulfur dioxide gas, which in some cases is reduced to elemental sulfur[7] but which at many smelters is used in the manufacture of sulfuric acid. The equivalent of about 162,000 long tons of sulfur was recovered as sulfuric acid annually from this source during the 5 years ended in 1939. Such sulfur is not included in the sulfur-production figures for the United States, but the following table shows the output of byproduct acid at both copper- and zinc-smelting plants. The acid reported is only that made from the sulfur content of sulfide ores but does include, for 1935 to 1938, inclusive, the relatively small amount of acid made from pyrites concentrate in Wisconsin.

Byproduct sulfuric acid (expressed as 60° B.) produced at copper and zinc plants in the United States, 1935–39, in short tons [1]

	1935	1936	1937	1938	1939
Copper plants	160,151	226,738	[2] 291,638	[2] 220,297	[2] 249,569
Zinc plants	443,476	505,882	542,356	466,879	528,872
	603,627	732,620	[2] 833,994	[2] 687,176	[2] 778,441

[1] Figures for 1940 not yet available.
[2] Includes a small amount of sulfuric acid produced as a byproduct in the roasting of high-sulfide gold and silver concentrates.

Byproduct sulfur is also recovered from coke-oven gas, water gas, refinery-still gas, natural gas, and other fuel gases. The removal of hydrogen sulfide from manufactured gases has long been accomplished by passing the gas through trays of iron hydroxide to form iron sulfide, known as spent oxide. This material has been used as a source of sulfur in Europe but not to any appreciable extent in the United States. During the last decade, however, the recovery of sulfur from fuel gases has been expanding in this country as a result of developments in various liquid-purification processes. Not all such processes are designed to permit recovery of sulfur as a byproduct, but those that do may be divided into two classes—those that recover elemental sulfur and those that give hydrogen sulfide as an end product. The latter has received increasing attention in recent years. Typically, processes that recover elemental sulfur operate on manufactured fuel gases, while those that recover hydrogen sulfide are applied to refinery still gas and natural gas, and usually these gases are under high pressure. Investigation has indicated, however, that the phenolate processes, at least, are adapted to the removal and recovery of sulfur from low-pressure, low-sulfur gases,[8] such as coke-oven gas.

[7] Howatt, D. W., Removal and Recovery of Sulfur from Smelter Gases: Chem. Age, vol. 43, Nos. 1118–1120, November 30, 1940, pp. 249–251, 255; December 7, 1940, pp. 259–261; December 14, 1940, pp. 273–275.
[8] Powell, Alfred R., Recovery of Sulfur from Fuel Gases: Ind. Eng. Chem., vol. 31, No. 7, July 1939, p. 795.

Most of the elemental sulfur recovered from gas purification results from operations using the Thylox process; only relatively minor amounts are recovered from Ferrox-process or Nickel-process operations. Production in 1940 (reduced to 100 percent sulfur) totaled 3,942 long tons, of which 3,528 tons valued at $143,769 were shipped. Output came from Illinois, Maryland, Missouri, New Jersey, New York, Washington, West Virginia, and Wisconsin, with New York the largest producer. The sulfur is produced and marketed either as a paste containing 39 to 57 percent sulfur or as dried, relatively pure sulfur. The fine particle size of the sulfur makes it valuable as a fungicide and insecticide for agricultural purposes, which absorb most of the shipments; some has been exported for such use. Of the 1940 shipments (reduced to 100 percent sulfur), 45 percent was in the form of paste and the remainder dried sulfur.

Most of the hydrogen sulfide recovered as a byproduct from fuel gases is either converted to sulfuric acid or burned as fuel. Recovery is by the phenolate, phosphate, and Girbotol processes. In 1940 the output of hydrogen sulfide extracted from fuel gases and, for the most part, converted to sulfuric acid was equivalent to 15,918 long tons of sulfur. Most of this was recovered by petroleum refineries in California and the remainder by companies in Indiana, New Jersey, Pennsylvania, and Texas.

The figures on byproduct yield of sulfur from gas purification are not included in the sulfur-production figures for the United States.

Stocks.—As production exceeded shipments in 1940, stocks at the mines increased during the year and on December 31 amounted to 4,200,000 long tons.

Price.—Sulfur is not quoted on any commodity exchange, and the sellers issue no list prices; however, the average quoted contract price for sulfur as reported by trade journals was unchanged at $16 a long ton f. o. b. mines throughout 1940.

Consumption.—The apparent domestic consumption of sulfur in 1940 increased 14 percent over 1939 and 2 percent over the previous peak in 1937 to attain a new record.

Apparent consumption of sulfur in the United States, 1936–40, in long tons

	1936	1937	1938	1939	1940
Shipments	1,968,820	2,466,512	1,628,847	2,233,817	2,558,742
Imports	729	628	2,603	13,976	27,845
	1,969,549	2,467,140	1,631,450	2,247,793	2,586,587
Exports:					
Crude	547,199	675,297	579,107	627,819	746,468
Refined	19,708	13,533	12,707	25,005	19,745
	566,907	688,830	591,814	652,824	766,213
Apparent consumption	1,402,642	1,778,310	1,039,636	1,594,969	1,820,374

The consumption of sulfur in various industries from 1936 through 1940 has been estimated by Chemical and Metallurgical Engineering as follows:

Sulfur consumed in the United States, 1936–40, by uses, in long tons [1]

Use	1936	1937	1938	1939	1940
Chemicals	620,000	777,000	484,000	695,000	800,000
Fertilizer and insecticides	266,000	415,000	220,000	370,000	410,000
Pulp and paper	260,000	302,000	174,000	240,000	320,000
Explosives	53,000	68,000	50,000	64,000	74,000
Dyes and coal-tar products	46,000	49,000	40,000	46,000	51,000
Rubber	39,000	37,000	29,000	43,000	47,000
Paint and varnish	54,000	64,000	50,000	49,000	54,000
Food products	4,500	6,000	5,500	6,000	6,000
Miscellaneous	78,000	82,000	47,500	82,000	86,000
	1,420,500	1,800,000	1,100,000	1,595,000	1,848,000

[1] Figures for 1937 and 1938 are not truly representative of consumption but rather of shipments to these specified industries. In 1938 consumers carried over large stocks from 1937, so that actual consumption in 1937 was less than the figures indicate and consumption in 1938 was larger than the above total.

Most of the sulfur and virtually all of the pyrites are consumed as sulfuric acid—one of the most fundamental of heavy chemicals. Consumption of sulfuric acid in 1940 increased 14 percent over 1939. The largest consumer—the fertilizer industry—used 15 percent more sulfuric acid in 1940 on account of increased demand for superphosphate. Second in importance as an outlet for sulfuric acid, petroleum refineries needed 5 percent more in 1940 than in 1939. Use of the alkylation process, which employs sulfuric acid as a catalyst, may reverse the long-time trend toward reduction of requirements in the refining industry. On the other hand, the hydrogen sulfide recovered in the refining process is being converted to sulfuric acid. The iron and steel industry—the third largest consumer—used 22 percent more sulfuric acid in 1940 than in 1939; practically all of this acid was used for pickling purposes.

Chemical and Metallurgical Engineering has estimated the consumption of sulfuric acid, by industries, from 1936 through 1940 as follows:

Sulfuric acid (expressed as 50° B.) consumed in the United States, 1936–40, by industries, in short tons

Industry	1936	1937	1938	1939	1940
Fertilizer	1,987,000	2,230,000	1,900,000	1,970,000	2,260,000
Petroleum refining	1,100,000	1,100,000	1,100,000	1,210,000	1,270,000
Chemicals	955,000	1,020,000	800,000	975,000	1,090,000
Coal products	770,000	865,000	585,000	740,000	900,000
Iron and steel	770,000	1,100,000	590,000	980,000	1,200,000
Other metallurgical	560,000	625,000	350,000	570,000	640,000
Paints and pigments	450,000	525,000	430,000	520,000	570,000
Explosives	222,000	180,000	140,000	160,000	175,000
Rayon and cellulose film	330,000	380,000	320,000	405,000	470,000
Textiles	108,000	112,000	90,000	116,000	125,000
Miscellaneous	380,000	450,000	355,000	384,000	450,000
	7,632,000	8,587,000	6,660,000	8,030,000	9,150,000

Sulfur is being sintered with soda ash at Mathieson Alkali Works, Lake Charles, La., to produce a synthetic salt cake used in the manufacture of pulp for kraft paper. Although not an emergency measure, appearance of the product has helped to stabilize the price of salt cake in the face of interrupted imports from Germany. Research work on the use of sulfur as an insecticide and fungicide is being sponsored by the Texas Gulf Sulphur Co., Inc., at Boyce Thompson Institute, Yonkers, N. Y.

FOREIGN TRADE

Exports of crude sulfur in 1940 were 19 percent above those in 1939 and the largest since 1929. Exports of treated sulfur, minor in comparison, dropped 21 percent in 1940 to previous levels from a 1939 high induced by large purchases in Greece. About 85 percent of the crude sulfur exported in 1940 went to the British Empire, and the United Kingdom doubled its take to supplant Canada as this country's principal sulfur market. Treated sulfur exported from the United States in 1940 went chiefly to British India, Canada, Brazil, Turkey, and the United Kingdom. Greece, which took more treated sulfur than any other country in 1939, was not a purchaser in 1940.

Sulfur exported from the United States, 1939–40, by countries

Country	Crude				Crushed, ground, refined, sublimed, and flowers of			
	1939		1940		1939		1940	
	Long tons	Value	Long tons	Value	Pounds	Value	Pounds	Value
North America:								
Canada	142,437	$2,315,336	197,746	$3,523,229	6,686,536	$144,304	5,983,432	$129,434
Central America	108	3,328	128	3,987	284,818	6,594	444,994	10,948
Mexico	7,053	140,354	5,959	116,178	1,879,576	36,683	2,034,873	40,215
Newfoundland and Labrador	4,983	79,728	5,230	91,526	3,000	122	4,000	124
West Indies	9,163	170,718	11,011	196,357	254,411	7,691	298,793	9,621
	163,744	2,709,464	220,074	3,931,277	9,108,341	195,394	8,766,092	190,342
South America:								
Argentina	29,051	513,310	5,222	122,597	367,373	13,182	439,704	17,948
Brazil	10,882	193,382	6,374	112,823	2,738,603	48,359	5,334,804	98,738
Colombia	-------	---------	7	260	803,125	17,306	509,683	10,706
Other South America	-------	---------	3,721	68,986	936,824	18,117	696,902	14,809
	39,933	706,692	15,324	304,666	4,845,925	96,964	6,981,093	142,201
Europe:								
Belgium	7,057	131,630	7,660	137,880	126,069	1,840	66,588	1,313
Denmark	-------	---------	-------	---------	1,066,998	13,775	345,936	4,595
France	39,811	699,326	29,498	522,952	591,918	8,220	---------	-------
Germany	8,702	148,409	-------	---------	157,722	2,079	---------	-------
Greece	-------	---------	-------	---------	18,739,160	252,516	---------	-------
Netherlands	12,515	232,283	-------	---------	972,605	12,867	203,144	2,753
Sweden	13,097	230,803	3,650	62,050	1,223,140	15,495	275,872	3,832
United Kingdom	112,810	1,745,164	245,469	4,057,618	5,001,073	75,099	3,986,698	68,905
Other Europe	11,678	192,558	4,900	86,300	1,364,243	19,186	117,827	2,482
	205,670	3,380,173	291,177	4,866,800	29,242,928	401,077	4,996,065	83,880
Asia	33,217	666,391	45,156	860,595	7,987,532	118,798	19,140,425	274,211
Africa:								
Algeria	5,500	98,999	-------	---------	---------	-------	---------	-------
Mozambique	-------	---------	150	3,532	1,019,840	18,877	146,012	2,245
Union of South Africa	19,911	358,415	29,460	531,225	1,822,980	33,823	2,580,447	54,003
Other Africa	750	18,069	1,585	33,112	559,949	7,951	699,442	9,866
	26,161	475,483	31,195	567,869	3,402,769	60,651	3,425,901	66,114
Oceania:								
Australia	109,341	1,952,859	78,766	1,356,091	1,142,501	29,501	708,208	19,046
New Zealand	49,753	880,689	64,776	1,154,613	282,039	7,589	210,530	5,138
Other Oceania	-------	---------	-------	---------	---------	-------	800	36
	159,094	2,833,548	143,542	2,510,704	1,424,540	37,090	919,538	24,220
	627,819	10,771,751	746,468	13,041,911	56,012,035	909,974	44,229,114	780,968

Sulfur imported into and exported from the United States, 1936–40

Year	Imports				Exports			
	Ore		In any form, n. e. s.		Crude		Crushed, ground, refined, sublimed, and flowers of	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
1936	530	$10,141	199	$27,437	547,199	$10,147,038	19,708	$746,985
1937	398	4,724	230	38,171	675,297	12,155,253	13,533	509,133
1938	51	562	2,552	71,903	579,107	10,378,991	12,707	469,773
1939	35	445	13,941	250,422	627,819	10,771,751	25,005	909,974
1940	(1)	5	27,845	473,052	746,468	13,041,911	19,745	780,968

[1] Less than 1 ton.

Imports of sulfur into the United States in 1940 totaled 27,845 long tons. They were mostly byproduct sulfur from the Trail smelter in Canada and were used in the pulp mills of the Northwestern States.

WORLD PRODUCTION

World production of sulfur in 1940, including elemental sulfur recovered in the treatment of pyrites and as a byproduct from the treatment of industrial gases, is estimated at 3,500,000 long tons. The following table shows the output of native sulfur for the world from 1936 through 1940.

World production of native sulfur, 1936–40, by countries, in long tons [1]

[Compiled by L. P. Lounsbery]

Country	1936	1937	1938	1939	1940
Bolivia (exports)	935	1,712	1,632	2,126	4,065
Chile	[2] 25,525	[2] 16,766	20,959	26,999	(3)
Ecuador	59	54	68	72	(3)
France (content of ore)	123	157	140	(3)	(3)
Greece	150	67	75	(3)	(3)
Guatemala	16	11	15	12	11
Italy (crude) [4]	322,396	338,101	374,339	(3)	(3)
Japan [5]	172,545	(3)	(3)	(3)	(3)
Mexico	[6] 1,272	(3)	49	(3)	(3)
Netherlands Indies	11,311	12,474	15,986	17,293	(3)
Palestine	79	494	1,196	829	(3)
Peru	1,696	1,551	1,944	569	616
Taiwan	1,207	(3)	(3)	(3)	(3)
Turkey	3,139	2,229	3,684	2,560	(3)
United States	2,016,338	2,741,970	2,393,408	2,090,979	2,732,088

[1] Sulfur is also believed to be produced in Argentina, China, Spain, and the U. S. S. R., but the quantity is unknown.
[2] In addition, the following quantities of sulfur rock are reported: 1936, 11,612 tons (40–80 percent sulfur); 1937, 1,050 tons.
[3] Data not available.
[4] In addition, the following quantities of sulfur rock are reported: 1936, 20,743 tons; 1937, 19,793 tons; 1938, 16,545 tons. Similar data are not available for 1939 and 1940.
[5] In addition, the following quantity of sulfur rock is reported: 1936, 31,576 tons. Similar data are not available for 1937–40.
[6] Crude sulfur product.

Canada.—Elemental sulfur is being produced in the treatment of base-metal smelter gases at Trail, British Columbia, by the Consolidated Mining & Smelting Co., Ltd. The plant has a reported daily capacity of 150 tons of sulfur. The company states that the proportion of sulfur dioxide recovered from flue gases was increased to 70 percent in 1939 compared with 62 percent in 1938 and 53 percent in 1937. In 1940, 27,774 long tons of this byproduct sulfur were exported to the United States by Canada. In Quebec the Aldermac Copper Corporation, Ltd., has been building a plant to produce 50 to 100 tons of elemental sulfur daily from pyrites concentrates, but construction has been suspended because of the favorable market in the United States for pyrites concentrates.

The Trail smelter and a plant at Copper Cliff, Ontario, operated by the International Nickel Co. of Canada, produce sulfuric acid from waste gases. The former has a capacity of 600 tons of sulfuric acid a day and the latter 150 tons a day. In 1939 Canada recovered 86,437 long tons of sulfur as elemental sulfur or in sulfuric acid manufactured from smelter gases.

Chile.—Chile is the principal sulfur producer in South America. Production data for 1940 are not yet available, but exports were 27,643 long tons in 1940 compared with 7,495 tons in 1939. The increased demand for Chilean sulfur came principally from Argentina, which on May 27, 1940, discontinued importing sulfur from the United States.

Germany.—Germany does not produce native sulfur; but the output of byproduct sulfur from coking plants, low-temperature carbonization plants, and coal-hydrogenation plants now supplies a large proportion of the domestic demand.

Italy.—Italy, including Sicily, is the world's second largest producer of sulfur, and the output is subsidized with minimum prices to mine operators guaranteed by the Government through its Italian Sulfur Board (Ente Zolfi Italiani or ENZI). The guaranteed minimum prices announced on May 31, 1940, for various grades of Italian sulfur were as follows:

Gialla superiore (guaranteed 99.5 percent sulfur), 420 lire a metric ton.
Gialla inferiore (guaranteed 99.25 percent sulfur), 410 lire a metric ton.
Buona (guaranteed 98 percent sulfur), 398 lire a metric ton.
Corrente (guaranteed 97 percent sulfur), 383 lire a metric ton.

These prices represent an increase of 70 lire a metric ton for the first three grades and 65 lire a ton for the Corrente grade compared with the prices announced in 1939.

Japan.—Recent data on the output and exports of sulfur in Japan—the third largest producer—are not available. The industry in Japan suffered a great set-back in 1940 from a disaster that wrecked the important Matsuo mine in the Province of Rikuchu. On the other hand, a new sulfur deposit discovered at the Seishin River in Hokkaido is expected to yield 3,000,000 tons of sulfur out of a probable content of 6,000,000 tons. Initial production from the new deposit is expected to be 3,000 to 4,000 tons a month.[9]

Mexico.—Production of sulfur in Mexico has been negligible in recent years. Late in 1940, however, the British-owned Colima & Ransburg Syndicate, incorporated in California, began development of a sulfur deposit near Cuidad Guzman at the borders of the western States of Colima and Jalisco. An initial daily output of about 300 tons, soon to be doubled, is expected. The company will establish a refining plant at San Pedro, Calif., and ship its sulfur to Vancouver, Canada.

[9] Chemical and Metallurgical Engineering, vol. 47, No. 12, December 1940, p. 863.

Norway.—Production of sulfur in Norway results from the treatment of cupriferous pyrites at the Thamshavn plant of the Orkla Metal Co. Output in 1939 was reported [10] to be about 108,263 long tons.

Portugal.—Elemental sulfur is produced from the San Domingos mine in Portugal. Production during 1940 was 9,917 long tons compared with 11,221 in 1939. Imports of sulfur in 1940 were 4,012 long tons compared with 3,157 in 1939.

Spain.—The output of native sulfur in Spain is supplemented by elemental sulfur obtained in the treatment of pyrites. Figures for recent years are not available.

Sweden.—Elemental sulfur recovered as a byproduct from smelter gases by the Boliden Co. at Ronskar in northern Sweden is the only sulfur produced in Sweden. The output at this plant in 1938 was 17,512 long tons.

PYRITES

Domestic production.—Production of pyrites (ores and concentrates) in the United States in 1940 exceeded that of 1939 by 20 percent and reached a new record. Of the 1940 total 92 percent was fines and the remainder lump, the bulk of the former being flotation concentrates.

Pyrites (ores and concentrates) produced in the United States, 1936–40

Year	Quantity		Value	Year	Quantity		Value
	Gross weight (long tons)	Sulfur content (percent)			Gross weight (long tons)	Sulfur content (percent)	
1936	547,236	39.6	$1,666,194	1939	516,408	42.2	$1,550,449
1937	584,166	39.7	1,777,787	1940	617,513	41.7	1,892,000
1938	555,629	39.4	1,685,766				

In 1940, 422,092 long tons were consumed by the producing companies and 196,015 tons were sold compared with 323,027 tons and 188,712 tons, respectively, in 1939. Prices of domestic pyrites are not quoted on any commodity exchange, but the trade journals listed Spanish pyrites, c. i. f. Atlantic ports, bulk, at 12–13 cents per long-ton unit of sulfur throughout 1940. This quotation has remained unchanged for a decade but ceased to be given after January 1941.

Tennessee continued in 1940 as the principal producer of pyrites. Other producing States were California, Colorado, Illinois, Indiana, Missouri, Montana, New York, Virginia, and Wisconsin. There was no output from Kansas during 1940.

THE INDUSTRY IN 1940 BY STATES

California.—The Mountain Copper Co. was the only producer of pyrites in California in 1940; output came from the Hornet mine in Shasta County.

Colorado.—The output of pyrites in Colorado in 1940 totaled 14,473 long tons and was produced by Minnesota Mines, Inc., Clear

[10] Mining Journal (London), Norway in 1939: Vol. 208, No. 5455, March 9, 1940, p. 147.

Creek County, and by P. E. Hamm and John Andrew from a mill-tailings dump in Lake County.

Illinois.—From its coal-cleaning operations at the Atkinson mine in Henry County the Midland Electric Coal Corporation produced and shipped 13,021 long tons of pyrites (coal brasses) containing 46 percent sulfur in 1940.

Indiana.—The Snow Hill Coal Corporation produced and shipped 2,734 long tons of pyrites (coal brasses) containing 40–45 percent sulfur from its Talleydale mine in Vigo County in 1940.

Missouri.—The pyrites production of Missouri totaled 29,325 long tons in 1940 and came principally from the Moselle mine in Phelps County, operated by R. E. Carney. Other output came from the Libhart mine, Franklin County, operated by Roy C. Libhart, and the Cherry Valley mine, Crawford County, operated by H. H. Lark.

Montana.—The pyrites produced in Montana in 1940 came from the Anaconda Copper Mining Co. at Anaconda, where it is recovered as a flotation concentrate in copper-plant operation.

New York.—In 1940 New York produced 64,498 long tons of pyrites containing 49.45 percent sulfur.

Tennessee.—The pyrites output in Tennessee during 1940 came from the Tennessee Copper Co., Ducktown Basin, Polk County. It is produced as a flotation concentrate but does not enter the market, as all of it is used by the company in the manufacture of acid.

Virginia.—The only pyrites mined in Virginia in recent years has been by the General Chemical Co. from the Gossan mine at Cliffview, Carroll County. The entire output is concentrated by air tables for the manufacture of sulfuric acid in the company plant at Pulaski.

Wisconsin.—The one company reporting production of pyrites in Wisconsin in 1940 was the Vinegar Hill Zinc Co., which recovers pyrites by flotation from ores produced from several mines in the Platteville district, Grant County.

FOREIGN TRADE

Imports of pyrites in 1940 dropped 16 percent compared with 1939, although they were still 22 percent more than in 1938. Spain, the principal source, increased shipments in 1940, but this was more than counteracted by decreased imports from Canada.

Pyrites, containing more than 25 percent sulfur, imported into the United States, 1936–40, by countries

Country	1936		1937		1938		1939		1940	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Belgium	5,290	$29,756								
Canada	55,105	200,184	20,558	$74,946	30,064	$135,659	176,804	$470,336	81,157	$560,476
Greece							22,800	106,271		
Mexico			549	1,473	202	522			203	719
Portugal	59,804	286,974	21,725	109,395						
Spain	309,114	913,820	481,598	1,158,671	303,968	709,983	282,732	738,439	325,644	790,172
	429,313	1,430,734	524,430	1,344,485	334,234	846,164	482,336	1,315,046	407,004	1,351,367

More than half of the pyrites imports in 1940 moved into Philadelphia. Shipments to Baltimore dropped heavily, but this was partly made up by increased amounts to Buffalo, New York City, and Philadelphia.

Pyrites, containing more than 25 percent sulfur, imported into the United States, 1936–40, by customs districts, in long tons

Customs district	1936	1937	1938	1939	1940
Buffalo	140	584	5,130	21,940	80,076
Georgia	2,500	4,795			
Maryland	172,290	220,430	113,838	176,982	19,702
New York	60,041	64,621	55,830	46,170	82,292
Ohio				2,000	
Philadelphia	158,088	194,680	130,703	189,727	215,373
San Diego		549	202		203
South Carolina	9,429	9,519	5,265	4,396	
Vermont	17,449	19,974	15,713	31,433	937
Virginia	9,376	9,278	7,553	8,885	8,331
Washington				803	90
	429,313	524,430	334,234	482,336	407,004

WORLD PRODUCTION

Recent figures on the pyrites output of the various countries are not obtainable, but annual world production has been running close to 10,000,000 metric tons of pyrites containing about 4,300,000 metric tons of sulfur.

World production of pyrites (including cupreous pyrites), 1938–40, by countries, in metric tons

[Compiled by L. P. Lounsbery]

Country [1]	1938		1939		1940	
	Gross weight	Sulfur content	Gross weight	Sulfur content	Gross weight	Sulfur content
Algeria	44,150	19,430	(2)	(2)	(2)	(2)
Australia (Tasmania)	51,084	(2)	55,099	(2)	(2)	(2)
Canada	40,464	20,300	206,507	103,826	(2)	(2)
Cyprus (exports)	523,574	256,551	403,935	(2)	(2)	(2)
Finland	102,979	44,281	(2)	(2)	(2)	(2)
France	147,208	65,655	(2)	(2)	(2)	(2)
Germany	465,267	200,064	(2)	(2)	(2)	(2)
Greece	244,000	118,605	217,200	98,826	(2)	(2)
Italy	930,312	386,079	(2)	(2)	(2)	(2)
Norway	1,027,776	446,939	(2)	(2)	(2)	(2)
Poland	92,209	36,883	(2)	(2)	(2)	(2)
Portugal	558,327	251,247	(2)	(2)	(2)	(2)
Rumania	11,205	7,061	5,869	(2)	(2)	(2)
Southern Rhodesia	27,065	10,900	27,386	(2)	(2)	(2)
Sweden	186,390	84,345	191,737	87,342	(2)	(2)
Union of South Africa	31,017	13,947	29,825	13,389	36,701	16,248
United Kingdom	4,351	(2)	(2)	(2)	(2)	(2)
United States	564,547	222,612	524,696	221,559	627,424	261,647
Uruguay	70	(2)	(2)	(2)	(2)	(2)
Yugoslavia	150,402	67,681	127,991	57,596	(2)	(2)

[1] In addition to countries listed Belgium, China, Chosen, Czechoslovakia, Japan, Spain, and the U. S. S. R. produced pyrites, but production data are not available.
[2] Data not available.

Australia.—The principal output of pyrites is as a byproduct to the flotation treatment of copper ore at the Mount Lyell mines, Tasmania. In 1940 the Lake George lead-zinc mine at Captains Flat, New South Wales, began producing daily about 60 tons of pyrites carrying 60 percent sulfur. The Commonwealth Government has placed a bounty on pyrites and byproduct sulfur recovered from waste gases.

Canada.—Byproduct to the treatment of copper ores, about 500 tons of pyrites concentrate are produced daily at the Aldermac mine and about 100 tons daily at the Noranda mine, both in Quebec. The Britannia copper mine in British Columbia is also a large producer of pyrites. Canada exported 81,157 long tons of pyrites to the United States in 1940 and 176,804 tons in 1939.

Germany.—There was a reported intensification of pyrites mining in Germany and Poland in 1940 as a result of difficulties of obtaining adequate supplies from abroad.

Greece.—Early in 1940 Greece was reported to have sold 50,000 tons of pyrites to Italy and to be in hopes of making additional shipments to that country later in the year.[11] Greek exports of pyrites in 1939 totaled about 182,000 metric tons and went primarily to Netherlands, France, and Germany.

Italy.—Three pyrites mines at Gavorano in the Tuscan Moaremma are now said to be producing 600,000 tons annually. An additional 300,000 tons comes from mines in the Trentino, Agordo, and Aosta Valleys.

Japan.—Japan is one of the leading producers of pyrites, but data on production have not been available since 1936. Japanese production of pyrites in 1940 was stimulated by a disaster that wrecked the Matsuo sulfur mine. Pyrites recovered from treatment of copper ores is said to yield about 200,000 tons of sulfuric acid a year. Japan is believed to be self-sufficient in pyrites supplies.

Norway.—Norway is the third largest producer of pyrites, but the state of the industry since German occupation in April 1940 is uncertain. The major deposits occur at Orklatal and Roros south of Trondhjem, at Sulitjelma on the southern shore of Narvik Fjord, and in the vicinity of Bergen, at all of which localities fighting was reported to have taken place in the spring of 1940.

Portugal.—The largest source of pyrites in Portugal is the San Domingo property at Mertola in the province of Alemtejo; it supplies one-fourth of the Portuguese output. Of the 432,895 metric tons of pyrites exported in 1939, about three-fourths went to France and the remainder to Belgium and Great Britain.

Spain.—Spain is normally the principal world producer of pyrites, but since official production figures have not been released in recent years it is not known how war conditions have affected the industry. Unofficial data indicate that exports dropped in 1939. The Rio Tinto mines in the Province of Huelva yield most of the output.

Sweden.—Most of the Swedish pyrites production comes from one of the Boliden mines in northern Sweden.

United Kingdom.—In 1940 orders were issued making all kinds of pyrites and sulfur subject to licensing restrictions.

Yugoslavia.—Two-thirds of the Yugoslav pyrites production comes from the Stantrg, Vojetin, and Dobrevo mines in Serbia; these formerly were operated by Trepca Mines, Ltd., but have been in German hands since April 1941.

[11] Metal Bulletin (London), No. 2472, March 12, 1940, p. 15.

PHOSPHATE ROCK

By Bertrand L. Johnson and K. G. Warner

SUMMARY OUTLINE

Domestic demand for phosphate rock in 1940 jumped 16 percent over that in 1939, an increase of 442,597 long tons, and far more than counterbalanced the 21-percent decrease—a little less than 200,000 tons—in exports, which declined to 751,495 tons. Total shipments of phosphate rock from American mines in 1940 were 4,002,700 long tons (see fig. 1) valued at $12,334,662, an increase over 1939 of nearly a quarter of a million tons (7 percent) but about 100,000 tons less than the 1920 record peak. Mine output likewise passed the 4-million-ton mark, exceeding 1939 but considerably below the 4,261,416-ton peak of 1937. Imports of phosphate rock were restricted to 2,953 long tons from Curaçao. No apatite was imported during the year. By a Presidential proclamation of March 4, 1941, effective March 24, 1941, phosphate rock was placed under export-license control.

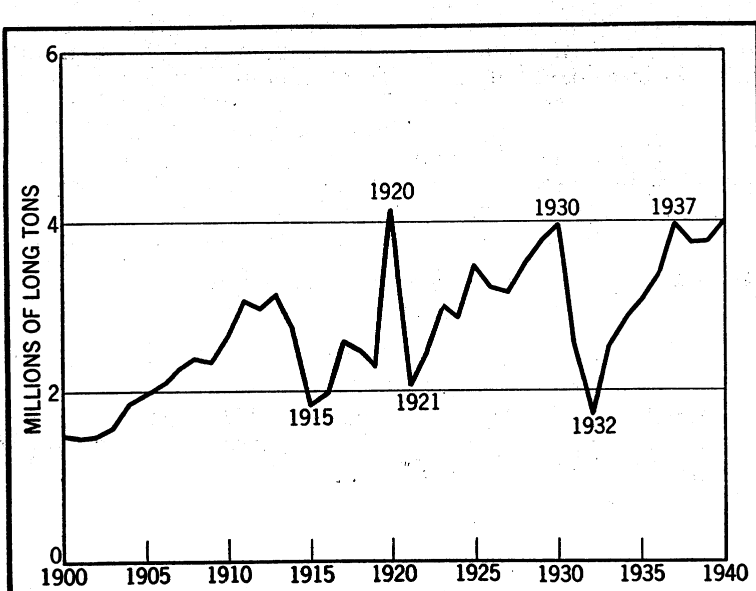

Figure 1.—Marketed production of United States phosphate rock, 1900–1940.

Salient statistics of the phosphate-rock industry in the United States, 1939–40

	1939			1940		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
Production (mined)	3,987,970	(1)	(1)	4,068,077	(1)	(1)
Sold or used by producers:						
Florida:						
Land pebble [2]	2,547,782	$7,353,567	$2.89	2,780,800	$7,538,316	$2.71
Soft rock	41,906	128,435	3.06	41,845	102,508	2.45
Hard rock	89,096	411,455	4.62	22,367	100,353	4.49
Total, Florida	2,678,784	7,893,457	2.95	2,845,012	7,741,177	2.72
Tennessee [2] [3]	938,448	3,856,505	4.11	994,361	3,967,043	3.99
Idaho	95,451	431,938	4.53	99,088	441,598	4.46
Montana	44,384	112,142	2.53	64,239	184,844	2.88
Virginia	(3)	(3)	(3)	(3)	(3)	(3)
Total, United States	3,757,067	12,294,042	3.27	4,002,700	12,334,662	3.08
Imports	3,500	[4] 23,625	[4] 6.75	2,953	[4] 19,536	[4] 6.62
Exports [5]	949,006	[6] 5,233,104	[6] 5.51	751,495	[6] 3,845,495	[6] 5.12
Apparent consumption [7]	2,811,561			3,254,158		
Stocks in producers' hands, Dec. 31:						
Florida	1,504,000	(1)	(1)	1,420,000	(1)	(1)
Tennessee [3] [8]	247,000	(1)	(1)	268,000	(1)	(1)
Other	2,000	(1)	(1)	3,000	(1)	(1)
Total stocks	1,753,000	(1)	(1)	1,691,000	(1)	(1)

[1] Figures not available.
[2] Includes sintered matrix.
[3] Virginia included with Tennessee.
[4] Market value (or price) at port and time of exportation to the United States.
[5] Excludes sintered matrix.
[6] Value at port of exportation.
[7] Quantity sold or used by producers plus imports minus exports.
[8] Includes brown-rock matrix of sinter grade and sintered brown rock.

Production.—Phosphate rock was mined in Florida, Tennessee. Idaho, and Montana, and apatite was recovered from titanium-bearing ores in central Virginia. Total mine production of 4,068,077 long tons in 1940 was a little greater than in 1939, but this increase did not raise production to the 4,261,416-ton record attained in 1937. Production in Florida fell slightly, but the decrease was more than overcome by increases in both Tennessee and the Western States, where the mined production reached all-time highs. In 1939 and in 1940 the mine production in Tennessee exceeded a million tons.

Phosphate rock mined in the United States, 1931–40, by States, in long tons

Year	Florida	Tennessee	Western States	United States	Year	Florida	Tennessee	Western States	United States
1931	2,155,903	393,925	116,681	2,666,509	1936	2,645,819	[1] 737,866	79,152	3,462,837
1932	1,500,891	[1] 152,533	44,724	1,698,148	1937	3,179,588	[1] 942,158	139,670	4,261,416
1933	2,039,531	[1] 296,441	23,663	2,359,635	1938	2,722,927	[2] 999,551	137,998	3,860,476
1934	2,464,969	[1] 394,311	38,958	2,898,238	1939	2,791,360	[1] 1,057,570	139,040	3,987,970
1935	2,598,337	[1] 493,501	67,490	3,159,328	1940	2,782,956	[1] 1,120,551	164,570	4,068,077

[1] Includes small quantity of apatite from Virginia.
[2] Includes small quantity of apatite from Virginia and phosphate rock from South Carolina.

Sales.—The quantity of phosphate rock sold or used by producers in 1940 was nearly a quarter of a million tons (7 percent) more than in 1939 but was about 100,000 tons less than the 1920 record. The total value of the shipments was only slightly larger than in 1939, and the average value a ton dropped from $3.27 in 1939 to $3.08 in 1940, a slump not evident in the published price quotations. The average value of total sales as well as of land pebble has trended downward slightly in recent years. (See fig. 2.)

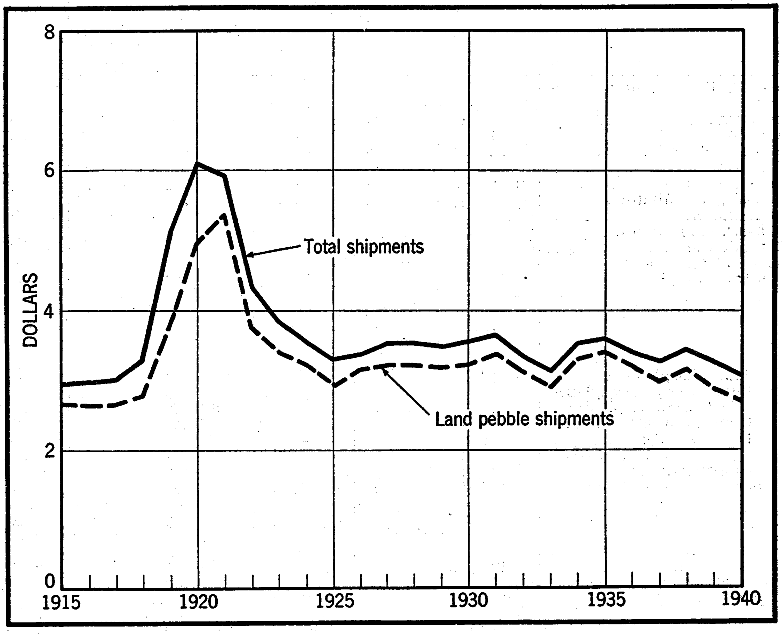

FIGURE 2.—Average values f. o. b. mine shipping point a long ton of total phosphate rock and land pebble phosphate rock shipped, 1915–40. (From reports of producers.)

Phosphate rock sold or used by producers in the United States, 1936–40

Year	Long tons	Value at mines		Year	Long tons	Value at mines	
		Total	Average			Total	Average
1936	3,351,857	$11,406,132	$3.40	1939	3,757,067	$12,294,042	$3.27
1937	3,956,189	12,975,268	3.28	1940	4,002,700	12,334,662	3.08
1938	3,739,238	12,952,143	3.46				

Distribution of sales.—Shipments of domestic phosphate rock have in the recent past fallen into two distinct groups according to grade—one below 60 percent B. P. L. (bone phosphate of lime) and the other containing 68 percent B. P. L. and higher grades. An intermediate group, which rose to 55,359 tons in 1940, appears to be developing, with grades between 60 and 66 percent B. P. L. Ninety percent of the phosphate rock shipped in 1940 was of 68 percent or higher grades. Nearly 60 percent of the total sales are of grades containing 72 to 75 percent B. P. L., inclusive. In 1940, 64 percent of the domestic phosphate rock sold or used by producers went into the manufacture of superphosphates compared with 58 percent in 1939, while the percentage exported decreased from 25 in 1939 to 19 in 1940. Relative percentages of quantities used for other purposes were unchanged in 1940 from 1939.

Phosphate rock sold or used by producers in the United States, 1939–40, by grades, uses, and classes of consumers

	1939			1940		
	Quantity		Value	Quantity		Value
	Long tons	Percent of total		Long tons	Percent of total	
Grades—B. P. L.[1] content (percent):						
Below 60	395,709	11	(2)	347,696	9	(2)
60 to 66	18,818	1	(2)	55,359	1	(2)
68 basis, 66 minimum	356,512	9	(2)	357,983	9	(2)
70 minimum	383,483	10	(2)	339,744	9	(2)
72 minimum	1,227,806	33	(2)	1,390,284	35	(2)
75 basis, 74 minimum 75 minimum	769,360	20	(2)	936,309	23	(2)
77 basis, 76 minimum 77 minimum	328,784	9	(2)	328,628	8	(2)
Above 85 (apatite)	(3)	(3)	(2)	(3)	(3)	(2)
Undistributed [4]	276,595	7	(2)	246,697	6	(2)
	3,757,067	100	$12,294,042	4,002,700	100	$12,334,662
Uses:						
Domestic:						
Superphosphates	2,192,779	58	(2)	2,564,844	64	(2)
Phosphates, phosphoric acid, ferrophosphorus	479,020	13	(2)	532,980	13	(2)
Direct application to soil	95,667	3	(2)	106,292	3	(2)
Fertilizer filler	30,994	1	(2)	32,804	1	(2)
Stock and poultry feed	1,794	(5)	(2)	1,311	(5)	(2)
Undistributed [6]	10,423	(5)	(2)	6,747	(5)	(2)
Exports [7]	946,390	25	3,747,608	757,722	19	2,995,59
	3,757,067	100	12,294,042	4,002,700	100	12,334,662
Classes of consumers:						
Affiliated companies	948,640	25	3,035,268	1,089,045	27	2,961,334
Other domestic consumers	1,862,037	50	5,511,166	2,155,933	54	6,377,737
Exports [7]	946,390	25	3,747,608	757,722	19	2,995,591
	3,757,067	100	12,294,042	4,002,700	100	12,334,662

[1] Bone phosphate of lime.
[2] Figures not available.
[3] Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.
[4] Includes grades of B. P. L. content between 68 and 70; 69/66; 71; 73; 73.8; 74.8; 76; 76.55; 78/76; 78; and above 85 percent; also ground phosphate rock and dust, B. P. L. content not known.
[5] Less than 0.5 percent.
[6] Includes some calcined phosphate and phosphatic material used in pig-iron blast furnaces, in concrete aggregates, and in the manufacture of concentrated fertilizers.
[7] As reported to the Bureau of Mines by producers (exclusive of exports by dealers, etc.).

The preceding table, showing the distribution of phosphate rock sold or used by producers, by grades, uses, and classes of consumers, is compiled from reports to the Bureau of Mines by the domestic producing companies. In the past 10 years gradually increasing quantities of phosphate rock have entered into superphosphates, chemicals, and "all other" uses, as shown in the accompanying diagram. (See fig. 3.)

Consumption.—The apparent domestic consumption of phosphate rock in 1940 was 3,254,158 long tons, the greatest ever recorded, exceeding the previous maximum of 3,034,333 tons in 1920 by 219,825 tons. The main factor in this increase was the greatly augmented quantity of Florida land pebble going into the manufacture of domestic superphosphates.

Prices.—Trade-journal quotations for various grades of domestic phosphate rock were unchanged during 1940 from the latter part of 1939. Florida land pebble, 68 percent B. P. L., continued at $1.90 a ton; 70-percent grade at $2.15; 72-percent grade, $2.40; and the

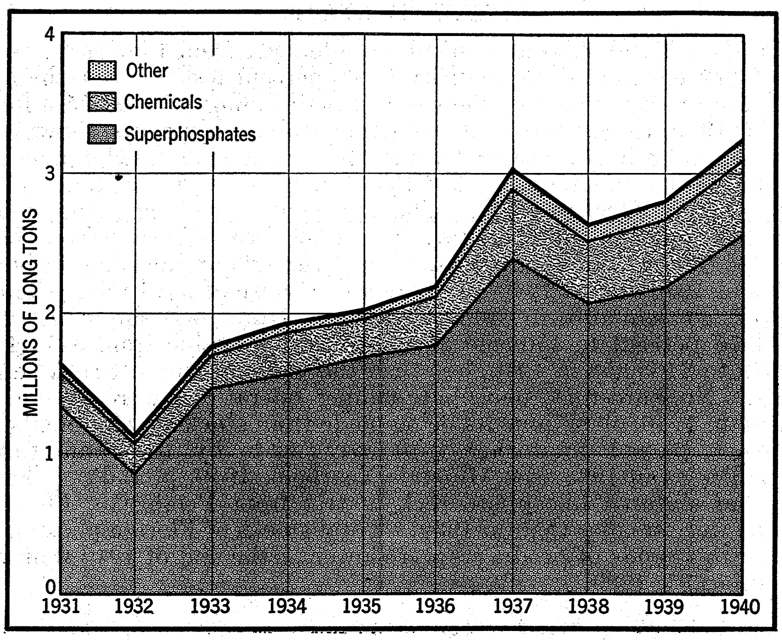

FIGURE 3.—Phosphate rock sold or used by producers in the United States, 1931–40, by uses.

75-percent grade at $2.90. The Florida high-grade hard-rock quotation remained at $4.35 throughout the year, and the Tennessee quotations for the 72-percent grade stayed at $4.50 and for the 75-percent grade at $5.50.

On February 10, 1941, the special Federal grand jury, which has been engaged at Winston-Salem, N. C., for nearly a year in an investigation of the fertilizer industry, returned an indictment of 102 defendants, comprising 2 associations (the National Fertilizer Association and the Superphosphate Association), 64 fertilizer manufacturing and distributing corporations, and 36 officials of the associations and corporations, on two counts, charging combination and conspiracy (1) to fix prices and (2) to restrict competition.

Brief reports covering the activities during 1939 and 1940 of the Joint Congressional Committee to Investigate the Adequacy and Use of the Phosphate Resources of the United States, pursuant to Public Resolution 112, have been published.[1]

General reports published in 1940 covering the phosphate-rock industry include papers by Barr, Jacob, and Johnson.[2]

Scientific papers published include one by Mansfield [3] on the part played by fluorine in the deposition of phosphate rock and a description by McConnell[4] of a carbonate-apatite from Magnet Cove, Ark.

[1] Joint Congressional Committee to Investigate the Adequacy and Use of the Phosphate Resources of the United States, Report Transmitted Pursuant to Public Res. 112, 75th Cong., and Senate Joint Res. 182, 76th Cong.: 76th Cong., 3d sess., House Report 1514, Washington, 1940, 3 pp. Report Transmitted Pursuant to Public Res. 112, 75th Cong. (as Extended by Public Res. 68, 76th Cong., and Senate Joint Res. 199): 77th Cong. 1st sess., Union Calendar 3, House Report 3, Washington, 1941, 3 pp.

[2] Barr, J. A., Phosphates for 1940: Min. Cong. Jour., vol. 27, No. 2, February 1941, p. 51–52.
Jacob, K. D., Phosphate Rock [in 1939]: Mineral Ind., vol. 48, 1940, pp. 457–473.
Johnson, Bertrand L., Potash and Phosphate Rock: Min. Cong. Jour., vol. 26, No. 2, February 1940, pp. 40–41.

[3] Mansfield, G. R., The Role of Fluorine in Phosphate Deposition: Am. Jour. Sci., vol. 238, December 1940, pp. 863–879.

[4] McConnell, Duncan, The Problem of the Carbonate-Apatites. III, Carbonate-Apatite from Magnet Cove, Ark.: Am. Mineral., vol. 25, No. 3, March 1940, pp. 157–167.

REVIEW BY STATES

Florida.—Total shipments of phosphate rock from Florida in 1940 were 6 percent greater in quantity but 2 percent less in value than in 1939, the average value of the shipments declining from $2.95 a long ton in 1939 to $2.72 in 1940. Land-pebble shipments, however, increased in both quantity and value; the tonnage increased 9 percent, but the total value increased less than 3 percent. The average value dropped from $2.89 to $2.71. The land-pebble-producing companies were the same as those operating in 1939 (see Minerals Yearbook 1940, p. 1305). Shipments of soft rock were about the same in both 1939 and 1940 and in 1940 nearly doubled those of hard rock. They dropped considerably in value, however. Hard-rock shipments declined 75 percent in tonnage and decreased in value from $411,455 in 1939 to $100,353 in 1940, less than the value of the soft-rock shipments. No hard-rock phosphate-mining operations were active in Florida in 1940, all shipments being made from stocks. Shipments of hard-rock phosphate during 1940 were made by the same three companies as in 1939 (see Minerals Yearbook 1940, p. 1305). Shipments of sintered phosphate rock matrix from Pembroke, Fla., to Europe were smaller than in 1939. Total stocks of Florida phosphate rock in the hands of producers were lower at the end of 1940 than on December 31, 1939.

Florida phosphate rock sold or used by producers, 1936–40, by kinds

Year	Hard rock			Soft rock [1]		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1936	138,859	$579,202	$4.17	31,769	$103,352	$3.25
1937	64,151	342,202	5.33	60,256	200,271	3.32
1938	125,048	601,922	4.81	53,479	178,093	3.33
1939	89,096	411,455	4.62	41,906	128,435	3.06
1940	22,367	100,353	4.49	41,845	102,508	2.45

Year	Land pebble			Total		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1936	2,454,272	$7,845,969	$3.20	2,624,900	$8,528,523	$3.25
1937	[2] 2,872,413	[2] 8,600,512	2.99	[2] 2,996,820	[2] 9,142,985	3.05
1938	[2] 2,528,808	[2] 7,993,665	3.16	[2] 2,707,335	[2] 8,773,680	3.24
1939	[2] 2,547,782	[2] 7,353,567	2.89	[2] 2,678,784	[2] 7,893,457	2.95
1940	[2] 2,780,800	[2] 7,538,316	2.71	[2] 2,845,012	[2] 7,741,177	2.72

[1] Includes material from waste-pond operations.
[2] Includes sintered matrix.

Electrostatic separation has been applied to recleaning land-pebble phosphate-rock flotation concentrates in Florida. A full-size refining plant built by the American Agricultural Chemical Co. in conjunction with the Ritter Products Co. of Rochester, N. Y., adjacent to the drying plant of the former company at Pierce, Fla., for electrostatic refining of phosphate-rock flotation concentrates by the Johnson process, was put in operation in September 1938. The process and the operating results are described in a recent article by H. B. Johnson.[5]

Cash and Colbert [6] describe the pebble-phosphate mining district, its production, mining methods, safety organizations, and accident experience and give a digest of the Florida Workmen's Compensation Act.

Roundy's[7] detailed description of the results of the Federal Geological Survey investigations in both the hard-rock and land-pebble phosphate-rock fields in 1934 and 1935 was published early in 1941.

Four comprehensive illustrated articles describing in detail the mining, washing, flotation, and drying technique of the various companies in the Florida land-pebble phosphate-rock field, by A. H. Hubbell, associate editor of the Engineering and Mining Journal, were published in that journal during the latter part of 1940.[8] The mining, washing, and flotation operations of the Swift & Co. Fertilizer Works, 2 miles south of Fort Meade, Fla., in the land-pebble field are described by Bror Nordberg.[9]

A new fertilizer plant recently erected by the American Agricultural Chemical Co. near Pierce, Fla., began operations in February 1940 Sulfuric acid is made by burning sulfur in an adjacent acid plant, and phosphate rock is treated with this acid to produce ordinary superphosphate.

The International Agricultural Corporation enlarged its central dry-grinding plant by adding a large bowl mill as well as storage and loading facilities to meet an increasing demand for ground phosphate rock.

During 1940 a flotation plant was installed by the Phosphate Mining Co., operating in the land-pebble field, to recover fertilizer-grade phosphates from washer tailings and waste. This company is also constructing a plant to manufacture sulfuric acid by the contact process and produce phosphoric acid by the wet method, supplementing the output from its electric furnace. Triple superphosphate and other fertilizer phosphate chemicals will be produced.

Recent practice in the mining and preparation of Florida hard rock phosphate is described in a paper by Kibler.[10]

Tennessee.—The tonnage of phosphate rock sold or used by producers in Tennessee, plus a small quantity of apatite from Virginia—994,361 long tons in all—topped the previous all-time high of 1939 (938,448 long tons) by 6 percent and fell only a little short of 1 million tons. No blue or white phosphate rock was marketed in 1940. All of that shipped from Tennessee was brown-rock phosphate. Stocks of phosphate rock in the hands of Tennessee producers at the close of 1940, slightly larger than on December 31, 1939, were a little over a quarter of a million tons.

A comprehensive discussion of the Tennessee phosphate deposits, by R. W. Smith and Geo. I. Whitlatch,[11] was published in 1940. This

[5] Johnson, H. B., Electrostatic Separation Scores Advance in Phosphate Recovery: Eng. and Min. Jour., vol. 142, No. 3, March 1941, pp. 35–38.

[6] Cash, F. E., and Colbert, G. W., Accident Experience at Pebble-phosphate Operations in Florida, 1930–38: Bureau of Mines Inf. Circ. 7100, 1940, 13 pp.

[7] Roundy, P. V., Phosphate Investigation in Florida, 1934 and 1935: Geol. Survey Bull. 906, 1941, pp. 267–345.

[8] Hubbell, A. H., Phosphate. The Vital Nonmetallic: Eng. and Min. Jour., vol. 141, No. 9, September 1940, pp. 49–56; No. 10, October 1940, pp. 39–42; No. 11, November 1940, pp. 53–57; No. 12, December 1940, pp. 53–59.

[9] Nordberg, Bror, Screening Under Water for Phosphate Recovery: Rock Products, vol. 43, No. 5, May 1940, pp. 27–29, 40.

[10] Kibler, D. B., Jr., Mining and Preparation of Florida Hard-rock Phosphate: Am. Inst. Min. and Met. Eng. Tech. Pub. 1315, Mining Technol., March 1941, 9 pp.

[11] Smith, R. W., and Whitlatch, G. I., The Phosphate Resources of Tennessee: Tennessee Dept. Conservation, Div. Geol., Bull. 48, 1940, Nashville, Tenn., 444 pp.

report discusses the general geology of the phosphate region, the geologic occurrence and origin of the phosphate deposits, reserves, prospecting, evaluation, and the ownership of deposits; describes in detail the brown, blue, and white phosphate-rock districts and individual properties; and includes an extensive bibliography.

Tennessee phosphate rock sold or used by producers, 1936–40

[Includes apatite from Virginia]

Year	Long tons	Value at mines		Year	Long tons	Value at mines	
		Total	Average			Total	Average
1936 [1]	643,822	$2,598,279	$4.04	1939 [1] [2]	938,448	$3,856,505	$4.11
1937 [1] [2]	825,099	3,343,108	4.05	1940 [2]	994,361	3,967,043	3.99
1938 [2]	899,298	3,725,601	4.14				

[1] Separate figures for brown rock and blue rock cannot be given without disclosing confidential data regarding blue-rock production.
[2] Includes sintered matrix.

Six phosphate-rock mining companies produced 96 percent of the entire phosphate-rock production of Tennessee in 1940: The Armour Fertilizer Works, Charleston Mining Co., Federal Chemical Co., Hoover & Mason Phosphate Co., International Agricultural Corporation, and Monsanto Chemical Co.

The mining and treatment of brown-rock phosphate at the properties of the above companies (with the exception of the Federal Chemical Co.) are described in two recent articles by A. H. Hubbell.[12]

The Armour Fertilizer Works erected and began to operate a brown-rock-phosphate flotation plant at its Century property to treat the lower grades of washed phosphate rock. The Federal Chemical Co. and the Charleston Mining Co. completed the remodeling of their plants. The Hoover & Mason Co. began extensive alterations in the method of feeding phosphate rock to its washing plant. The Victor Chemical Works did no actual mining of phosphate rock but purchased all its requirements of Tennessee brown rock. In August 1940 it began to construct a fourth electric furnace at its Mount Pleasant plant. The International Agricultural Corporation installed a unit for producing defluorinated phosphate at its Wales (Tenn.) plant; the commodity is to be used in animal feeds to replace bone meal.

The Monsanto Chemical Co. added to its phosphate-rock holdings in Tennessee and early in January 1941 also put in operation a fourth electric furnace to produce elemental phosphorus from Tennessee brown rock. The operations of this company are described and illustrated in detail in a paper by W. E. Trauffer.[13]

According to its Annual Report,[14] the Tennessee Valley Authority produced about 80,000 tons of concentrated superphosphate and shipped 82,000 tons in the fiscal year ended June 30, 1940. More than 4,000 tons of calcium metaphosphate were produced and about 8,000 tons shipped. Limited quantities of fused phosphate rock, potassium metaphosphate, and potassium-calcium metaphosphate were produced for experimental tests. Raw rock for making elemental phosphorus was obtained both from the Florida land-pebble

[12] Hubbell, A. H., Phosphate. The Vital Nonmetallic: Eng. and Min. Jour., vol. 142, No. 1, January 1941, pp. 48–52; No. 3, March 1941, pp. 56–61.
[13] Trauffer, W. E., Processing Tennessee Phosphate Rock at Monsanto's Plant Near Columbia: Pit and Quarry, vol. 32, No. 11, May 1940, pp. 24–26, 28.
[14] Tennessee Valley Authority, Annual Report for the Fiscal Year Ended June 30, 1940: Washington, D. C., 1941, 414 pp.

and the Tennessee brown-rock fields. Recent improvements in the electric-furnace method of smelting rock phosphate have lowered the cost of producing concentrated superphosphate and calcium metaphosphate. To reduce costs still further the T. V. A. is giving attention to salable byproducts of fertilizer manufacture. Additional phosphate land was purchased during the fiscal year, and seven tracts in Maury County were sold to the Monsanto Chemical Co. Holdings of phosphate lands, as of June 30, 1940, approximated 2,900 acres and contained 16,000,000 tons of phosphate-rock matrix. Construction is reported to have been commenced on a sintering plant at Godwin, Tenn., and a large washing and processing plant at the Akin place.

Some elemental phosphorus of Tennessee origin was purchased by the T. V. A. in 1940 for use in manufacturing phosphoric acid for production of superphosphate.

Regarding operations at Muscle Shoals, the T. V. A. states that "The requirements of national defense can be met without interrupting the Authority's work on phosphatic fertilizer conducted at this plant."

Virginia.—Apatite-bearing titanium ore (nelsonite) was mined by the Southern Mineral Products Corporation, a subsidiary of the Vanadium Corporation of America, in Amherst County, Va., and milled at its nearby plant, Piney River, Nelson County, Va.

Moore,[15] in Economic Geology, discusses the origin of the nelsonite dikes of this region, suggesting a slightly different origin for the nelsonites from that proposed in earlier papers by Watson and Taber and by Ross and favoring an igneous origin for the dikes from hypersthene granodiorite, with contemporaneous and later alteration of the dikes by hydrothermal solutions from the cooling granodiorite magma.

Western States.—In 1940, as usual, Idaho and Montana were the only Western States that produced phosphate rock. The Anaconda Copper Mining Co. operated its No. 3 mine at Conda, Caribou County, Idaho, and shipped 99,088 long tons. There were two producers in Montana. The Montana Phosphate Products Co. of Trail, British Columbia, the larger of the two, operated the Anderson and Graveley mines and some Federal Government leases near Garrison, Mont., supplying the requirements of the Consolidated Mining & Smelting Co. of Canada, Ltd., at Trail. The Mineral Hill Mining Co. shipped several thousand tons of phosphate rock from its mine near Avon, Powell County, Mont., to the Anaconda (Mont.) plant of the Anaconda Copper Mining Co.

The mine and plant of the Anaconda Copper Mining Co. at Conda, Idaho, and the methods of mine haulage are described in recent articles.[16]

Late in 1940, Mansfield[17] revised his earlier estimate[18] of the reserves of 50-percent or better grade phosphate rock in Utah, raising the quantity to 634,050,000 long tons.

In an address before the Fourth Regional Phosphate Conference, Ogden, Utah, September 5–6, 1940, Brand[19] discussed in considerable

[15] Moore, C. H., Jr., Origin of the Nelsonite Dikes of Amherst County, Va.: Econ. Geol., vol. 35, No. 5 August 1940, pp. 629–645.

[16] Campbell, Arthur, Forty-second Annual Report of the Mining Industry of Idaho for the Year 1940: 265 pp. (See pp. 125–127.)
Woodward, C. D., Mine Haulage at Conda: Eng. and Min. Jour., vol. 141, No. 11, November 1940, p. 41.

[17] Mansfield, G. R., Utah Phosphate Reserves: Min. and Met., December 1940, p. 559.

[18] Mansfield, G. R., Recent Studies of Reserves of Domestic Phosphate: Am. Inst. Min. and Met. Eng. Tech. Pub. 1208, Mining Technol., May 1940, p. 8.

[19] Brand, C. J., Economic Feasibility of Expanding the Western Phosphate Industry: Am. Fertilizer, vol. 93, No. 7, September 28, 1940, pp. 5–8, 24, 26.

detail the future economic possibilities of the phosphate industry in the Western States; he estimated 600,000 tons of 33-percent P_2O_5 phosphate rock as the ultimate market upon the basis of a complete-fertilizer-use economy for that region, normally destined to be supplied its phosphates from the western deposits (the Dakotas, Nebraska, Colorado, Montana, Wyoming, Idaho, Utah, Nevada, and that part of Oregon and Washington east of the Cascade Range), and discussed the not unduly promising possibility of wider geographical extension of the use of western phosphate.

In August 1940 the A. R. Maas Chemical Co. began direct production of phosphoric acid from elemental phosphorus at Los Angeles, Calif.; its plant was reportedly the first of its kind in the West.

Western States phosphate rock sold or used by producers, 1936–40

Year	Idaho			Montana			Total		
	Long tons	Value at mines		Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average		Total	Average
1936	47,113	$203,264	$4.31	36,022	$76,066	$2.11	83,135	$279,330	$3.36
1937	83,436	356,037	4.27	50,834	133,138	2.62	134,270	489,175	3.64
1938	66,014	296,595	4.49	66,491	155,917	2.34	132,505	452,512	3.42
1939	95,451	431,938	4.53	44,384	112,142	2.53	139,835	544,080	3.89
1940	99,088	441,598	4.46	64,239	184,844	2.88	163,327	626,442	3.84

FOREIGN TRADE [20]

Imports.—Imports of phosphate rock into the United States continued to recede, dropping in 1940 to 2,953 long tons valued at $19,536; all came from the island of Curaçao in the Netherlands West Indies. No apatite was imported during the year. Imports of guano were only 785 tons and continued a marked decline that began in 1938. Imports of basic slag, although only 3,397 tons in 1940, were over eight times as great as in 1939 and more than four times as great as in any recent year. Imports of ammonium phosphate used as fertilizer continued their steady increase, reaching 44,782 tons in 1940.

Phosphate rock and phosphatic fertilizers imported for consumption in the United States, 1936–40

Fertilizer	1936		1937		1938		1939		1940	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Apatite	3,100	$17,187			2	$5				
Phosphate rock, crude			(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Phosphates, crude, not elsewhere specified	(2)	(2)	13,400	$115,926	7,004	80,534	3,500	$23,625	2,953	$19,536
Ammonium phosphates, used as fertilizer	13,383	475,483	27,253	1,089,657	29,028	1,286,935	34,995	1,627,608	44,782	1,959,900
Bone dust, or animal carbon, and bone ash, fit only for fertilizing	23,215	465,585	37,341	857,349	19,581	393,808	40,530	799,179	27,676	618,538
Guano	22,804	457,209	13,104	375,650	15,199	717,817	5,151	211,941	785	17,164
Slag, basic, ground or unground	758	9,758	714	7,339	691	9,547	405	5,168	3,397	10,656
Precipitated bone, fertilizer grade	3,817	96,166	4,414	120,225	3,385	98,725	2,314	68,611	1,141	38,225

[1] Not shown separately; included with "Phosphates, crude, not elsewhere specified" beginning January 1, 1937.
[2] New classification beginning January 1, 1937.

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

Exports.—A 21-percent decrease (nearly 200,000 long tons) in exports in 1940 brought down the total to 751,495 tons valued at only $3,845,495 from 949,006 tons valued at $5,233,104 in 1939. Not only was a smaller quantity of a lower total value exported, but the average value a ton declined further—from $5.51 in 1939 to $5.12 in 1940. Most of the exports were from Florida, but some were from the Western States.

The quantity and value of exports of both high-grade hard rock and land pebble again were less in 1940 than in 1939. The quantity of exports of other phosphatic materials, including sintered phosphate rock material, was also less, but there was a slight increase in value, possibly owing to smaller shipments of sintered matrix. No high-grade hard-rock phosphate or land pebble was exported to Germany, formerly one of the leading consumers of domestic rock. In 1940 the United Kingdom, in sharp contrast with its usual custom, took extremely large quantities of land pebble (218,872 tons)—nearly a third of the total exports—and was the leading importer of that commodity. Japan was a very close second with 218,456 tons, but accepted a much lower grade rock. These two countries bought nearly two-thirds of the total land-pebble exports. The Union of South Africa received 51,311 tons, and Canada increased its imports to 87,112 tons. The following tables show the total exports of high-grade hard rock and land-pebble phosphate rock, as well as shipments of each type of rock to various countries from 1936 to 1940, inclusive.

Phosphate rock exported from the United States, 1936–40

Year	Long tons	Value		Year	Long tons	Value	
		Total	Average			Total	Average
1936 [1]	1,208,951	$6,776,917	$5.61	1939	949,006	$5,233,104	$5.51
1937	1,052,802	5,818,231	5.53	1940	751,495	3,845,495	5.12
1938	1,140,841	6,637,638	5.82				

[1] Includes sintered matrix.

Phosphate rock exported from the United States, 1936–40, by countries

HIGH-GRADE HARD ROCK

Country	1936		1937		1938		1939		1940	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Belgium	4,300	$30,100	4,250	$29,750	4,000	$28,000				
British Malaya					507	5,000	1,200	$12,000		
Canada	39,271	274,934	49,970	305,865	67,134	406,463	45,162	276,372	64,542	$394,576
Cuba									22	210
Germany [1]	72,400	507,950	31,457	216,016	57,250	369,787	55,246	345,290		
Italy					3,000	18,750	2,000	12,500		
Japan			1	11						
Lithuania [1]			12,150	85,050						
Netherlands	15,050	115,350	1,800	12,600	14,450	94,420	14,750	92,188		
Panama			50	812	4	48			673	3,365
Poland and Danzig [1]	7,700	53,900			2,900	18,125				
Portugal									8,990	60,673
Sweden	25,225	174,350	20,800	145,600	32,675	219,425	14,625	102,375	10,365	72,625
	163,946	1,156,584	120,478	795,704	181,920	1,160,018	132,983	840,725	84,592	531,449

See footnotes at end of table.

Phosphate rock exported from the United States, 1936–40, by countries—Con.

LAND PEBBLE

Country	1936		1937 [2]		1938 [2]		1939 [2]		1940 [2]	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Austria	3,001	$15,005	7,397	$42,308	[3] 5,781	[3] $32,301				
Belgium	77,972	478,384	88,050	546,730	96,073	588,299	36,729	$221,107		
Belgian Congo									3,500	$28,000
Canada	37,853	165,166	60,174	267,983	59,275	250,465	68,386	319,829	87,112	440,346
Czechoslovakia [1]	5,983	30,114	29,494	185,867	26,238	155,987	2,498	16,612		
Denmark			7,331	34,404	7,495	33,503				
Germany [1]	278,404	1,660,508	189,603	1,104,534	358,077	2,181,869	271,801	1,623,330		
Hungary [1]	4,852	24,163	26,266	135,330	10,017	69,107	2,500	15,750	5,261	27,884
Ireland									6,200	34,100
Italy	65,813	393,657	69,012	426,094	49,911	305,718	86,375	562,533	33,315	210,286
Japan	281,797	1,176,953	278,155	1,153,910	159,270	664,392	229,404	888,598	218,456	813,095
Mexico					39	200				
Netherlands	142,432	904,135	98,850	628,370	103,666	675,249	27,517	178,283		
Nigeria									1,500	12,000
Norway									2,001	15,007
Poland and Danzig [1]	16,654	93,428	17,586	115,975	2,993	19,821	2,800	18,814		
Portugal									24,837	136,593
Rumania	12,852	64,260								
Spain	28,720	151,789								
Sweden	45,664	291,870	48,608	306,412	66,113	412,948	71,479	455,332	11,536	74,290
Switzerland			4,814	37,068	6,620	46,316				
Union of South Africa									51,311	282,211
United Kingdom	43,008	170,901	5,488	28,940	7,353	41,445	13,531	71,921	218,872	1,220,721
Yugoslavia			1,496	8,602			3,003	20,270	3,002	19,513
	1,045,005	5,620,333	932,324	5,022,527	958,921	5,477,620	816,023	4,392,379	666,903	3,314,046

[1] For statistical purposes, trade with the Sudeten area, as far as ascertainable, is included with Germany while trade with the other Czechoslovak Provinces occupied by Germany, Hungary, and Poland has been included with these countries, since March 18 or 19, 1939. After November 16, 1939, trade with Danzig and that part of Poland occupied by Germany has been included with Germany, and trade with that part of Poland occupied by U. S. S. R. has been included with U. S. S. R.
[2] Excludes sintered matrix.
[3] Figures cover period Jan. 1 to May 5.

Other phosphate materials [1] *exported from the United States, 1936–40*

Year	Long tons	Value	Year	Long tons	Value
1936	3,489	$165,385	1939 [2]	29,080	$192,306
1937 [2]	55,665	466,850	1940 [2]	11,924	201,047
1938 [2]	32,581	208,550			

[1] Includes bone ash, dust, and meal; animal carbon for fertilizer; basic slag; etc.
[2] Includes sintered matrix.

The following table shows exports of high-grade hard rock from the various customs districts. In 1940 the relative positions of the Florida and Montana-Idaho customs districts as exporters of this type of rock were reversed because it was impossible to make shipments from Florida to various European markets and Florida shipments consequently dropped from 87,821 long tons in 1939 to 19,377 in 1940. On the other hand, shipments from the Montana-Idaho customs district to Canada increased 38 percent.

Shipping conditions created by the European war have diverted to the American route through Buffalo a large movement of phosphate rock from Florida to Canada. Previously, Canadian-bound phosphate rock has moved to inland ports over the St. Lawrence River.

High-grade hard-rock phosphate exported from the United States, 1939–40, by customs districts

Customs district	1939		1940	
	Long tons	Value	Long tons	Value
Buffalo	2	$25		
Dakota	23	260	16	$230
Florida	87,821	564,353	19,377	133,508
Michigan	251	2,595	402	2,756
Montana and Idaho	44,873	273,373	61,975	372,872
New York			673	3,365
Ohio			912	8,247
St. Lawrence	13	119	19	257
Virginia			760	7,352
Washington			458	2,862
	132,983	840,725	84,592	531,449

WORLD PRODUCTION

Phosphate mining on the island of Curaçao in the Netherlands West Indies ceased in 1940, presumably for the duration of the war. The Mijnmaatschappij Curaçao, an affiliate of John Godden & Co., Ltd., of London, had mined phosphate rock at Newport, Curaçao, since 1875. In recent years shipments had averaged about 86,000 metric

World production of phosphate rock, 1936–40, by countries, in metric tons

[Compiled by L. P. Lounsbery]

Country	1936	1937	1938	1939	1940
Algeria	530,998	631,148	584,452	[1] 450,000	(2)
Angaur Island (exports)	89,226	90,652	105,578	(2)	(2)
Australia: New South Wales	178	20	244	(2)	(2)
Belgium	16,090			(2)	(2)
Brazil			100	(2)	(2)
Canada	476	91	189	142	325
China [3]	8,000	8,000	8,000	8,000	8,000
Christmas Island, Straits Settlements (exports)	157,564	154,378	162,425	177,972	(2)
Egypt	531,031	517,002	458,404	547,538	(2)
Estonia	11,408	10,112	13,012	(2)	(2)
France	55,000	103,600	(2)	(2)	(2)
Germany	1,060	3,314	3,221	(2)	(2)
Austria	120				(2)
India, British	130	169	23	185	(2)
Indochina	10,336	20,252	37,341	35,694	(2)
Italy		200		(2)	(2)
Japan	113,102	(2)	(2)	(2)	(2)
Madagascar	5,349	4,290	5,699	(2)	(2)
Makatea Island (exports)	122,936	166,726	102,941	160,680	(2)
Morocco, French (shipments) [4]	1,257,796	1,501,767	1,447,544	1,491,754	(2)
Nauru and Ocean Islands [5]	965,349	1,024,168	1,184,816	1,244,170	1,267,014
Netherlands Indies	12,072	26,167	33,113	18,777	(2)
Netherlands West Indies: Curaçao (exports)	78,131	101,837	99,283	(2)	(2)
New Caledonia	4,877	307	5,000	(2)	(2)
Philippine Islands	497	750	(2)	(2)	(2)
Poland	12,497	(2)	(2)	(2)	(2)
Rumania	1,039	950	970	(2)	(2)
Seychelles Islands (exports)	23,942	9,594	21,703	23,545	(2)
Sweden (apatite)	6,140	4,917	6,192	6,267	(2)
Taiwan	213	(2)	(2)	(2)	(2)
Tanganyika Territory		104	69	132	(2)
Tunisia	1,488,000	1,771,439	1,934,200	1,608,045	(2)
U. S. S. R. [6]	920,000	(2)	(2)	(2)	(2)
United States (sold or used by producers)	3,405,654	4,019,686	3,799,253	3,817,368	4,066,943

[1] Estimated.
[2] Data not available.
[3] Estimated (Imp. Inst., London).
[4] Including exports as follows: 1936, 1,247,923 tons; 1937, 1,484,562 tons; 1938, 1,427,643 tons; 1939, 1,465,673 tons; 1940, data not available.
[5] Exports during fiscal year ended June 30 of year stated.
[6] Apatite concentrates. Production of apatite ore in 1936 totaled 2,000,000 tons. In addition, low-grade phosphate rock is produced, but production data are not available.

tons of 77- to 79-percent B. P. L. grade. Germany was formerly the principal market, but in late years Finland, Denmark, Netherlands, Sweden, and Lithuania were also important outlets. Some had also been exported to the United States. A skeleton staff remained at the plant to keep the machinery in order and protect the property;[21] it has been learned that operations were renewed early in 1941 by this concern.

The phosphate works on Nauru Island were reported to have been shelled by German raiders near the end of 1940 and were considerably damaged; several phosphate-carrying boats were sunk. The deposits in this British-controlled island in the Pacific are operated by the British Phosphate Commission for the Governments of Australia, New Zealand, and the United Kingdom.

TECHNOLOGY

Besides the numerous technical articles cited in other parts of this chapter, several papers have appeared on various phases of processing or utilizing phosphates.

In a study of the methods of processing phosphate rock Jacob[22] considers ordinary superphosphates, double superphosphates, phosphoric acid, ammoniated superphosphates, ammonium phosphates, organic phosphates, dicalcium and tricalcium phosphates, basic slag, defluorinated phosphate, calcium metaphosphate, raw phosphate rock, and other phosphates. Jacob, Marshall, Reynolds, and Tremearne[23] describe the volatilization of fluorine in the manufacture of superphosphates; the fluorine volatilized from the rock in the production of superphosphate ranged from 10.7 to 42.1 percent of the fluorine content and in the production of double superphosphate from 30 to 75 percent. Copson and Newton[24] discuss the proportioning of phosphate-rock dust and phosphoric acid in making superphosphate; Brunauer and Schultz,[25] the oxidation of phosphorus by steam; Shuey,[26] the free acids in superphosphate; and Frear, Deese, and Lefforge,[27] the effects of impurities on various properties of calcium metaphosphate. In a recent article, Davies[28] covers the use of phosphoric acid or phosphates in clarifying sugar. A series of papers presented before the forty-third annual meeting of the American Ceramic Society, April 1, 1941, included reports on the characteristic properties of phosphate glasses by Kreidl and Weyl,[29] on phosphorous compounds as reducing and fining agents for glasses by Weyl and

[21] American Consular Report: World Trade Notes, vol. 14, No. 28, July 13, 1940, p. 454.
[22] Jacob, K. D., New and Old Methods of Processing Phosphate: Am. Fertilizer, vol. 93, No. 8, October 12, 1940, pp. 7–9, 20, 22; No. 9, October 26, 1940, pp. 7–10, 22, 24.
[23] Jacob, K. D., Marshall, H. L., Reynolds, D. S., and Tremearne, T. H., Composition and Properties of Superphosphates, Volatilization of Fluorine in Superphosphate Manufacture: Paper presented at meeting of Am. Chem. Soc., Div. Fertilizer Chemistry, Detroit, Mich., September 9–13, 1940; abs. Am. Fertilizer, vol. 93, No. 5, August 31, 1940, p. 5.
[24] Copson, R. L., and Newton, R. H., Superphosphate Manufacture, Proportioning of Rock Phosphate Dust and Phosphoric Acid: Paper presented at meeting of Am. Chem. Soc., Div. Fertilizer Chemistry, Detroit, Mich., September 9–13, 1940; abs. Am. Fertilizer, vol. 93, No. 5, August 31, 1940, pp. 5–6.
[25] Brunauer, Stephen, and Schultz, J. F., The Oxidation of Phosphorus by Steam: Paper presented at meeting of Am. Chem. Soc., Div. Fertilizer Chemistry, Detroit, Mich., September 9–13, 1940; abs. Am. Fertilizer, vol. 93, No. 5, August 31, 1940, p. 6.
[26] Shuey, P. M. G., Free Acids in Superphosphate and a Rapid, Accurate Method for Making Their Determination: Paper presented at meeting of Am. Chem. Soc., Div. Fertilizer Chemistry, Detroit, Mich., September 9–13, 1940; abs. Am. Fertilizer, vol. 93, No. 5, August 31, 1940, p. 6.
[27] Frear, G. L., Deese, E. F., and Lefforge, J. W., Effects of Impurities upon the Fusibility, Citrate-Solubility, and Hygroscopicity of Calcium Metaphosphate: Paper presented at meeting of Am. Chem. Soc., Div. Fertilizer Chemistry, Detroit, Mich., September 9–13, 1940; abs. Am. Fertilizer, vol. 93, No. 5, August 31, 1940, p. 7.
[28] Davies, J. G., Industrial Chemicals in Cane Sugar Manufacture: Chem. Age, July 13, 1940, pp. 21–22.
[29] Kreidl, N. J., and Weyl, W. A., Phosphate Glasses and Some Characteristic Properties: Bull. Am. Ceram. Soc., vol. 20, No. 3, March 1941, p. 93.

Kreidl,[30] and on the possible use of various phosphates in producing opacity in certain types of sanitary ware glazes by Earhart.[31]

SUPERPHOSPHATES

The following table gives the salient features of the superphosphate industry in the United States, 1937–40.

Salient statistics of the superphosphate industry in the United States, 1937–40

	1937	1938	1939	1940
Production:[1]				
Bulk superphosphate short tons	4,429,767	3,575,588	3,801,194	4,385,971
Wet base and wet mixed goods do	122,680	156,730	152,500	136,204
Shipments:[1]				
All superphosphate, to consumers do	1,046,334	902,490	897,749	1,048,508
All superphosphate, to others do	2,130,860	1,817,293	2,073,123	2,252,620
Base and mixed goods[2] do	1,723,590	1,537,491	1,526,026	1,519,443
Stocks in manufacturers' hands, Dec. 31:[1]				
Bulk superphosphate do	1,313,327	1,361,127	1,233,297	1,285,408
Base and mixed goods[2] do	784,532	669,503	701,649	740,914
Exports of superphosphates[3] long tons	78,949	90,237	95,224	141,289
Imports of superphosphates[3] do	57,930	18,753	17,238	10,017
Sales of phosphate rock by producers for superphosphate production long tons	2,391,245	2,074,779	2,192,779	2,564,844

[1] Bureau of the Census, Monthly Statistics, Superphosphate Industry, 16 percent available phosphoric acid.
[2] Includes wet and dry bases and wet and dry mixed goods.
[3] Bureau of Foreign and Domestic Commerce.

The sources of imported superphosphates and destinations of exported domestic superphosphates for 1939 and 1940 are given in the following table.

Superphosphates (acid phosphates) imported into and exported from the United States, 1939–40, by countries

Country	Imports				Exports			
	1939		1940		1939		1940	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Argentina							200	$9,286
Belgium	4,619	$142,510						
Bolivia					5,136	$70,933	13,587	286,915
Canada	10,536	172,519	10,017	$139,615	71,665	694,217	89,350	861,956
Chile					15	1,192		
El Salvador					57	1,613	41	1,681
Mexico					238	12,027	548	6,925
Netherlands	1,885	22,724						
Philippine Islands					(1)	16	340	7,964
Union of South Africa					500	5,550	20,167	223,044
Venezuela					185	8,305	287	12,797
West Indies:								
British:								
Jamaica					294	5,862	66	1,499
Other British					281	3,841	228	3,942
Cuba					16,594	197,122	14,097	181,603
Dominican Republic					58	2,303	36	1,492
Other countries	198	2,124			201	7,355	2,342	56,232
	17,238	339,877	10,017	139,615	95,224	1,010,336	141,289	1,655,336

[1] Less than 1 ton.

[30] Weyl, W. A., and Kreidl, N. J., Phosphorous Compounds as Reducing and Fining Agents for Glasses: Bull. Am. Ceram. Soc., vol. 20, No. 3, March 1941, p. 93.
[31] Earhart, W. H., Use of Phosphate Opacifying Agents in Sanitary Ware Glazes: Bull. Am. Ceram. Soc., vol. 20, No. 3, March 1941, p. 107.

Superphosphate was officially defined by the Association of Official Agricultural Chemists at its annual meeting in Washington in October 1940 as: "A product obtained by mixing rock phosphate with either sulfuric acid or phosphoric acid, or with both acids. The grade that shows the available phosphoric acid shall be used as a prefix to the name, for example, 20 percent superphosphate."

At the annual meeting in 1939 a definition had been tentatively adopted which specified merely that the P_2O_5 content must be chiefly mono-calcium phosphate but did not name the materials from which it might be produced. This definition would have permitted the inclusion, as superphosphate, of a product made by mixing concentrated phosphoric acid with limestone. The recently approved definition, however, is virtually the same as that which has prevailed in recent years and limits the term "superphosphate" to a product made from phosphate rock.

The manufacture of superphosphate by the Davison Chemical Corporation at Curtis Bay, Baltimore, Md., was described in detail in two recent reports.[32]

Marshall, Hendricks, and Hill, in one of a series of papers on the composition and properties of superphosphate, discuss the conditions that affect the distribution of water, with special reference to the calcium sulfate constituent.[33]

BASIC SLAG

Basic slag is an important source of phosphorus. Little is produced in the United States—only a few thousand tons a year in the Birmingham iron district of Alabama—and only a small quantity is imported annually; in Europe, however, where it is produced in abundance, basic slag has become an important competitor of phosphate rock and superphosphate as a source of fertilizer phosphorus.

No figures for the production of basic slag in European countries during 1939 or 1940 are available. Output in the United States for these years probably was comparable with that in years recently preceding. Production data for 1935–38 are given in Minerals Yearbook 1940 (p. 1319).

Imports of basic slag into the United States in 1940—3,397 long tons valued at $10,656—were much larger than in recent years, but the average value was much lower.

The history of the development of the basic process of steel making, which yields the basic slag used as a phosphatic fertilizer, is related in a recent biography [34] of its inventor, Sidney Gilchrist Thomas. He is so well known for the application of his invention to the basic Bessemer process that in Europe it is known as the Thomas process.

[32] McBride, R. S., Fertilizer Practice at Curtis Bay: Chem. and Met. Eng., vol. 47, No. 1, January 1940, pp. 4-9.
Mackall, J. N., and Shoeld, Mark, Granulating Phosphate Fertilizers: Chem. and Met. Eng., vol. 47, No. 2, February 1940, pp. 102-105.

[33] Marshall, H. L., Hendricks, S. B., and Hill, W. L., Composition and Properties of Superphosphate. Conditions Affecting the Distribution of Water, with Special Reference to the Calcium Sulfate Constituent: Ind. and Eng. Chem., vol. 32, December 1940, pp. 1631-1636.

[34] Thompson, Lillian Gilchrist, "Sidney Gilchrist Thomas": Faber & Faber, London, 1940, 328 pp.; rev. by G. B. Waterhouse, Min. and Met., March 1941, p. 184.

TALC, PYROPHYLLITE, AND GROUND SOAPSTONE[1]

By Bertrand L. Johnson and K. G. Warner

SUMMARY OUTLINE

Sales of talc, pyrophyllite, and ground soapstone made another new record in 1940, exceeding the 1939 peak by over 27,000 short tons

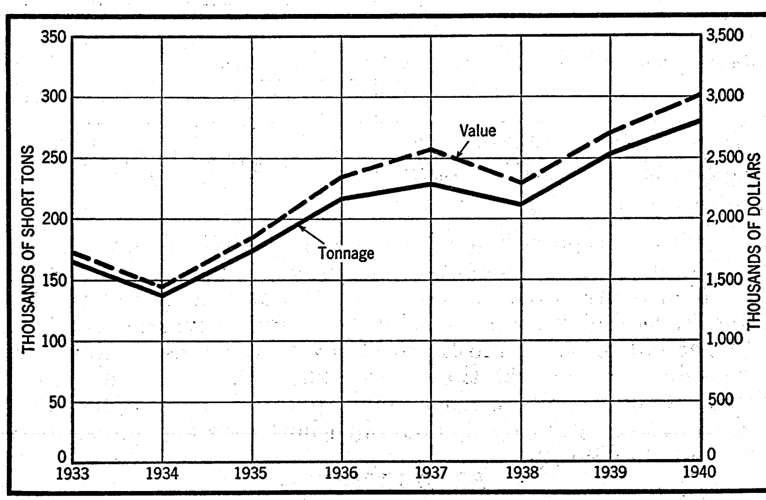

Figure 1.—Sales of domestic talc, pyrophyllite, and ground soapstone, 1933–40.

(see fig. 1.); both quantity and value increased 11 percent, reaching 281,375 tons valued at $3,008,320. Sales of crude, sawed and manufactured, and ground all rose in both quantity and value, the greatest increase being in ground products. Imports of crude materials were less in 1940 than in 1939, both as to quantity and value, but imports of "ground, washed, or pulverized" materials and "cut and sawed" products were larger in both quantity and value. Exports of "talc, steatite, soapstone, and pyrophyllite, crude and ground," were slightly larger in 1940 than in 1939, but the value of talcum powder exported was less.

Pyrophyllite is included with talc in this discussion solely because the custom was established many years ago in these annual reports of the Bureau of Mines. Although pyrophyllite resembles talc in certain physical properties, it is a hydrous aluminum silicate ($Al_2Si_4O_{10}(OH)_2$) instead of a hydrous magnesium silicate like talc ($Mg_3Si_4O_{10}(OH)_2$). Some mineralogists class pyrophyllite as one of the kaolin minerals (see Minerals Yearbook, 1939, p. 1273).

[1] Soapstone sold in slabs or blocks is included in the chapter on Stone.

Salient statistics of the talc, pyrophyllite, and ground-soapstone industries in the United States, 1939–40

	1939		1940	
	Short tons	Value	Short tons	Value
Sales by producers:				
Crude	15,722	$82,188	[1] 17,724	[1] $118,424
Sawed and manufactured	1,871	77,915	1,894	140,565
Ground	236,383	2,540,731	261,757	2,749,331
	253,976	2,700,834	[1] 281,375	[1] 3,008,320
Imports for consumption:				
Crude and unground steatite and French chalk	133	2,392	93	1,479
Ground, washed, or pulverized	25,943	408,178	28,145	465,049
Cut and sawed	94	14,651	125	20,739
	[2] 26,170	[2] 425,221	[2] 28,363	[2] 487,267
Exports:				
Talc, steatite, and soapstone, crude and ground	9,047	162,426	[3] 9,402	[3] 167,992
Powder—talcum (in packages), face, and compact	(4)	1,115,176	(4)	945,530
		1,277,602		1,113,522

[1] Includes a small quantity of pinite from Nevada.
[2] Exclusive of "manufactures n. s. p. f.; except toilet preparations," as follows: 1939, 98 short tons valued at $27,398; 1940, quantity not available, valued at $21,588.
[3] Includes pyrophyllite.
[4] Quantity not recorded.

Eleven States reported sales of talc, pyrophyllite, ground soapstone, or pinite in 1940 compared with nine in 1939. Eight of these States, which contributed 86 percent of the output, are in the East; the other three—California, Washington, and Nevada—which supplied 14 percent of the domestic total, are in the West. New Jersey reported sales for the first time since 1935. Nevada (reporting for the first time since 1930, when a small quantity of pyrophyllite was shipped from Pershing County) supplied both talc and pinite in 1940 from Esmeralda County.

PRODUCTION

The following list of producers of talc, pyrophyllite, soapstone, and pinite in the United States is compiled from reports made to the Bureau of Mines covering operations in 1940.

Producers of talc, pyrophyllite, and soapstone in the United States in 1940

Producer	Material [1]	Product	Location	
			County	Nearest town
CALIFORNIA				
Blue Star Mines, Ltd., 840 San Julian St., Los Angeles.	Talc	Crude, ground	Inyo	Bigpine.
Wm. Bonham & W. V. Skinner, Lone Pine.	Soapstone	Crude	do	Keeler.
Lee Bristo, Baker	Talc	do	San Bernardino.	Barstow.
Industrial Minerals & Chemical Co., 6th & Gilman Sts., Berkeley.	Soapstone	Ground	Alameda	Berkeley.
Lew A. McEachran, 2652 Harrison St., San Francisco.	do	Crude	Butte	Isaiah.
Moorhouse Talc Co., 3215 West 6th St., Los Angeles.	Talc	do	San Bernardino.	Shoshone, Inyo County.
Pacific Coast Talc Co., 2149 Bay St., Los Angeles.	do	Ground	Inyo	Keeler or Lone Pine.
Do	do	Crude, ground	San Bernardino.	Baker.
Pacific Minerals Co., Ltd., 337 10th St., Richmond.	Soapstone	do	Eldorado	Shingle Springs.

[1] As reported by producers.

Producers of talc, pyrophyllite, and soapstone in the United States in 1940—Con.

Producer	Material	Product	Location	
			County	Nearest town
CALIFORNIA—continued				
Pomona Tile Mfg. Co., Los Angeles.	Talc	Ground	Inyo	Death Valley.
Sierra Talc Co., 428 Union League Building, Los Angeles.	do	Crude, ground	do	Darwin.
Southern California Minerals Co., 320 South Mission Road, Los Angeles.	do	Ground	San Bernardino, Inyo.	Las Vegas, Nev.
Western Talc Co., 1901 East Slauson Ave., Los Angeles.	do	Crude, ground	San Bernardino	Tecopa, Inyo County.
GEORGIA				
Cohutta Talc Co., Dalton	Talc, soapstone	Crayons, ground	Murray	Chatsworth.
Georgia Talc Co., Asheville, N. C.	Talc	do	do	Do.
J. H. Long, Box 52, Dawsonville	Soapstone	Crude	Dawson	Dawsonville.
Southern Talc Co., Chatsworth	Talc	Sawed, ground	Murray	Chatsworth.
Thompson, Weinman & Co., Inc., Cartersville.	do	Ground	Pickens	Jasper.
MARYLAND				
Clinchfield Sand & Feldspar Co., 430 Hearst Tower Building, Baltimore.	Soapstone	do	Carroll	Marriottsville Howard County.
Harford Talc & Quartz Co., Bel Air.	Steatite	Crude, ground	Harford	Dublin.
W. O. Hoffman, Conowingo	Talc	Sawed	Cecil	Oakwood.
Herbert I. Oursler, Marriottsville.	Soapstone	Crude, ground	Carroll	Marriottsville, Howard County.
NEVADA				
Clay Corporation of California, 1767 Russ Building, San Francisco, Calif.	Pinite	Crude	Pershing	Lovelock.
Lemke Bros., Oasis, Calif	Talc	do	Esmeralda	Goldfield.
NEW JERSEY				
Rock Products Co., 317 Trust Building, Easton, Pa.	do	do		
NEW YORK				
Carbola Chemical Co., Inc., Natural Bridge.	do	Ground	Lewis	Natural Bridge.
International Pulp Co., 41 Park Row, New York.	do	do	St. Lawrence	Gouverneur.
W. H. Loomis Talc Corporation, 223 East Main St., Gouverneur.	do	do	do	Do.
NORTH CAROLINA				
Carolina Pyrophyllite Co., Staley	Pyrophyllite	Crude, ground	Randolph	Staley.
The Hitchcock Corporation, Box 20, Asheville.	Talc	Crude	Cherokee	Murphy.
Nantahala Talc & Limestone Co., Andrews.	do	Crude, crayons	Swain	Nantahala.
Pyrophyllite Talc Products, Inc., Glendon.	Pyrophyllite	Ground	Moore	Glendon.
Standard Mineral Co., Inc., 230 Park Ave., New York, N. Y.	do	do	do	Hemp.
Victor Mica Co., Inc., Spruce Pine.	Talc	do	Mitchell	Spruce Pine.
PENNSYLVANIA				
C. K. Williams & Co., 640 North 13th St., Easton.	Soapstone	Crude	Northampton	Easton.
VERMONT				
Eastern Magnesia Talc Co., Inc., Burlington.	Talc	Crude, ground	Lamoille	Johnson.
Do	do	Crude, crayons, ground.	Washington	Waterbury.
Vermont Talc Co., Chester	do	Crude	Windham	Windham.
Do	do	Ground	Windsor	Chester.
Vermont Mineral Products, Inc., Chester.	do	do	do	Do.
VIRGINIA				
Alberene Stone Corporation of Virginia, Schuyler.	Soapstone	Sawed, ground	Nelson	Schuyler.
Blue Ridge Talc Co., Inc., Henry	do	Crushed, ground	Franklin	Henry.
Bull Run Talc Co., Llanerch, Pa.	Talc	Ground	Fairfax	Clifton Station.
WASHINGTON				
Skagit Talc., Inc., Sedro Woolley	do	Crayons	Skagit	Sedro Woolley.

SALES

Sales of talc, pyrophyllite, and ground soapstone by producers again increased in 1940 and reached an all-time record of 281,375 short tons valued at $3,008,320, a rise of 27,399 tons in quantity and $307,486 in value over 1939, an increase of 11 percent in both quantity and value. Sales of crude, sawed and manufactured, and ground materials all rose in 1940 over 1939 levels; sales of sawed and manufactured materials were only slightly greater, while sales of crude were up 13 percent and those of ground products increased 11 percent. Sales of ground materials alone in 1940 again exceeded the total sales of all classes in any previous year.

Talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1936–40, by classes

Year	Crude		Sawed and manufactured		Ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1936	10,910	$59,556	618	$90,542	204,663	$2,193,073	216,191	$2,343,171
1937	11,087	52,750	1,101	111,680	217,811	2,397,323	229,999	2,561,753
1938	13,498	72,845	1,729	70,268	197,548	2,159,447	212,775	2,302,560
1939	15,722	82,188	1,871	77,915	236,383	2,540,731	253,976	2,700,834
1940	[1] 17,724	[1] 118,424	1,894	140,565	261,757	2,749,331	[1] 281,375	[1] 3,008,320

[1] Includes a small quantity of pinite from Nevada.

Sales by States.—In 1940 larger tonnages were sold in all States for which figures can be published, except Vermont and Washington; in both of these, however, the value of the material sold was higher than in 1939. The greatest advances in tonnage sold were in New York, California, and North Carolina. All-time high records were again established in California, Georgia, North Carolina, and New York. Although more talc was sold in California in 1940 than in 1939 the value of the sales was slightly less. In all the other listed States the total values of sales were higher in 1940 than in 1939. New York was by far the leading State, with a production of 113,611 short tons valued at $1,402,524; California, North Carolina, and Vermont ranked about equally, but each produced only about one-third as much as New York.

Talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1939–40, by States

State	1939		1940	
	Short tons	Value	Short tons	Value
California	33,796	$483,839	36,282	$476,926
Georgia	20,090	177,881	20,104	219,959
New York	99,880	1,252,525	113,611	1,402,524
North Carolina	36,772	283,789	39,206	298,382
Vermont	39,393	378,492	38,516	423,368
Washington	190	1,225	4	1,394
Other States [1]	23,855	123,083	[2] 33,652	[2] 185,767
	253,976	2,700,834	[2] 281,375	[2] 3,008,320

[1] 1939: Maryland, Pennsylvania, and Virginia; 1940: Maryland, Nevada, New Jersey, Pennsylvania, and Virginia.
[2] Includes a small quantity of pinite from Nevada.

MARKETS

Five industries—paint, ceramics, roofing, paper, and rubber—use 75 percent of the talc, pyrophyllite, and ground soapstone of domestic production. As indicated by reports from producers to the Bureau of Mines the paint industry—the leading market for these materials—took only 24 percent of the total sales in 1940 compared to 27 percent in 1939, or less than its share in recent years. The ceramic industry increased its hold on second place, taking 18 percent in 1940 as against 15 percent in 1939. Rubber dropped to fifth place from its tie with the roofing and paper industries for third place in 1939. The quantities consumed in the paint industry were only very slightly greater in 1940 than in 1939, whereas 10,254 more tons went into ceramics. There were increases during 1940 in the quantities sold to the roofing, paper, and foundry facings industries, whereas decreases were indicated in the rubber and toilet preparation industries.

Talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1939-40, by uses

Use	1939		1940	
	Short tons	Percent of total	Short tons	Percent of total
Paint	67,859	27	67,875	24
Ceramics	38,407	15	48,661	18
Roofing	30,516	12	34,347	12
Paper	30,177	12	31,657	11
Rubber	31,078	12	28,501	10
Toilet preparations	9,672	4	8,818	3
Foundry facings	3,986	2	5,532	2
Other uses [1]	12,918	5	31,331	11
Use not reported	29,363	11	24,653	9
	253,976	100	[2] 281,375	100

[1] Includes crayons, bleaching, insecticides, plaster, textile, and other minor uses.
[2] Includes a small quantity of pinite.

PRICES

The average value of sales of all grades of talc, pyrophyllite, and ground soapstone, as reported to the Bureau of Mines by producers, has been about $11 a ton, ranging from about 60 cents below that figure to $1.50 above it; in 1940 it was $10.69. The average values for the past 5 years are given in the following table.

Average value per short ton of talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1936-40

1936	$10.84	1939	$10.63
1937	11.14	1940	10.69
1938	10.82		

Quotations on finely ground domestic talc, f. o. b. works, carlots, in April 1941, were as follows according to the Oil, Paint, and Drug Reporter: California, $17 to $20; New York, $14 to $19.25; and Vermont, $14, all virtually unchanged from a year earlier. No quotations were available on imported talcs.

The price of pyrophyllite, standard, 200-mesh, carlots, mines, was $9 a ton; 325-mesh, $12; No. 3, 200-mesh, carlots, mines, $7.50 a ton; 325-mesh, $12. The trade journal quotations showed the same range in April 1940.

DEVELOPMENTS IN THE INDUSTRY

Pyrophyllite.—The results of the comprehensive study of pyrophyllite dust as an industrial hazard by H. F. Easom and others was published in 1939 by the division of industrial hygiene of the North Carolina Board of Health and Industrial Commission.[2] In February 1940 M. F. Trice of that organization presented a paper on this work before the American Institute of Mining and Metallurgical Engineers (see Minerals Yearbook, 1940, p. 1327).

In a recent report Spence[3] summarizes available data on the properties and uses of pyrophyllite and its occurrences in North Carolina and Newfoundland and also describes the Canadian deposits on Vancouver Island, British Columbia, and in the Lake Memphremagog district, Quebec.

The use of pyrophyllite in the manufacture of unfired refractories has been developed in the department of ceramic engineering of the University of North Carolina.[4]

Lyamina[5] presents the results of an X-ray study of the mineral composition of some pyrophyllites.

Emrich[6] describes tests on the use of pyrophyllites containing 4.2 to 9.3 percent sericite in vitreous ceramic bodies.

Pyrophyllite is the principal mineral constituent of Brazilian agalmatolite; an extensive deposit is now being exploited on a very small scale at Pará de Minas in the State of Minas Gerais.[7] The agalmatolite outcrops in a narrow strip that trends southeasterly for 6 kilometers. Six quarries are in operation, but no production statistics are available. The product is used as a substitute for talc, for construction purposes, and for sculpture.

A unique pyrophyllite-bearing rock is the so-called "Wonderstone" of the Transvaal, Union of South Africa. Detailed studies have been printed[8] of the occurrence and properties of this material. Wonderstone occurs as bands or lenses of sedimentary material intercalated in a thick mass of volcanic rocks composed predominantly of acid lavas. According to the evidence available the rock is said to appear to be a metamorphosed clay derived from volcanic ash. The quantity available is said to be enormous.

Natural wonderstone is light bluish gray, but the fired material ranges from white to gray and pink. The rock is compact and very fine grained, the average grain size of the principal constituent being about 10 microns or less. The hardness of the rock is less than that of the average slate, and it can be readily sawed, chiseled, drilled, and finely carved with ordinary wood-working tools; it can also be turned on a lathe. It takes and retains a very good polish. Chemical

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[2] Easom, H. F., and others, A Study of the Effects of Exposure to Dust in the Mining and Milling of Pyrophyllite: North Carolina Board of Health and Industrial Commission, Division of Industrial Hygiene, Raleigh, N. C., 1939, 100 pp. (bibliography, diagrams, illus.).

[3] Spence, H. S., Talc, Steatite, and Soapstone, Pyrophyllite: Canada Dept. Mines and Resources, Mines and Geology Branch, Bureau of Mines, No. 803, Ottawa, 1940, 146 pp. (see pp. 121–140).

[4] Bowles, Oliver, Refractories: Bureau of Mines Mineral Trade Notes, vol. 11, No. 6, December 20, 1940, p. 22.

[5] Lyamina, A. N., (X-ray Study of the Mineral Composition of Some Pyrophyllite Specimens): Trans. All-Union Sci., Res. Inst. Econ. Mineral (U. S. S. R.), No. 142, 1939, pp. 14–18; Chem. Abs., vol. 34, No. 12, November 20, 1940, p. 7788.

[6] Emrich, E. W., Use of a High-sericite Pyrophyllite in Vitreous Bodies: Jour. Am. Ceram. Soc., vol. 24, No. 4, April 1941, pp. 141–144.

[7] de Moraes, Luciano Jacques, Leinz, Viktor, and Orosco, Eros, Estudo do agalmatolito: Republica dos Estados Unidos do Brasil, Ministerio da Agricultura, Departamento Nacional da Produção Mineral, Serviço do Fomento da Produção Mineral, Avulso 32, 1938, 33 pp.

[8] Nel, L. T., Jacob, H., Allan, J. T., and Bozzoli, G. R., Wonderstone: Union of South Africa, Department of Mines, Geol. Series, Bull. 8, 1937, 44 pp.

Bosazza, V. L., Wonderstone—A Unique Refractory Material: Trans. British Ceram. Soc., vol. 39, No. 11, 1940, pp. 369–376; contains additional references.

analyses show this rock to be composed principally of silica, alumina, and water. Pyrophyllite forms about 89 percent of the rock; the remainder is chloritoid or epidote, rutile, and hematite. According to Bosazza, wonderstone on firing shows a slight permanent volume expansion of about 3 percent, owing mainly to the growth of cristobalite crystals in a dense matrix. Firing to high temperature increases the hardness and mechanical strength. Some wonderstone has been imported into the United States and used in the ceramic industry.

A hydrothermally altered acidic tuff, composed of a mixture of sericite and pyrophyllite and termed "pinite," has been mined recently at American Canyon, Nev., for use as a refractory in rotary cement-kiln linings. The occurrence and properties of this material have been described by Kerr [9] and the ceramic properties by Page, Raine, and Sullivan.[10] It is said to be highly refractory, with a fusion point of cone 32, and to fire snow-white.

Talc.—The results of an experimental study at the National Bureau of Standards of the treatment of ceramic talcose whiteware bodies in an electrically heated tunnel kiln of semicommercial size and capable of heating ware on a wide range of temperatures and time cycles is described in a paper by Geller and Creamer.[11]

Inuzuka [12] showed that when talc is heated at 1,100° C. it dissociates as follows:

$$H_2Mg_3(SiO_3)_4 \longrightarrow H_2O + SiO_2 + 3\ MgSiO_3,$$

and that the X-ray pattern shows that the resultant silica is cristobalite.

Thurnauer [13] describes the uses of talc as carving stone and as an insulating and refractory material. Powdered talc is used extensively in ceramic bodies, and in steatite bodies powdered talc is the chief raw material. Smaller amounts of talc are used in cordierite bodies.

Akhyan [14] noted that $MgSiO_3$ and mullite crystallized from the glass, the former as clinoenstatite, and that the addition of corundum dust increases the deformation temperature and solidifies the crystalline skeleton of the ware.

Romodan [15] suggested that the durability of saggers can be improved by adding talc.

Zodac [16] describes the Carlton quarry of the Vermont Mineral Products Co., Inc., now operated for grit talc.

Fuller [17] describes the use of talc as an inert material in paint in a recent bulletin of the American Society for Testing Materials.

Policard [18] described the results of his experiments that showed the effects on white rats of the foliaceous industrial talc dust used in powdering rubber.

In a recent comprehensive report Spence [19] has assembled the

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9 Kerr, P. F., A Pinitized Tuff of Ceramic Importance: Jour. Am. Ceram. Soc., vol. 23, No. 3, March 1940, pp. 65–71.

10 Page, G. A., Raine, F. F., and Sullivan, V. R., Development and Preliminary Studies of Pinite: Jour. Am. Ceram. Soc., vol. 23, No. 3, March 1940, pp. 71–77.

11 Geller, R. F., and Creamer, A. S., Some Factors Affecting the Properties of Ceramic Talcose Whiteware: Nat. Bureau of Standards Research Paper 1371 (Jour. Research, Nat. Bureau of Standards), vol. 26, March 1941, pp. 213–226.

12 Inuzuka, Hideo, Cristobalite: Jour. Geol. Soc. Japan, vol. 47, 1940, pp. 306–309.

13 Thurnauer, Hans, Talc as a Ceramic Raw Material: Ceram. Age, vol. 35, 1940, pp. 146–148.

14 Akhyan, A. M., (Talc Spark-plug Insulators): Prom. Stroitel. Materialov, vol. 2, No. 7, 1940, pp. 49–54; Jour. Am. Ceram. Soc., Ceram. Abs., vol. 20, No. 3, March 1941, p. 72.

15 Romodan, P. F. (Improving Saggers): Keramika, No. 8, 1939, pp. 20–27; Jour. Am. Ceram. Soc., Ceram. Abs., vol. 19, No. 6, June 1940, p. 142.

16 Zodac, Peter, A Talc Quarry near Chester, Vt.: Rocks and Minerals, vol. 15, October 1940, pp. 369–370.

17 Fuller, W. R., Inert Materials for Admixture with Paint Pigments: Am. Soc. Test. Materials Bull. 105, August 1940, pp. 35–38.

18 Policard, A., (Action of Talc Dust on the Lungs (Experimental Study)): Arch. Malad. Profess. vol. 2, 1939–40, pp. 530–539; Jour. Am. Ceram. Soc., Ceram. Abs. vol. 20, No. 4, April 1941, p. 105.

19 Spence, H. S., Talc, Steatite, and Soapstone, Pyrophyllite: Canada Department of Mines and Resources, Mines and Geology Branch, Bureau of Mines, Ottawa, Canada, Report 803, 1940, 146 pp.

salient information on occurrences of Canadian talc and soapstone in earlier publications, with later data on the world talc and soapstone industry, methods of mining and milling, utilization, and markets.

The talc-magnesite rock of the Eastern Magnesia Talc Co., Inc., Johnson, Vt., contains numerous accessory minerals, constituting, however, less than 2 percent of the rock. According to a letter from W. P. Mould to Dr. Oliver Bowles, Bureau of Mines, dated May 29, 1940, the following minerals have been identified: Chlorite, augite, tourmaline (var. dravite), hornblende, spinel, siderite, chromite, pyrrhotite, pentlandite, magnetite, pyrite, gersdorffite, and breunnerite. The rock runs about 0.67 percent Ni. The pyrrhotite carries about 6 percent Ni, but the main source of the nickel is believed to be the gersdorffite. Chemical analyses also show the presence of cobalt, arsenic, antimony, and manganese, but the minerals carrying these elements have not been determined.

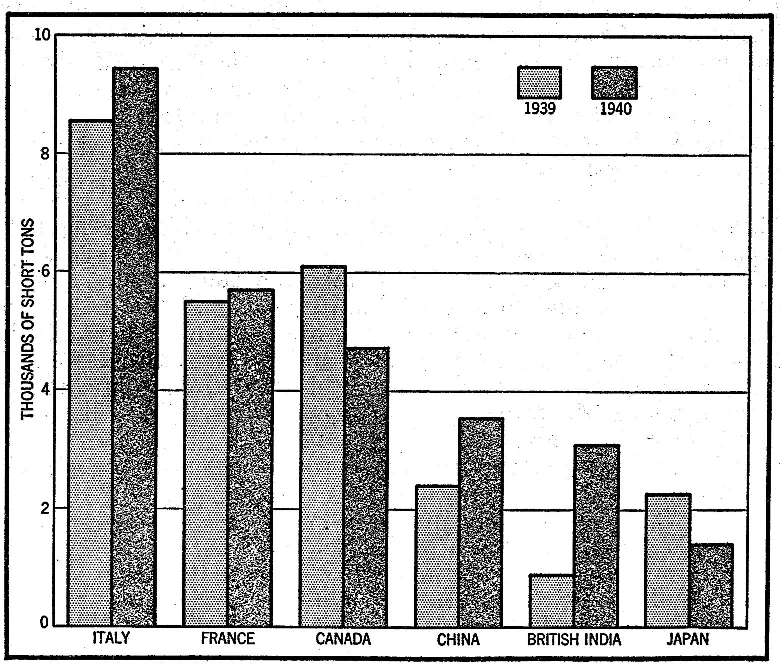

FIGURE 2.—Imports of ground, washed, or pulverized talc, steatite or soapstone, and French chalk for consumption in the United States, 1939–40, by leading countries.

FOREIGN TRADE

Imports.—By far the greatest proportion of the imports of talc, steatite or soapstone, and French chalk into the United States is of "ground, washed, or pulverized" materials. In 1940 these totaled 28,145 short tons valued at $465,049 compared with only 93 tons of crude and unground valued at $1,479 and 125 tons of cut and sawed materials valued at $20,739. The total value of all materials imported including some "manufactured n. s. p. f." was slightly over one-half million dollars.

The tables in this section this year are not strictly comparable with those in previous chapters. As the import tonnage of certain manufactures of these materials was not available in 1940 in the official statistics certain figures were eliminated and the tables rearranged.

Imports from the various countries are listed in detail for the three types of imported material in the accompanying tables (see also fig. 2). In 1940 most of the crude and unground material came from China and the Union of South Africa and the cut and sawed varieties from Italy and Japan. Ground talc, steatite or soapstone, and French chalk came from seven countries, with Italy the leading source, followed by France, Canada, China, British India, Japan, and Egypt in the order named.

Talc, steatite or soapstone, and French chalk imported for consumption in the United States, 1936–40

Year	Crude and unground		Ground, washed, powdered, or pulverized, except toilet preparations		Cut and sawed		Total		Manufactures n. s. p. f., except toilet preparations	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1936	188	$2,915	24,209	$422,502	24	$4,039	24,421	$429,456	99	$27,211
1937	324	7,644	26,379	423,032	72	11,799	26,775	442,475	102	30,344
1938	337	5,956	21,568	351,541	129	7,866	22,034	365,363	93	25,835
1939	133	2,392	25,943	408,178	94	14,651	26,170	425,221	98	27,398
1940	93	1,479	28,145	465,049	125	20,739	28,363	487,267	(1)	21,588

1 Quantity not recorded.

Talc, steatite or soapstone, and French chalk imported for consumption in the United States, 1939–40, by countries

Country	Crude and unground		Ground, washed, powdered, or pulverized, except toilet preparations		Cut and sawed		Total		Manufactures n. s. p. f., except toilet preparations	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1939										
Canada			6,116	$64,506			6,116	$64,506		
China	99	$1,009	2,397	22,657			2,496	23,666	97	$26,693
Egypt			110	2,519			110	2,519		
France	4	353	5,526	79,596	14	$590	5,544	80,539		
Germany			1	68			1	68		
Greece	3	55					3	55		
Hong Kong									(1)	70
India, British			892	10,857			892	10,857	(1)	200
Italy	1	20	8,575	201,465	41	8,403	8,617	209,888		
Japan	1	19	2,264	25,925	39	5,658	2,304	31,602	1	432
Norway			62	585			62	585		
Union of South Africa	25	936					25	936		
United Kingdom									(1)	3
	133	2,392	25,943	408,178	94	14,651	26,170	425,221	98	27,398
1940										
Canada			4,725	49,737			4,725	49,737	(2)	20
China	67	442	3,550	34,496			3,617	34,938	(2)	20,797
Egypt			165	2,818			165	2,818		
France			5,732	94,830	10	1,174	5,742	96,004		
Hong Kong									(2)	45
India, British			3,103	41,829			3,103	41,829		
Italy			9,456	224,007	29	6,154	9,485	230,161		
Japan	1	37	1,414	17,332	86	13,411	1,501	30,780	(2)	721
Trinidad and Tobago									(2)	5
Union of South Africa	25	1,000					25	1,000		
	93	1,479	28,145	465,049	125	20,739	28,363	487,267	(2)	21,588

1 Less than 1 ton. 2 Quantity not recorded.

Exports.—The quantity of "talc, steatite, soapstone, and pyrophyllite, crude and ground," exported in 1940 was about 400 tons greater than in 1939, and the value was over $5,000 above 1939. The value of "powders—talcum (in packages), face, and compact," however, was the lowest since 1936.

Talcum and other powders exported from the United States, 1936–40

Year	Description	Short tons	Value
1936	Talc, steatite, and soapstone, crude and ground	6,670	$115,434
	Powders—talcum (in packages), face, and compact	(1)	803,571
1937	Talc, steatite, and soapstone, crude and ground	8,878	149,625
	Powders—talcum (in packages), face, and compact	(1)	966,473
1938	Talc, steatite, and soapstone, crude and ground	7,118	124,194
	Powders—talcum (in packages), face, and compact	(1)	978,100
1939	Talc, steatite, and soapstone, crude and ground	9,047	162,426
	Powders—talcum (in packages), face, and compact	(1)	1,115,176
1940	Talc, steatite, soapstone, and pyrophyllite, crude and ground	9,402	167,992
	Powders—talcum (in packages), face, and compact	(1)	945,530

[1] Quantity not recorded.

WORLD PRODUCTION

Production figures for talc, pyrophyllite, and soapstone in foreign countries in 1940 are available at this time only for Indochina, Union of South Africa, and Uruguay, where the quantities produced were comparatively small; in these three countries an increase occurred in the Union of South Africa only. The data available show no marked changes in the generally established production trends. The United States, long by far the leading producing nation, apparently retained that position in 1939 and 1940.

World production of talc and soapstone, 1936–40, by countries, in metric tons [1]

[Compiled by L. P. Lounsbery]

Country [1]	1936	1937	1938	1939	1940
Argentina	177	208	80	303	(2)
Australia:					
New South Wales	520	526	597	(2)	(2)
South Australia	1,003	991	973	1,115	(2)
Tasmania	3				(2)
Canada [3]	13,161	11,301	9,846	11,924	(2)
China (Manchuria)	80,326	(2)	(2)	(2)	(2)
Egypt	351	2,266	1,251	833	(2)
Finland	1,683	881	(2)	(2)	(2)
France	51,550	56,300	(2)	(2)	(2)
Germany:					
Austria (exports)	19,975	14,089	5,625	(2)	(2)
Bavaria	9,589	7,790	6,805	(2)	(2)
Greece	864	1,838	1,293	1,003	(2)
India, British	10,128	13,249	18,888	22,616	(2)
Indochina	630	428		400	305
Italy	43,938	45,714	53,511	(2)	(2)
Morocco, French (exports)	1,368	841	1,702	(2)	(2)
Norway	29,714	24,701	23,703	(2)	(2)
Rumania	2,529	1,976	2,256	(2)	(2)
Sweden	7,146	7,937	6,797	7,195	(2)
Tanganyika Territory			38	5	(2)
Union of South Africa (Transvaal)	413	376	1,554	449	1,757
United States [4]	196,124	208,650	193,025	230,402	[5] 255,258
Uruguay (exports)	772	437	952	2,460	1,699

[1] In addition to the countries listed talc is produced in Brazil, Bulgaria, Newfoundland, Spain, and the U. S. S. R., but data on production are not available.
[2] Data not available.
[3] Excludes soapstone, which is reported only by value and was as follows: 1936, $32,770; 1937, $40,513; 1938, $35,038; 1939, $41,471; 1940, data not available. Soapstone is sold in the form of both blocks and powder.
[4] Talc, pyrophyllite, and ground soapstone sold or used by producers.
[5] Includes a small quantity of pinite.

FLUORSPAR AND CRYOLITE

By H. W. Davis and M. E. Trought [1]

SUMMARY OUTLINE

FLUORSPAR

Greatly expanded operations at steel mills, the chief consumers of fluorspar, coupled with increased production of hydrofluoric acid, which is essential in the manufacture of artificial cryolite (an aluminum raw material), stimulated activity in the fluorspar industry in 1940 and resulted in the mining, milling, and shipment of substantially larger quantities of fluorspar than in 1939. In fact, so great was the demand for fluorspar that shipments from domestic mines in 1940 were the second highest on record. Shipments from Kentucky and Nevada established all-time highs, and the movement from Illinois was the largest since 1920. Shipments by river or river-rail also made a new record. Sales of imported fluorspar, however, were 41 percent less than in 1939. On the other hand, exports, which usually are small, jumped to 8,482 tons, some of which went to India.

Sales of fluorspar to consumers in the United States totaled 236,042 short tons in 1940 (225,118 tons from domestic mines and 10,924 from foreign sources) compared with 198,198 tons in 1939 (179,795 tons from domestic mines and 18,403 from foreign sources). Total sales to the steel industry increased to 172,047 tons in 1940 (139,060 in 1939), while sales to manufacturers of hydrofluoric acid advanced to 35,242 tons (31,966 in 1939). Sales to makers of glass and enamel, however, dropped to 20,280 tons (22,018 in 1939).

Despite the large demand for fluorspar in 1940, the average composite selling price ($20.40 a ton) of all grades (both domestic and foreign) delivered to consumers in the United States was slightly less than in 1939 ($20.45). The average selling price f. o. b. Illinois-Kentucky mines of fluorspar shipped to domestic steel plants was $18.93 a short ton ($18.24 in 1939), of that shipped to manufacturers of hydrofluoric acid $26.10 ($27.34 in 1939), and of that to makers of glass and enamel $28.26 ($26.87 in 1939). The average selling price at seaboard (duty paid) of imported fluorspar shipped to steel plants was $22.03 a short ton in 1940 ($20.64 in 1939) and of that shipped to makers of hydrofluoric acid $27.44 ($29.76 in 1939).

[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 of fluorspar supplied by the producers. No exports recorded by the Bureau of Foreign and Domestic Commerce.

Salient statistics of the fluorspar industry in the United States, 1939–40

	1939		1940	
	Short tons	Value	Short tons	Value
Shipments from domestic mines—				
To consumers in United States:				
Metallurgical	130,131	$2,327,814	170,638	$3,159,531
Ceramic	22,201	572,319	20,872	554,671
Chemical	27,463	730,383	33,608	852,139
To consumers in foreign countries	2,976	74,443	8,482	178,467
	182,771	3,704,959	233,600	4,744,808
Stocks at mines or shipping points Dec. 31:				
Ready-to-ship	38,619	(1)	43,866	(1)
Crude	26,746	(1)	30,859	(1)
	65,365	(1)	74,725	(1)
Imports for consumption:				
Containing more than 97 percent CaF_2	3,351	79,088	3,050	59,398
Containing not more than 97 percent CaF_2	12,951	97,603	8,821	83,533
	16,302	176,691	11,871	142,931
Consumption (by industries):				
Metallurgical	128,600	(1)	162,100	(1)
Ceramic	21,900	(1)	19,400	(1)
Chemical	26,300	(1)	35,700	(1)
	176,800	(1)	217,200	(1)
Stocks at consumers' plants Dec. 31:				
Metallurgical	73,000	(1)	84,500	(1)
Ceramic	3,300	(1)	4,600	(1)
Chemical	14,100	(1)	14,300	(1)
	90,400	(1)	103,400	(1)

[1] Figures not available.

Because of the emphasis that has centered lately upon minerals from the defense standpoint, the following historic tables comprising data on production and imports may be of interest in studying the position of fluorspar.

The total quantity of fluorspar shipped in and imported into the United States from about 1870 through 1940 was about 5,579,000 short tons, including about 81 percent from domestic mines and 19 percent from foreign sources.

The total shipments since commercial production was begun (about 1870) in the United States through 1940 were approximately 4,528,000 short tons, of which Illinois and Kentucky contributed 56 and 36 percent, respectively. Imports of fluorspar into the United States from 1910 through 1940 were 894,231 short tons, and imports before 1910 are estimated at 157,000 tons—a total of about 1,051,000 tons, of which the United Kingdom and Germany contributed 50 and 20 percent, respectively.

Fluorspar shipped[1] from mines in the United States, 1880–1940, by States[2]

Year	Arizona		Colorado		Illinois		Kentucky		Nevada		New Hampshire		New Mexico		Tennessee		Utah		Other States		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1880–1909[3]	718	$7,280	5,807	$27,766	330,120	$1,965,288	203,929	$1,188,477					710	$3,728	1,020	$6,920					542,304	$3,199,459
1910			268	1,608	47,302	277,764	17,003	124,574					4,854	26,250							69,427	430,196
1911			721	4,226	68,817	481,635	12,403	96,574			800	$6,400	4,307	22,612							87,048	611,447
1912			1,639	9,834	103,937	695,467	10,473	61,186			300	1,500	196	1,176							116,545	769,163
1913	100	800	4,432	26,592	85,854	550,815	19,622	113,903			200	1,200	5,372	42,976							115,580	736,286
1914			1,978	12,992	73,811	426,063	19,077	128,986			250	2,000									95,116	570,041
1915			247	1,482	116,340	624,040	19,219	129,873			650	5,200	485	3,880							136,941	764,475
1916	199	2,587	8,669	42,457	126,369	746,150	19,698	123,596			800	7,864									155,735	922,654
1917	135	1,080	17,104	196,633	156,676	1,373,333	43,639	697,566			1,274	19,110									218,828	2,287,722
1918	364	5,537	38,475	416,780	132,798	2,887,099	87,604	2,069,185			1,059	21,243	3,437	64,348			20	$465	[4] 60	[4] $824	263,817	5,465,481
1919	45	450	9,687	150,739	92,729	2,430,361	32,386	883,171	400	$5,600	531	12,826	2,346	37,643			166	4,784			138,290	3,525,574
1920	181	3,264	12,852	251,308	120,299	3,096,767	46,091	1,246,942	532	8,672	202	4,040	6,353	101,460			268	6,094			186,778	4,718,547
1921			3,143	39,907	12,477	815,767	15,266	294,513			567	13,721	3,507	60,186							34,960	724,094
1922			2,309	20,169	83,855	1,498,188	52,484	970,059			690	15,353	2,180	30,992			78	1,404			141,596	2,531,165
1923			6,044	59,710	65,045	1,443,490	45,441	945,402			142	3,160	4,328	50,861			188	3,196			121,188	2,505,819
1924			12,301	135,411	62,067	1,288,310	47,847	988,940					2,580	35,178			184	3,292			124,979	2,451,131
1925			11,776	153,707	54,428	1,024,516	44,826	833,794					2,639	40,325							113,669	2,052,342
1926			10,440	128,211	53,734	1,012,879	62,494	1,167,129					1,989	33,058							128,657	2,341,277
1927			6,432	82,503	46,006	863,909	57,495	1,040,338					2,613	47,978							112,546	2,034,728
1928			1,815	18,040	65,884	1,154,983	69,747	1,426,766	455	6,603			2,589	50,162							140,490	2,656,554
1929			4,808	56,607	67,009	1,284,834	70,827	1,390,603	1,357	23,400			2,438	35,682							146,439	2,791,126
1930			9,248	101,758	44,134	836,473	39,181	763,370	974	14,267			2,312	30,775							95,849	1,746,643
1931			529	5,921	28,072	468,386	23,462	437,642	395	5,697			1,026	13,629							53,484	931,275
1932			333	3,330	9,615	156,279	14,725	225,052	49	882			529	6,956							25,251	392,499
1933			742	6,778	36,075	543,060	34,614	469,451	505	6,639			994	13,250							72,930	1,039,178
1934			6,537	83,132	33,234	567,396	43,163	690,990	631	8,817			2,040	39,020					[5] 181	[5] 2,050	85,786	1,391,405
1935			6,978	88,454	44,120	685,794	68,679	1,017,451	1,040	([6])	12	([6])	2,726	([6])	6	116	180	([6])			123,741	1,860,638
1936	40	([6])	9,412	109,411	82,056	1,525,606	80,241	1,409,433	2,126	([6])	257	([6])	2,045	([6])			700	([6])			176,877	3,119,668
1937	610	([6])	7,883	98,493	78,664	1,730,585	87,296	1,710,122	2,544	([6])	478	([6])	3,324	([6])			431	([6])			181,230	3,666,629
1938	1,093	([6])	1,704	([6])	35,368	751,227	34,803	678,094	2,909	([6])	90	([6])	4,066	([6])			370	([6])			80,403	1,599,666
1939	([6])	([6])	7,569	107,459	75,257	1,638,693	89,563	1,773,063	3,520	([6])			([6])	([6])			385	([6])			182,771	3,704,959
1940	([6])	([6])	11,032	163,285	104,698	2,313,747	103,939	2,043,866	5,803	([6])			([6])	([6])			142	([6])			233,600	4,744,808
	([6])	([6])	222,914	([6])	2,536,850	36,653,904	1,617,237	27,140,111	23,240	([6])	8,302	([6])	([6])	([6])	1,026	7,036	3,112	([6])	241	2,874	4,502,855	68,286,649

[1] Figures for 1880–1905 represent production.
[2] Figures on production not recorded for Colorado before 1905, for Illinois before 1880, and for Kentucky before 1886 and for 1888–95; total unrecorded production, chiefly from Illinois, estimated at 25,000 short tons.
[3] Figures by years for 1880–1909 are given in Mineral Resources of the United States, 1925, pt. 2, p. 13.
[4] Washington. [5] California. [6] Bureau of Mines not at liberty to publish figures.

Fluorspar imported into the United States, 1910–40, by countries [1]

Year	Africa		Canada		France		Germany		Italy		Newfoundland		Spain		United Kingdom		Other countries [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1910							142	$1,386							42,335	$133,716	11	$50	42,488	$135,152
1911							198	1,919							32,566	78,673			32,764	80,592
1912							256	2,444							25,920	69,172			26,176	71,616
1913							320	3,073							22,362	68,390			22,682	71,463
1914							184	1,818							10,021	37,125			10,205	38,943
1915							127	1,154							7,040	21,724			7,167	22,878
1916															12,323	54,000			12,323	54,000
1917			618	$3,813											12,998	110,785			13,616	114,598
1918			913	21,973											11,659	147,391			12,572	169,364
1919			902	13,532											6,041	94,099			6,943	107,631
1920	30	$1,080	7,068	110,532			407	9,450							17,096	144,142	11	426	24,612	265,630
1921			4,370	52,855			215	4,420							1,644	12,031			6,229	69,306
1922	486	8,415	2,877	32,679			5,804	49,196							23,836	206,950	105	1,948	33,108	299,188
1923	10,380	157,625	(3)	5			8,580	67,595	268	$2,471					22,862	202,548	136	2,075	42,226	432,319
1924	11,125	147,977	213	3,216	232	$2,782	6,834	69,357	1,585	14,804					29,365	298,391	1,689	19,115	51,043	555,642
1925	7,906	108,647			2,537	20,887	11,680	103,845	4,278	32,208					21,635	195,229	664	8,031	48,700	468,847
1926	8,506	136,502	1,109	10,310	11,163	90,737	20,465	171,769	1,379	15,434			2,948	$33,915	29,407	281,735	694	6,835	75,671	747,237
1927	7,069	90,966	560	4,250	11,711	86,279	31,829	230,821	449	5,969			978	3,650	18,449	168,840	470	4,410	71,515	595,185
1928	2,661	36,471			15,072	141,434	17,601	150,872	1,033	9,600			680	5,178	9,360	56,585	776	8,560	47,183	408,700
1929	6,387	75,856			16,850	159,059	16,488	140,860	1,258	10,528			7,168	52,039	4,828	30,580	1,366	12,053	54,345	480,975
1930	2,712	31,069			23,313	184,238	23,797	189,587	1,802	17,198			6,784	53,612	5,756	60,995	739	7,957	64,903	544,656
1931	3,672	40,375	280	2,313	4,462	33,646	6,491	77,067	1,523	24,267			4,068	31,786			213	1,981	20,709	211,435
1932	1,587	14,809			1,578	9,588	5,842	70,294	1,457	11,848			2,659	24,881	[4] 1	[4] 378	112	867	13,236	132,665
1933	712	12,449			204	1,247	4,333	54,836	533	4,533	320	$2,646	4,262	28,690	17	229	27	413	10,408	105,043
1934	1,997	31,872	187	2,962			8,224	98,565	60	587	745	10,460	4,914	35,316	466	2,534	112	990	16,705	183,286
1935	1,347	23,739	1	14			9,843	119,275	55	589			5,094	35,432					16,340	179,049
1936	947	19,424			1,595	16,039	12,944	160,937			4,317	28,497	5,701	31,365					25,504	256,262
1937	1,194	19,479			14,158	80,816	14,501	219,393	1,124	5,752	5,520	67,723	566	4,464					37,063	397,627
1938	3,359	56,298			7,411	67,097	3,062	51,304			4,752	103,909	309	3,535	644	4,237	85	1,263	19,622	287,643
1939					13,094	100,769	19	603			2,268	61,775	168	2,542	56	650	697	10,352	16,302	176,691
1940					5,735	47,345					3,640	69,825	112	841			2,384	24,920	11,871	142,931
	72,077	1,013,053	19,098	258,454	129,115	1,041,963	210,186	2,051,840	16,804	155,788	21,562	344,835	46,411	347,246	368,687	2,481,129	10,291	112,246	894,231	7,806,554

[1] Imports Aug. 1 to Dec. 31, 1909, 6,971 short tons valued at $26,377; not separately recorded before Aug. 1, 1909. Imports before Aug. 1, 1909, virtually all from the United Kingdom, estimated at 150,000 short tons.
[2] Argentina, Australia, Austria-Hungary, Belgium, China, Czechoslovakia, Mexico, Netherlands, Norway, Tunisia, and Soviet Russia in Asia.
[3] Quantity not recorded.
[4] Optical fluorspar.

Production and shipments.—Production of merchantable fluorspar amounted to 244,000 short tons in 1940 compared with 173,000 in 1939. Of the production in 1940, 6 mines producing over 10,000 tons each accounted for 106,600 tons or 44 percent, 10 mines producing 5,000 to 10,000 tons each accounted for 67,800 tons or 28 percent, 22 mines producing 1,000 to 5,000 tons each accounted for 44,700 tons or 18 percent, and 16 mines producing 500 to 1,000 tons each accounted for 10,900 tons or 4 percent. Thus, 54 mines produced 230,000 tons or 94 percent of the total. The remainder (14,000 tons or 6 percent) was produced in quantities ranging from a few tons to 500 from an undetermined but large number of small mines and prospects and reclaimed from mill ponds, waste dumps, and old workings of abandoned mines.

Fluorspar shipments from domestic mines in 1940 were the second highest on record and aggregated 233,600 short tons valued at $4,744,808, increases of 28 percent both in quantity and total value over 1939. In 1940 they were equivalent to 187 percent of the average annual tonnages shipped in the 5-year period 1926–30. Of the 1940 shipments, 66,428 tons (an all-time high) were shipped by river or by river-rail for delivery to consumers in Illinois, Kentucky, New Jersey, Ohio, and Pennsylvania and for export to India. In 1939, 48,648 tons were so shipped.

In 1940, mines operated by or for consumers shipped 53,162 short tons of fluorspar for use in their own plants compared with 36,335 tons in 1939.

The average value of all grades of domestic fluorspar shipped in 1940 was $20.31, or virtually the same as the 1939 average. The value recorded for domestic fluorspar is the price paid f. o. b. mine shipping point and excludes the cost of containers.

The following table shows shipments of fluorspar by States for 1939 and 1940.

Fluorspar shipped from mines in the United States, 1939–40, by States

State	1939			1940		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Colorado	7,569	$107,459	$14.20	11,032	$163,285	$14.80
Illinois	75,257	1,638,693	21.77	104,698	2,313,747	22.10
Kentucky	89,563	1,773,063	19.80	103,939	2,043,866	19.66
Arizona / New Mexico	6,477	132,408	20.44	7,986	139,675	17.49
Nevada	3,520	53,336	13.66	5,803	84,235	14.17
Utah	385			142		
	182,771	3,704,959	20.27	233,600	4,744,808	20.31

Shipments, by uses.—The predominance of the steel industry as a purchaser of fluorspar is evident from the following table.

Fluorspar shipped from mines in the United States, 1939–40, by uses

Use	1939				1940			
	Quantity		Value		Quantity		Value	
	Percent of total	Short tons	Total	Average	Percent of total	Short tons	Total	Average
Steel	68.59	125,371	$2,234,996	$17.83	69.68	162,772	$2,998,054	$18.42
Foundry	1.31	2,391	42,428	17.74	1.21	2,829	50,758	17.94
Glass and enamel	11.97	21,884	569,349	26.02	8.68	20,269	548,069	27.04
Hydrofluoric acid	15.03	27,463	730,383	26.60	14.39	33,608	852,139	25.36
Miscellaneous	1.47	2,686	53,360	19.87	2.41	5,640	117,321	20.80
	98.37	179,795	3,630,516	20.19	96.37	225,118	4,566,341	20.28
Exported	1.63	2,976	74,443	25.01	3.63	8,482	178,467	21.04
	100.00	182,771	3,704,959	20.27	100.00	233,600	4,744,808	20.31

Uses.—As figure 1 shows graphically, the steel industry is the chief consumer of fluorspar in the United States, followed in order by the hydrofluoric acid, glass, and enamel industries. Comparatively small quantities of fluorspar are used in a number of miscellaneous operations, such as production of the finer grades of iron castings, nickel and Monel metal, cement, ferro-alloys, carbon electrodes, and calcium carbide and cyanamid; reducing aluminum; refining lead and silver; extracting various rare metals from their ores; smelting refractory ores of gold, silver, and copper; as a paint pigment; and as a binder in abrasives.

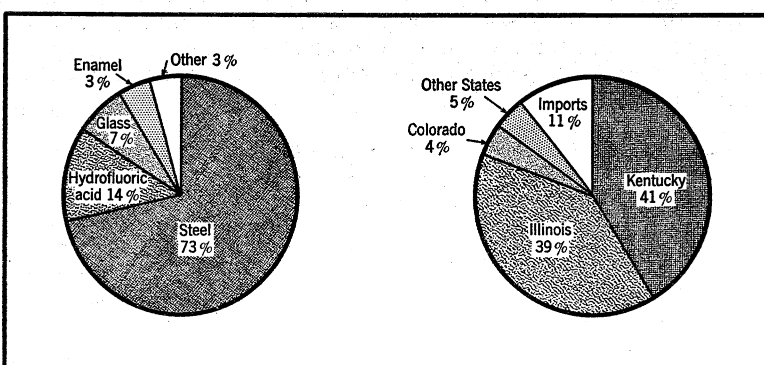

FIGURE 1.—Average annual fluorspar sales (domestic and foreign) to consumers in the United States, 1936–40, by consuming industries and by sources.

Schwerin [2] has discussed the use of fluorspar as a metallurgical flux and has outlined the results of his research in that field.

According to Lightner,[3] the advantages obtainable in open-hearth operation by the use of low-silicon iron include the requirement of less lime and fluorspar to control the sulfur and phosphorus.

[2] Schwerin, Lenher, Fluorspar—Its Chemical and Industrial Applications: Chem. Education, vol. 17, No. 4, April 1940, pp. 160–165.

[3] Lightner, M. W., Open-hearth Operators Discuss Advances in Steel-making Methods: Metal Progress, June 1940, pp. 647–652.

Chief commercial grades of fluorspar

Name	Chief use	Form	Specifications, in percent		
			CaF_2 (minimum)	SiO_2 (maximum)	Fe_2O_3 (maximum)
Metallurgical	Basic open-hearth steel.	Washed gravel, less than 1 inch and not more than 15 percent of fines.	85	5	
Ceramic	Glass and enamel	Ground: Coarse, fine, and extra fine	95	3	0.12
Acid	Hydrofluoric acid	Lump, gravel, and ground	98	1	

Consumption and consumers' stocks.—The following tables give data on consumption and stocks of fluorspar.

Fluorspar (domestic and foreign) consumed and in stock in the United States, 1939–40, by industries, in short tons

[Partly estimated by Bureau of Mines]

Industry	1939		1940	
	Consumption	Stocks at consumers' plants Dec. 31	Consumption	Stocks at consumers' plants Dec. 31
Basic open-hearth steel	116,200	69,900	143,800	79,800
Electric furnace steel	7,600	1,400	11,700	1,700
Foundry	2,400	800	2,700	900
Ferro-alloys	1,100	400	1,900	900
Hydrofluoric acid	26,300	14,100	35,700	14,300
Enamel and glass	21,400	3,100	18,900	4,400
Miscellaneous	1,800	700	2,500	1,400
	176,800	90,400	217,200	103,400

Consumption and stocks of fluorspar (domestic and foreign) at basic open-hearth steel plants, 1936–40

	1936	1937	1938	1939	1940
Production of basic open-hearth steel ingots and castings long tons	43,615,000	46,361,000	25,868,000	43,368,000	55,038,000
Consumption of fluorspar in basic open-hearth steel production short tons	133,900	138,900	73,600	116,200	143,800
Consumption of fluorspar per ton of steel made pounds	6.1	6.0	5.7	5.4	5.2
Stocks of fluorspar on hand at steel plants at end of year short tons	59,200	71,400	55,000	69,900	79,800

The quantity of fluorspar used by individual plants per ton of basic open-hearth steel produced ranges from 1 to 50 pounds—a relatively small proportion of the furnace charge. The average is generally 5 to 8 pounds, but it decreased to 5.22 pounds in 1940 from 5.36 pounds in 1939. It is noteworthy that since 1921—the first year for which these data were collected—the average consumption of fluorspar per ton of basic open-hearth steel made has declined almost steadily from 8.2 to 5.2 pounds. The following table shows the variation in average consumption of fluorspar per ton of basic open-hearth steel over a 5-year period in certain plants that make about 88 percent of the total.

Average consumption of fluorspar (domestic and foreign) per ton of steel, 1936–40, in pounds

1936	1937	1938	1939	1940	1936	1937	1938	1930	1940
13.187	13.867	12.548	14.079	15.973	6.734	7.360	8.420	6.337	5.972
4.792	5.623	4.457	3.623	3.453	10.495	6.623	11.984	8.506	8.369
4.541	4.376	3.845	3.793	3.929	5.104	4.358	3.831	3.171	.807
10.519	8.795	8.297	8.095	5.566	5.027	6.619	6.448	6.551	7.447
4.105	3.550	6.843	6.814	6.137	6.357	8.895	8.340	9.370	8.692
5.160	5.275	3.694	3.709	4.183	5.917	5.236	6.195	4.578	5.043
7.416	6.404	6.806	4.958	4.599	6.789	6.816	6.097	6.896	7.356

Quoted prices.—In 1940 the quoted price f. o. b. Illinois-Kentucky mines for fluxing gravel fluorspar ranged from $19 to $22 a short ton for rail delivery and $20 to $22 a ton for barge delivery at Ohio River and tributary landings. Imported fluxing gravel fluorspar (at seaboard, duty paid) was quoted at $25 to $25.50 a short ton.

Stocks at mines or shipping points.—According to reports of producers the quantity of fluorspar in stock at mines or shipping points at the close of 1940 totaled 74,725 tons, or 14 percent more than in 1939. These stocks comprised about 30,900 tons of crude fluorspar (calculated to be equivalent to 20,000 tons of ready-to-ship fluorspar) and 43,866 tons of ready-to-ship fluorspar.

Stocks of fluorspar at mines or shipping points in the United States, Dec. 31, 1939 and 1940, by States, in short tons

State	1939			1940		
	Crude [1]	Ready-to-ship	Total	Crude [1]	Ready-to-ship	Total
Arizona		209	209			
California	150		150	150		150
Colorado	565	329	894	205	364	569
Illinois	17,667	17,163	34,830	23,934	18,269	42,203
Kentucky	4,570	20,333	24,903	3,906	22,707	26,613
New Mexico	3,686	585	4,271	2,604	2,483	5,087
Texas	48		48		43	43
Utah	60		60	60		60
	26,746	38,619	65,365	30,859	43,866	74,725

[1] The greater part of this crude (run-of-mine) fluorspar must be beneficiated before it can be marketed.

Technologic developments.—Interest in the flotation of fluorspar continued in 1940. New plants were completed by the Rosiclare Lead & Fluorspar Mining Co. at Rosiclare, Ill., and by the Southwestern Mineral Co. at Fox, Ariz., and a plant is being constructed by the Non-Metallic Corporation at Silver City, N. Mex. The plants planned at Lordsburg, N. Mex., by the Fluorspar Milling Co., and at Skyline, Mont., by Paul E. Flynn, noted in the chapter of this series for 1940, were not installed. Output of flotation concentrates was 41,467 short tons in 1940 compared with 22,450 in 1939.

A method of producing fluorspar-bearing metallurgical flux is covered by United States Patent 2,232,242 granted to Fred A. Jordan, assignor to Mahoning Mining Co. The principal object of this invention is to provide a synthetic metallurgical flux of the required fluorspar content as well as physical form from fluorspar concentrates or other fluorspar-bearing materials which cannot be used as metallurgical fluxes because of their finely divided condition. A further objective is the production of a metallurgical flux from such materials by initially agglomerating a mass thereof and then treating the agglomerated mass to yield relatively large lumps of hard, water-resistant, fluorspar-bearing material having physical and chemical properties that adapt it for substantially all the purposes served hitherto by the natural flux. Another objective is to provide a novel method of producing, from finely divided fluorspar concentrates or like materials heretofore considered virtually useless for fluxing, a synthetic metallurgical fluorspar flux which is in such physical condition that it can be handled and charged readily and which conforms to or even excels the usual chemical and physical trade specifications for natural flux. The method of making fluorspar-bearing metallurgical flux comprises preparing a dry mixture of fluorspar concentrate and petroleum coke, then spraying the mixture with water while continuing the mixing to form damp pellets of the mixed solids, subjecting the pelletized material to a sintering operation to effect substantially complete combustion of the coke and then cooling the residual solid while maintaining, in the resultant irregularly shaped lumps thereof, the voids produced by combustion of the coke.

The Mahoning Mining Co., which operates a flotation plant at Rosiclare, Ill., shipped several thousand tons of fluorspar to the steel trade in 1940, presumably pelletized material produced by the above method.

A process of concentrating minerals of the class comprising phosphate, calcite, barite, and fluorspar is the subject of United States Patent 2,222,728. This patent describes flotation tests of fluorspar from Hillside Fluor Spar Mines.

INDUSTRY IN 1940, BY STATES

Arizona.—Except for a small quantity from Pima County, production in Arizona came from mines and prospects in Greenlee County, and most of it was shipped to steel plants. Some, however, was shipped to the flotation plants at Fox, Ariz., and at Deming and Lordsburg, N. Mex. Instead of the run-of-mine material produced, the flotation concentrates recovered from the fluorspar have been credited to Arizona in the statistics. The new flotation mill of the Southwestern Mineral Co. at Fox, Ariz., was completed and put into operation during 1940; the mill feed comprised ore chiefly from the company's Mohawk and Great Eagle mines in Grant County, N. Mex., and shipments of concentrates were made to the chemical, ceramic, and metallurgical industries.

California.—Some development work was done at the Big Horn mine, San Bernardino County. Development work was also in progress at the Warm Springs prospect near Shoshone, Inyo County, from May to August 26, when operations were discontinued. Some Nevada fluorspar was ground at the grinding plant at West Berkeley and shipped to the ceramic trade during 1940. The ground fluorspar has been credited to Nevada in the statistics.

Colorado.—Increased production at the mines of the American Fluorspar Corporation and the Colorado Fluorspar Corporation in Chaffee County and at the Wagon Wheel Gap mine in Mineral County is indicated by the shipments of 11,032 short tons of fluorspar from

Colorado in 1940 compared with 7,569 tons in 1939. Most of the 1940 shipments went to steel plants, but some went to iron foundries and to ferro-alloy, cement, glass, and enamel plants. Production in 1940 came from Boulder, Chaffee, Jackson, Jefferson, and Mineral Counties, but mines in Chaffee and Mineral Counties supplied 94 percent of the total for Colorado.

At the 125-ton combination flotation-jig mill of the Colorado Fluorspar Corporation at Salida (which was completed the latter part of 1939 but was closed after a short test run) mechanical changes were made in the flow sheet; the mill was again put into operation during November 1940, and over 200 tons of flotation concentrates were produced. The Western Feldspar Milling Co. shipped 493 tons of ground fluorspar to the ceramic trade from its mill at Denver.

Illinois.—Approximately 213,000 short tons of fluorspar-bearing ore, equivalent to 111,000 tons of merchantable fluorspar, were mined in 1940 compared with about 128,000 tons, equivalent to 71,000 tons of merchantable fluorspar, in 1939. Of the merchantable fluorspar produced in 1940, 61,000 tons were from mines where the fluorspar occurs in veins, chiefly fault fissures, and 50,000 from mines where the fluorspar occurs in flatlying tabular masses, locally called blanket formations. Except for a small output at the Clay Diggings prospect and the Douglas mine in Pope County, production came from Hardin County.

Fluorspar-bearing material milled in Illinois in 1940 totaled 208,000 tons, from which 105,000 tons of fluorspar were recovered—a ratio of 1.98 : 1.

Shipments from Illinois—the largest since 1920—totaled 104,698 tons in 1940 compared with 75,257 in 1939; 36,756 tons were shipped by river or river-rail to consumers in 1940 compared with 23,989 in 1939.

The Air Shaft, Argo, Cave in Rock, Crystal, Daisy-Blue Diggings, W. L. Davis, Hamp, Hillside, Humm, Midway-North Boundary, Spar Mountain, Stewart, and Victory mines supplied about 95 percent of the total merchantable fluorspar produced in Illinois during 1940. Most of the remainder came from the Big Creek, Boundary Shaft, Dimick, Douglas, Eureka No. 5, Guard & Kamm, Lead Hill, Pell, and Preen mines.

At the Argo mine of the Aluminum Ore Co. crosscuts were driven north and south on the 500-foot level, and at its Hamp mine a three-compartment shaft was begun during 1940 and sunk vertically to 178 feet by the end of the year. The flotation plant of the company was inactive during November on account of a strike at its East St. Louis plant, but otherwise it operated three shifts during the year; the capacity was increased, and drying and grinding equipment were added to the mill. The company output of flotation concentrates was 32 percent greater than in 1939.

Production at the Crystal mine of Crystal Fluorspar Co. increased 37 percent over that in 1939. The mine was operated on a two-shift basis from June 24 to August 19 and the mill on a two-shift basis from June 24 to October 24.

Output of the Hillside Fluor Spar Mines (Hillside mine at Rosiclare, Ill., and Keystone near Marion, Ky.) was 56 percent more than in 1939. The flotation plant, which was completed late in 1939, produced 1,464 tons of concentrates in 1940.

The Rosiclare Lead & Fluorspar Mining Co. operated the Air Shaft, Boundary Shaft, Daisy-Blue Diggings, Eureka No. 5, and Midway-North Boundary mines in 1940, and output was about 7 percent greater than in 1939. Its Rosiclare mine, which has been flooded since January 1924, has been dewatered to below the 600-foot level, and work has been begun on cleaning the mine and retimbering shafts preparatory to production. At the 600-foot level, four station pumps having a capacity of 1,000 gallons per minute each have been installed. These pumps, with a deep-well-type pump having a capacity of 3,200 gallons a minute at 620-foot head and equipped with a 600-horsepower motor installed in the main shaft, give a pumping capacity of 7,200 gallons a minute, or more than double the inflow of water. The large pump will be used as a stand-by unit. A small flotation plant for handling low-grade fluorspar fines was added to the Rosiclare plant in 1940 and produced 491 tons of concentrates.

The Cave-in-Rock Spar Co. completed a mill at Cave in Rock during 1940. In addition to increased production from its own mines, the company treated a larger quantity of purchased ore in its mills; as a consequence, shipments were about four times greater than in 1939.

Production of fluorspar concentrates at the mill of Mahoning Mining Co. increased 254 percent in 1940. The mill was put into operation in June 1939 and produces fluorspar, lead, and zinc concentrates by selective flotation. In 1940 the mill feed comprised ore from the company W. L. Davis mine and a small quantity of tailings from the old Benzon mill. Of the fluorspar flotation concentrates shipped in 1940, 21.9, 0.5, and 59.1 percent, respectively, went to domestic steel, glass, and hydrofluoric acid plants, and 18.5 percent was exported to Canada.

The Big Creek Fluorspar Co. did prospecting and development work at its Big Creek mines and is considering erection of a mill that will produce 2½ to 3 tons of finished fluorspar hourly.

Knight, Knight & Clark operated its mill on ore from the Douglas mine in Pope County, purchased ore from the Spar Mountain mine, and ore from the Ellis mine in Livingston County, Ky.

The Fluorspar Products Co. operated the Lead Hill and Stewart mines and in addition milled purchased ore from the Spar Mountain and other properties.

Production at the Humm mine, operated by C. C. Mackey, was somewhat less than in 1939.

Beecher Williams operated the Cox and Pell mines and in addition milled purchased ore from the Spar Mountain and other properties.

Kentucky.—Production of merchantable fluorspar in Kentucky was 107,000 short tons in 1940 compared with 81,000 in 1939; and shipments, which established an all-time high, were 103,939 tons compared with 89,563 in 1939. Of the 1940 shipments, 29,672 tons were shipped by river or river-rail to consumers compared with 24,659 in 1939.

The effect of resuming operation at the S. L. Crook Corporation properties by J. D. Summers & Co., W. H. Crider, and others and at the Hollowell & Hobby mine by the New York & Kentucky Mining Co., plus output at the H. & W. mine by H. W. Morse, is mirrored in the output of about 5,000 tons of fluorspar in Caldwell County in 1940.

Production in Crittenden County, totaling 80,000 short tons, came chiefly from the Bachelor, Davenport, Keystone, Mary Belle, Pigmy, Summers, Tabb, and Watson (Eagle) mines, which contributed 83 percent of the county total. Most of the remainder came from the Beard, Blue, Butler, Dyke, Haffaw, Susie Beeler, and Two Brothers mines, which supplied 6 percent of the county total.

The Beard, Brown, Cross, Haffaw, Mary Belle, Memphis, Split Nickel, and Susie Beeler mines of the Aluminum Ore Co. were operated by lessees, and output was 185 percent more than in 1939. Most of the output, as well as a small quantity of purchased ore, was milled in the company plant at Marion. Production of finished fluorspar at the mill was 69 percent greater than in 1939.

The Watson (Eagle) mine of the Eagle Fluor Spar Co. was operated on a two-shift basis, and the output of finished fluorspar was 29 percent larger than in 1939.

R. J. Forester's Summers mine, inactive since 1937, was reopened in 1940.

The Tabb mines and mill of the United States Coal & Coke Co. were worked on a two-shift basis during 1940, and production of finished fluorspar was 18 percent higher than in 1939. Shipments, however, increased 50 percent. In addition to the production from the Tabb mines, contractors made a considerable output on the company properties; most of it was treated in the company mill.

The Two Brothers mine was operated by J. D. Summers & Co. the first half of 1940, after which the lease was surrendered. Production was about 65 percent less than in 1939.

The Kentucky Fluor Spar Co., which has a mill a short distance south of Marion, shipped 15 percent more fluorspar than in 1939. The company does not operate any mines but buys part or all of the output of many local mines and prospects. In 1940 the company obtained its supply chiefly from the Babb, Blue, Crook, Dyke, Eagle, H. & W., Hollowell & Hobby, and Nancy Hanks mines in Kentucky and the Guard & Kamm and Spar Mountain mines in Illinois.

The Keystone mine of Hillside Fluor Spar Mines was operated on a two-shift basis, and output was substantially greater than in 1939. Although the fluorspar from the Keystone mine is finished at the company mill at Rosiclare, Ill., production and shipments are credited to Kentucky in the statistics.

Production at the Pigmy mine of Pigmy Corporation was about 300 percent more than in 1939. Some of the fluorspar from the Pigmy mine is processed further at the Rosiclare (Ill.) mill of the Rosiclare Lead & Fluorspar Mining Co., but the finished product so recovered is included in the statistics for Kentucky.

The Davenport mine of National Fluorspar Co. made a 35-percent increase in output in 1940 compared with 1939. Extensive development was done on the east vein at the 260-foot level of No. 3 shaft, and a winze was sunk from the 260- to the 300-foot level.

Production at the Bachelor mine of the Delhi Fluorspar Corporation was 21 percent greater than in 1939. A new shaft was sunk 350 feet at the Bachelor mine.

Shipments of fluorspar by the Howard Easley Corporation were 81 percent larger than in 1939. This concern does not operate any mines but purchases fluorspar from numerous mines and prospects; it also operates a mill at Marion, where much of the purchased fluorspar is finished and where considerable tonnages are milled for others on a custom basis.

W. H. Crider made some production at the Crook property in Caldwell County and at the Haffaw mine in Crittenden County. Virtually all fluorspar from the Haffaw mine was sold to the local mill of Aluminum Ore Co. The output from the Crook property, with fluorspar purchased from many local mines, was shipped to consumers.

In Livingston County 21,000 short tons of merchantable fluorspar were produced in 1940 compared with 28,000 tons in 1939. The decline was due chiefly to suspension of operations at the Klondike mine of the Klondike Fluorspar Corporation. Of the production in 1940, the C. R. Babb, Ellis, Nancy Hanks, and Klondike mines and the jig plant reclaiming fluorspar from Klondike tailings supplied about 96 percent of the county total.

Output at the Alvis, C. R. Babb, Ellis, and Wright mines, operated by Roberts & Frazer, was slightly greater than in 1939.

Knight, Knight & Clark resumed operations at a shaft at the Ellis mine in 1940.

Production at the Nancy Hanks mine, operated by Haynes Fluorspar Co., increased 9 percent over that in 1939. Sales by Haynes Fluorspar Co. and Standard Fluorspar Co., however, were about 38 percent higher than in 1939.

In 1940 the Faircloth mine of Ralph E. Jones near Wilmore, Woodford County, produced and shipped 877 tons of fluorspar.

Nevada.—Shipments of fluorspar from Nevada—5,803 short tons in 1940 compared with 3,520 in 1939—established an all-time record. Most of the 1940 shipments went to steel mills and hydrofluoric-acid plants, but some went to iron foundries and cement and ceramic plants.

The chief producing mine in Nevada in 1940 was the Daisy, in Nye County, operated by J. Irving Crowell, Jr., which shipped 2,960 tons. The other active mine was the Baxter, in Mineral County, operated by V. S. Baxter, which shipped 2,843 tons. The Tonopah & Tidewater Railroad, the only line serving Beatty, the shipping point for the Daisy mine, discontinued operation on June 14, 1940. As a consequence, shipments are now made from Las Vegas, a distance of 116 miles; a 20-ton truck was purchased for this purpose. The mill serving the Daisy mine was revamped and Diesel power installed.

New Mexico.—Shipments of fluorspar from New Mexico and Arizona were 7,986 short tons in 1940 compared with 6,477 in 1939. Shipments in 1940 comprised flotation concentrates, which went chiefly to ceramic and hydrofluoric-acid plants, and metallurgical grade, which went chiefly to steel plants.

Production in 1940 was from Catron, Grant, Luna, Sierra, and Valencia Counties. Output at the flotation mill of Indian Metals Co. at Lordsburg increased more than 400 percent over 1939. The flotation mill of General Chemical Co. at Deming operated only part of 1940; in consequence, production was less than in 1939. Shipments from inventories, however, were continued throughout the year. A flotation mill is being built at Silver City by the Non-Metallic Corporation.

Texas.—A small quantity of fluorspar was produced (but not shipped) by U. B. Melton from a property near Hot Wells, in Hudspeth County.

Utah.—Shipments of fluorspar from Utah were 142 short tons in 1940 compared with 385 tons in 1939, all from the Fred Staats mine in Beaver County; they were consigned to steel plants and iron foundries.

Development work was under way at a new property near Milford, Beaver County, by the Western Fluorite Co. The company is constructing a mill.

IMPORTS AND EXPORTS

Imports of fluorspar for consumption in the United States in 1940 totaled 11,871 short tons (3,050 containing more than 97 percent and 8,821 containing not more than 97 percent calcium fluoride) valued [4] at $142,931 compared with 16,302 tons (3,351 containing more than 97 percent and 12,951 containing not more than 97 percent calcium fluoride) valued [4] at $176,691 in 1939. The value assigned to the foreign fluorspar in 1940 averaged $12.04 a ton. The cost to consumers in the United States also includes duty, loading charges at the docks, ocean freight, insurance, consular fee, and freight from docks to consuming points. The duty on fluorspar containing not more than 97 percent calcium fluoride is $7.50 a short ton and on fluorspar containing more than 97 percent calcium fluoride $3.75 a short ton.

Fluorspar imported for consumption in the United States in 1940, by countries and customs districts

Country and customs district	Containing more than 97 percent calcium fluoride		Containing not more than 97 percent calcium fluoride		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
France:						
New York	11	$307			11	$307
Philadelphia	140	1,625	5,584	$45,413	5,724	47,038
	151	1,932	5,584	45,413	5,735	47,345
Mexico:						
New York	931	16,866			931	16,866
Philadelphia	624	4,600			624	4,600
	1,555	21,466			1,555	21,466
Newfoundland:						
Buffalo			2,296	33,825	2,296	33,825
Philadelphia	1,344	36,000			1,344	36,000
	1,344	36,000	2,296	33,825	3,640	69,825
Spain: New York			112	841	112	841
Tunisia: Philadelphia			829	3,454	829	3,454
Total: 1940	3,050	59,398	8,821	83,533	11,871	142,931
1939	3,351	79,088	12,951	97,603	16,302	176,691

[4] As defined in sec. 402 of the tariff act of 1930, "The value of imported merchandise * * * is the foreign value or the export value, whichever is higher—that is, the market value or the price at which the merchandise, at the time of exportation to the United States, is offered for sale in the principal markets of the country from which exported, including the cost of containers or coverings and all expenses (including any export tax) incident to placing the merchandise in condition ready for shipment to the United States."

France was the chief source of imported fluorspar in 1940; however, no fluorspar has been received in the United States from France since February 1940. Imports of acid-grade fluorspar from Mexico gained substantially, and indications point to further increase in receipts from that source in 1941.

Of the 1940 imports, 74.3 percent was metallurgical gravel fluorspar, 25.6 percent acid-grade fluorspar, and 0.1 percent ceramic ground fluorspar. The metallurgical gravel fluorspar was imported from France, Newfoundland, Spain, and Tunisia; the ceramic ground fluorspar from France; and the acid-grade fluorspar from France, Mexico, and Newfoundland. Imports were equivalent to 5 percent of the total shipments of domestic fluorspar in 1940 compared with 9 percent in 1939.

The following table, compiled from data furnished to the Bureau of Mines by importers, shows the quantities of imported fluorspar delivered to consumers in the United States in 1939 and 1940 and the selling price at tidewater (duty paid), irrespective of the year of importation into the United States; it differs from the preceding table, which shows the quantities received in the United States during 1939 and 1940. The quantities in the following table are based upon the actual outturn weights ascertained by sworn weighers and represent the weights on which duty was paid and entries were liquidated. Stocks of foreign fluorspar in the hands of importers in the United States were only 3 short tons at the close of 1940 compared with 466 in 1939.

Imported fluorspar delivered to consumers in the United States, 1939–40, by uses

Use	1939			1940		
	Short tons	Selling price at tidewater, including duty		Short tons	Selling price at tidewater, including duty	
		Total	Average		Total	Average
Steel	13,689	$282,487	$20.64	9,275	$204,342	$22.03
Glass and enamel	134	5,240	39.10	11	361	32.82
Hydrofluoric acid	4,503	134,014	29.76	1,634	44,845	27.44
Miscellaneous	77	1,597	20.74	4	160	40.00
	18,403	423,338	23.00	10,924	249,708	22.86

Producers of fluorspar reported exports of 8,482 short tons of fluorspar valued at $178,467 in 1940 compared with 2,976 valued at $74,443 in 1939. Of the 1940 exports, 7,922 tons went to Canada and 560 to India. In 1940 some of the fluorspar exported to Canada was shipped by rail to Chicago, thence by water to Canada. In 1939 all the exported fluorspar went to Canada, and the greater part of it was shipped from the Illinois-Kentucky district by rail to Chicago, thence by water over Lakes Michigan, Huron, Erie, and Ontario and the St. Lawrence and Saguenay Rivers to Quebec.

Fluorspar reported by producers as exported from the United States, 1936–40

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1936	240	$4,079	$17.00	1939	2,976	$74,443	$25.01
1937	456	9,091	19.94	1940	8,482	178,467	21.04
1938	788	9,061	11.50				

WORLD PRODUCTION

The following table shows the world production of fluorspar by countries from 1936 to 1940, insofar as statistics are available. Although complete returns for 1938, 1939, and 1940 are not yet available, it is evident that the upward trend in world production, which began in 1933, was arrested in 1938 but was resumed in 1939. The greatly increased world production in recent years has been due chiefly to gains in the output of steel and aluminum in many European countries. Despite the fact that fluorspar is produced in about 20 countries, 5—United States 32 percent, Germany 29 percent, U. S. S. R. 13 percent, United Kingdom 9 percent, and France 7 percent—supply 90 percent of the world total.

World production of fluorspar, 1936–40, by countries, in metric tons [1]

[Compiled by L. P. Lounsbery]

Country [1]	1936	1937	1938	1939	1940
Argentina [2]	450	350	1,406	739	(3)
Australia:					
New South Wales	339	55		(3)	(3)
Queensland	487	1,410	2,479	20	(3)
South Australia	23				(3)
Victoria			804		(3)
Canada	68	136	197	218	(3)
Chosen	8,740	11,000	(4)	(3)	(3)
France	30,600	51,430	(4)	(3)	(3)
Germany:					
Anhalt	11,225	13,662	10,462	(3)	(3)
Baden	7,359	13,637	21,350	(3)	(3)
Bavaria	49,153	62,455	59,919	(3)	(3)
Prussia	36,271	30,514	22,956	(3)	(3)
Saxony	7,990	8,074	12,063	(3)	(3)
Thuringia	18,792	16,117	22,405	(3)	(3)
India, British				20	(3)
Italy	11,437	13,385	12,186	(3)	(3)
Newfoundland (shipments)	8,498	8,479	8,944	11,227	14,697
Norway	1,014	1,692	1,676	(3)	(3)
South-West Africa			585	105	(3)
Southern Rhodesia			156		(3)
Tunisia		1,676	2,060	2,473	(3)
Union of South Africa	3,123	3,615	4,736	10,322	(3)
U. S. S. R.	65,000	[5] 70,000	(4)	(3)	(3)
United Kingdom	33,491	42,837	33,866	(3)	(3)
United States (shipments)	160,459	164,408	72,940	165,806	211,917
	455,000	516,000	415,000	(3)	(3)

[1] In addition to countries listed, China, Mexico, and Spain produce fluorspar but data of output are not available.
[2] Railway shipments.
[3] Data not available.
[4] Estimate included in total.
[5] Estimated.

Canada.—According to the Northern Miner: [5]

Moira Fluorspar Mining Syndicate, Ltd., advises the Northern Miner that it is at present working the old Noyes property near Madoc. All buildings and equipment with minor exceptions are installed and the milling plant is in process of tuning in. Officials of the syndicate report that large tonnages of good ore are blocked out on three sides with more indicated. The syndicate is figuring on a shipping schedule of 15,000 tons this year and it is expected that this will likely be produced from the present workings on the 100-foot level. Development continues to 250 feet with a total of about 2,600 feet of drifting and numerous raises, stopes, and chutes. The syndicate holds 300 acres in this block and controls about 2,500 acres in addition.

The geology of the Madoc area, its structure, age, and ore deposits have been described recently by Emery.[6]

Newfoundland.—Shipments of fluorspar from Newfoundland in 1940 were 16,201 short tons; of this, 2,242 tons of fluxing grade went to the United States, and 6,699 tons of acid grade and 7,260 tons of fluxing grade to Canada. Shipments in 1939 totaled 12,376 tons. Considerable new equipment, including a pump for the Black Duck mine where water has hindered mining, has been installed at the property of the St. Lawrence Corporation of Newfoundland, Ltd.

South-West Africa.—Production of fluorspar in South-West Africa during the first 9 months of 1940 was 260 short tons; none was shipped. According to the Department of Mines [7] of the Union of South Africa:

A revival in fluorspar production has followed the opening up of extensive deposits on the farm Aukam in the Bethanie district. The material is of excellent quality and the veins are strong and persistent. Active mining operations ceased during September 1940.

Union of South Africa.—Figures of production of fluorspar in the Union of South Africa are available for only the first 9 months of 1940 and totaled 5,562 short tons. Shipments during this period were 5,023 short tons, of which 3,243 were exported to Japan, 19 exported to England, and 1,761 sold to local consumers. Production in 1939 was 11,378 short tons, and shipments were 10,724 tons, the greater part of which was exported to Japan.

CRYOLITE

Cryolite occurs in commercial quantity and is mined at only one place—Ivigtut, Greenland. It is used in the metallurgy of aluminum, in the manufacture of glass and enamels, and in insecticides.

Gibbs [8] has described the mine at Ivigtut, grades of ore produced, methods of processing and purification, and various uses of cryolite.

Imports.—The following table shows imports of cryolite into the United States in 1939 and 1940. As cryolite is mined only in Greenland, it is evident that importations credited to countries other than Greenland probably include artificial cryolite.

[5] Northern Miner, March 21, 1940, vol. 25, No. 3, p. 7.
[6] Emery, C. L., Fluorspar Ores of Madoc, Ont.: Canadian Min. Jour., October 1940, vol. 61, No. 10, pp. 667–668.
[7] Department of Mines, Union of South Africa, Pretoria, Industrial Minerals: Quarterly Inf. Circ., July–September 1940, p. 42.
[8] Gibbs, A. E. (technical director, Pennsylvania Salt Manufacturing Co.), Cryolite as a Chemical Raw Material: Chem. Ind., vol. 38, May 1936, pp. 471–476.

Cryolite (natural and artificial) imported for consumption in the United States, 1939–40, by countries

Country	1939		1940	
	Long tons	Value	Long tons	Value
Canada	39	$7,426		
Denmark	(1)	21		
France	140	21,499	20	$3,300
Germany	731	125,150	20	3,713
Greenland	9,300	558,000	25,818	1,322,775
	10,210	712,096	258,858	1,329,788

[1] Less than 1 ton.

FELDSPAR

By Robert W. Metcalf

SUMMARY OUTLINE

Stimulated by new high records in glass-container output and shipments and a substantial pick-up in residential building, both crude and ground feldspar set new production (sales) records in 1940. Sales of crude spar advanced to 290,763 long tons—8 percent higher than the previous peak in 1937 and 14.7 percent more than the 1939 figure of 253,466 tons. Sales of ground feldspar in 1940 rose to 285,713 short tons—2 percent above the 1937 high and 10.2 percent greater than in 1939.

Salient statistics of the feldspar industry in the United States, 1939–40

	1939	1940	Percent of change in 1940
Crude feldspar:			
Domestic sales:			
Long tons	253,466	290,763	+14.7
Value	$1,112,857	$1,271,995	+14.3
Average per long ton	$4.39	$4.37	−.5
Imports:			
Long tons	7,460	12,522	+67.9
Value	$52,141	$80,274	+54.0
Average per long ton	$6.99	$6.41	−8.3
Ground feldspar sold by merchant mills:			
Short tons	259,194	285,713	+10.2
Value	$2,862,278	$3,065,482	+7.1
Average per short ton	$11.04	$10.73	−2.8

Imports of crude feldspar (all from Canada) jumped to 12,522 long tons valued at $80,274 in 1940 compared with 7,460 tons valued at $52,141 in 1939 and nearly equaled the 1937 imports.

The majority of States produced more spar in 1940 than in the previous year. South Dakota and Connecticut produced record tonnages of crude, and South Dakota and Colorado also sold more ground spar than in any previous year.

DOMESTIC PRODUCTION

In accordance with the usual practice in the industry crude feldspar is reported in long tons of 2,240 pounds and ground spar in short (net) tons of 2,000 pounds, although an increasing number of producers report sales of crude in short tons.

Crude feldspar.—Crude feldspar sold or used in 1940 rose to 290,763 long tons valued at $1,271,995, a new record in tonnage—8 percent greater than in 1937 (the previous high) and 15 percent more than in 1939. The total value, however, was $111,254 less than the 1937 high of $1,383,249.

Crude feldspar sold or used by producers in the United States, 1936–40

[Value at mine or nearest shipping point]

Year	Long tons	Value		Year	Long tons	Value	
		Total	Average			Total	Average
1936	244,726	$1,303,090	$5.32	1939	253,466	$1,112,857	$4.39
1937	268,532	1,383,249	5.15	1940	290,763	1,271,995	4.37
1938	196,119	895,081	4.56				

Crude feldspar sold or used by producers in the United States, 1938–40, by States

[Value at mine or nearest shipping point]

State	1938		1939		1940	
	Long tons	Value	Long tons	Value	Long tons	Value
Arizona	(1)	(1)	(1)	(1)	(1)	(1)
California	1,396	$7,675	2,076	$12,655	2,711	$18,254
Colorado	27,452	104,673	29,995	107,536	34,105	123,514
Connecticut	7,461	45,153	10,033	53,120	24,404	128,348
Maine	13,764	68,047	18,109	74,165	18,390	84,796
Maryland			(1)	(1)	(1)	(1)
New Hampshire	25,555	135,760	34,414	161,968	38,589	149,031
New York	(1)	(1)	(1)	(1)	(1)	(1)
North Carolina	56,795	295,800	76,738	397,631	79,312	426,784
Pennsylvania	(1)	(1)	(1)	(1)	(1)	(1)
South Dakota	42,297	122,467	48,328	133,893	54,692	157,323
Virginia	9,766	52,037	18,544	100,299	21,705	116,531
Wyoming	1,168	4,343	6,726	25,008	7,833	29,128
Undistributed [2]	10,465	59,126	8,503	46,582	9,022	38,286
	196,119	895,081	253,466	1,112,857	290,763	1,271,995

[1] Included under "Undistributed." [2] Includes States indicated by "1."

Crude feldspar was produced in 1940 in the same States where crude was mined in 1939. North Carolina produced 3 percent more spar in 1940 but supplied only 27 percent of the national total compared with 30 percent in 1939 and 35 percent in 1937. Output in South Dakota increased 13 percent to 54,692 long tons, the highest yet recorded for that State, and New Hampshire with 38,589 tons produced more crude than in any year since 1924. Connecticut also produced more feldspar in 1940 than in any previous year and advanced to fifth place in size of output.

The average sales realization for all crude spar decreased slightly in 1940 to $4.37. Except for New Hampshire and Connecticut, however, most of the chief producing States for which data may be shown (including the western producers) indicated moderate increases in the average value per ton as follows: South Dakota, 1939—$2.77, 1940—$2.88; Colorado, 1939—$3.59, 1940—$3.62; Maine, 1939—$4.10, 1940—$4.61; and North Carolina, 1939—$5.18, 1940—$5.38.

Ground feldspar.—Ground feldspar sold by merchant mills in the United States in 1940 broke all records and rose to 285,713 short tons—10.2 percent higher than in 1939 and 2 percent above the previous record in 1937. The total value in 1940, while considerably more than in 1939, did not reach the 1937 figure. As in 1938 and 1939, South Dakota and Colorado supplied about 35 percent of the total ground spar sold or used compared with 30 percent in 1937. The share of total sales furnished in 1940 by Tennessee and North Carolina mills dropped slightly to 27 percent compared with approximately 29 percent in 1938 and 1939 and 32 percent in 1937. Three percent of the total sales of ground feldspar from United States mills in 1940, 4 percent in 1938 and 1939, and 6 percent in 1937 was of Canadian origin.

South Dakota—the leading producer of ground feldspar—again shipped more processed spar than in any previous year (54,783 short tons valued at $374,024), surpassing the former record in 1939 by 11 percent in tonnage and 10 percent in value. Colorado, third in order of sales, reported a record tonnage of ground spar (44,260 tons). Tennessee and North Carolina ranked second and fourth, respectively. Sales by mills in California, Maine, New Hampshire, and New Jersey were substantially higher in 1940 than in 1939.

Ground feldspar sold by merchant mills [1] in the United States, 1936–40

Year	Active mills	Domestic			Canadian			Total	
		Short tons	Value		Short tons	Value		Short tons	Value
			Total	Average		Total	Average		
1936	30	222, 126	$2, 884. 493	$12. 99	14, 764	$270, 360	$18. 31	236, 890	$3, 154, 853
1937	31	263. 387	3, 187. 185	12. 10	15, 885	299, 556	18. 86	279, 272	3, 486, 741
1938	30	206, 646	2, 314, 675	11. 20	7, 868	151, 577	19. 26	214, 514	2, 466, 252
1939	31	249, 889	2. 685. 473	10. 75	9, 305	176, 805	19. 00	259, 194	2, 862, 278
1940	29	277. 612	2. 912, 470	10. 49	8, 101	153, 012	18. 89	285, 713	3. 065, 482

[1] Excludes potters or others who grind for consumption in their own plants.

Continuing the general downward trend of recent years, the average sales realization for ground spar in 1940 was $10.73 compared with $11.04 in 1939 and $11.50 in 1938. Average sales values for individual States ranged from $6.38 to $17.96 in 1940, from $6.42 to $18.01 in 1939, and from $6.55 to $21.09 in 1938. The sales realization for North Carolina-Tennessee in 1940 was $11.97; for Colorado and South Dakota $6.38 and $6.83, respectively; for New Jersey (including Connecticut) $17.96; and for Maine $13.02.

Quoted prices on ground feldspar, however, remained unchanged during the year, according to Engineering and Mining Journal Metal and Mineral Markets. As of February 6, 1941, quotations were reported as follows: Potash spar, f. o. b. North Carolina, 200-mesh, white, $17 per ton in bulk; soda spar, $19 per ton; potash spar, f. o. b. Maine, 200-mesh, white, $17 per ton in bulk; North Carolina granular glass spar, 20-mesh, white, f. o. b., $12.50 per ton in bulk; semigranular, $11.75 per ton; Virginia feldspar, No. 1, 230-mesh, $18, 200-mesh, $17; No. 17 glassmakers' spar, $11.75, No. 18 glassmakers' spar, $12.50; and enamelers' spar, $14 to $16 (quotations upon Spruce Pine, N. C., or Keene, N. H., basis).

Ground feldspar sold by merchant mills [1] in the United States, 1938–40, by States

State	1938			1939			1940		
	Active mills	Short tons	Value	Active mills	Short tons	Value	Active mills	Short tons	Value
Arizona	1	(2)	(2)	1	(2)	(2)	1	(2)	(2)
California	3	1,263	$17,561	3	2,082	$27,149	3	2,624	$32,847
Colorado	2	33,529	219,699	3	41,176	264,153	3	44,260	282,178
Connecticut							1	(3)	(3)
Illinois	1	(2)	(2)	1	(2)	(2)	1	(2)	(2)
Maine	4	15,651	196,460	4	15,246	193,352	3	19,580	255,020
Minnesota	1	(2)	(2)	1	(2)	(2)			
New Hampshire	2	(2)	(2)	2	(2)	(2)	2	(2)	(2)
New Jersey	3	13,901	258,123	3	18,727	337,359	3	[3] 21,158	[3] 379,899
New York	4	(2)	(2)	4	(2)	(2)	4	(2)	(2)
Ohio	1	(2)	(2)						
North Carolina	3	61,467	821,686	3	75,740	920,556	3	78,077	934,702
Tennessee	2			2			2		
South Dakota	2	42,489	300,192	2	49,497	340,424	2	54,783	374,024
Virginia	1	8,940	117,874	2	(2)	(2)	1	(2)	(2)
Undistributed		37,274	534,657		56,726	779,285		65,231	806,812
	30	214,514	2,466,252	31	259,194	2,862,278	29	285,713	3,065,482

[1] Excludes potters or others who grind for consumption in their own plants.
[2] Included under "Undistributed."
[3] Connecticut included with New Jersey.

CONSUMPTION AND USES

Crude feldspar.—Most crude feldspar is sold to merchant mills, which obtain material from a number of mines or localities, store and sort it according to grade and source, blend and grind it to required purity and fineness, and sell the ground product. However, some pottery and enamel manufacturers purchase part of their feldspar requirements crude and process it as needed with their own equipment; and at least two sanitary-ware manufacturers mine and grind spar for their own use. Makers of soap, cleansers, and sweeping compounds also mine crude feldspar or purchase it—chiefly in New England, Virginia, and North Carolina—and (after grinding or other processing) utilize it as an abrasive in their products. Manufacturers of artificial teeth each year use a small tonnage of carefully selected crude material, which is sold at a substantial premium over No. 1 grade commercial feldspar.

Ground feldspar.—The quantity of feldspar consumed by the glass industry in 1940 rose to 149,623 short tons—an 8-percent increase over 1939—although the proportion of total sales used by the industry declined to 52.4 percent in 1940 compared with 53.4 percent in 1939 and 54.9 percent in 1938. These figures do not include nepheline syenite, aplite, or other sources of alumina in the making of glass, whose importance in the competitive pattern is increasing steadily. Sales to potteries, however, increased 20 percent. Sales of ground spar to enamel manufacturers by merchant mills decreased somewhat both actually and relatively. Ground spar sold for use in soap and abrasives, a minor sales outlet for ground material, increased sharply. The remainder was utilized for other purposes not specified and for various ceramic uses other than glass, pottery, or enamel.

Ground feldspar sold by merchant mills in the United States, 1938–40, by uses, in short tons

Use	1938		1939		1940	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Ceramic:						
Glass	117,800	54.9	138,336	53.4	149,623	52.4
Pottery	74,035	34.5	87,209	33.7	104,586	36.6
Enamel	19,395	9.0	28,356	10.9	26,420	9.3
Other ceramic uses	2,077	1.0	2,132	.8	649	.2
Soaps and abrasives	1,021	.5	770	.3	2,682	.9
Other uses	186	.1	2,391	.9	1,753	.6
	214,514	100.0	259,194	100.0	285,713	100.0

The distribution of ground feldspar sold by merchant mills according to chief consuming States, as reported by mills grinding 99 percent of the feldspar ground in 1939 and 100 percent in 1940, is shown in the accompanying table. Ohio, taking 18 percent of the ground spar sold, again proved to be the largest market, although it did not consume as much spar as in 1939. Pennsylvania was second in 1940 with 16 percent, followed by New Jersey (15 percent), Illinois (11 percent), Indiana (10 percent), West Virginia (8 percent), and New York (5 percent). Shipments to "Other States"—comprising in each year about 10 percent of the total distribution—included sizable tonnages to Maryland, Mississippi, Oklahoma, Missouri, and South Carolina and smaller amounts to 19 other States, the District of Columbia, and Puerto Rico. Small shipments to Mexico, England, and Canada also were reported.

Shipments of ground feldspar from mills into States, 1939–40, in short tons

State	1939 [1]	1940	State	1939 [1]	1940
California	7,590	7,897	Tennessee	5,077	5,911
Illinois	15,948	32,811	West Virginia	19,188	21,889
Indiana	38,189	28,634	Wisconsin	5,134	6,967
New Jersey	34,309	42,381	Other States [2]	25,463	27,721
New York	14,995	13,236			
Ohio	53,410	50,835		256,769	285,713
Pennsylvania	37,466	47,431			

[1] Data include 99 percent of total ground feldspar.
[2] Arkansas, Colorado, Kentucky, Maryland, Mississippi, Missouri, Oklahoma, South Carolina, and other States for which shipments cannot be segregated. Small shipments to Puerto Rico, Mexico, England, and Canada also included.

Names and addresses of merchant grinders of feldspar in the United States follow:

Abingdon Sanitary Mfg. Co., Abingdon, Ill.
American Radiator & Standard Sanitary Corporation, Campo, Calif.
Atlas Feldspar Co., Broadalbin, N. Y.
Colorado Feldspar Co., Canon City, Colo.
Consolidated Feldspar Corporation, Trenton Trust Building, Trenton, N. J. (mills in Arizona, Maine, New Jersey, New York (2), and Tennessee).
Coors Porcelain Co., Golden, Colo.
Eureka Flint & Spar Co., Inc., New York Ave., Trenton, N. J. (mills in Connecticut and New Jersey).
Feldspar Milling Co., Inc., Burnsville, N. C.
Genesee Feldspar Co., Inc., 360 Boxart Street, Rochester, N. Y.

Gladding, McBean & Co., 2901 Los Feliz Boulevard, Los Angeles, Calif.
Golding, Keene Co., 29 Ralston Street, Keene, N. H.
Industrial Minerals & Chemical Co., 6th and Gilmore Streets, Berkeley, Calif.
North Carolina Feldspar Corporation, Erwin, Tenn.
F. E. Schundler Feldspar Co., Custer, S. Dak.
Seaboard Feldspar Co., Hearst Tower Building, Baltimore, Md. (mill in Virginia).
Seaboard Minerals Corporation, 52 William Street, New York, N. Y. (mill in New Hampshire).
Southern Feldspar, Inc., Toecane, N. C.
Standard Flint & Spar Corporation, 1401 New York Avenue, Trenton, N. J.
Topsham Feldspar Co., P. O. Box 34, Topsham, Maine.
United Feldspar & Minerals Corporation, 10 East 40th Street, New York, N. Y. (mills in Maine and North Carolina).
Virginia Feldspar Co., Bedford, Va.
Western Feldspar Milling Co., 1333 West Maple Avenue, Denver, Colo.
White Hill Mineral Co., Inc., Gouverneur. N. Y.

NEPHELINE SYENITE

Although commercial production of nepheline syenite has been reported from the Kola Peninsula in northern U. S. S. R.[1] and deposits have been discovered in a number of countries (including the United States and more recently Chosen (Korea)[2] the only commercial development in North America remains that in Ontario, Canada. Shipments from a small mill near Lakefield, Ontario, were begun in 1936, the raw material coming from Blue Mountain in Peterborough County. The American Nepheline Corporation, Rochester, N. Y.—a subsidiary of the original company, Canadian Nepheline, Ltd.—later erected a modern mill particularly to supply the American glass trade. The Canadian Nepheline, Ltd., has announced its consolidation with the American Nepheline Corporation, Rochester, N. Y., and will be known as the American Nepheline Corporation, Canadian Branch, with office and plant at Lakefield, Ontario.[3] Other companies have entered the field more recently, for the most part American feldspar producers who import crude nepheline syenite from Hastings and other counties and blend it with granular glass spar.

Within 5 years of the initial development of the Canadian nepheline deposits, the tonnage of crude nepheline syenite imported from Canada into the United States approaches in quantity the high feldspar imports in the nineteen twenties and greatly exceeds the current production of Canadian feldspar. Crude nepheline syenite imports in 1940 totaled 27,848 short tons valued at $87,162 compared with 29,231 tons valued at $95,453 in 1939. Imports of ground nepheline syenite in 1940 were 6 short tons valued at $25. No imports of ground material were reported in 1939.

A recent customs court decision (U. S. Customs Court, Third Division, C. D. 293) directed that ground nepheline syenite be admitted into the United States free of duty as "manufactured sand." However, it is reported that this action has been nullified through instructions to its collectors by the Bureau of Customs to assess on this material in the ground condition a duty of 15 percent ad valorem under the Tariff Act of 1930. The United States Department of Justice, coop-

[1] "Industriya", Moscow, June 6 and June 13, 1939, reported in Russian Economic Notes, vol. 1 (N. S.), No. 14, July 30, p. 14, and No. 15, August 15, 1939, p. 1.
[2] Nagai, Shoichiro; Naruse, Akira; Morimoto, Ichiro, and Yamabe, Takeo, Nepheline Syenite in Korea: I, Dissolution Tests of Alumina and Alkali by Treatment with Acid Solutions: Jour. Soc. Chem. Ind. Japan, vol. 43, No. 5, 1940, pp. 362–366; suppl. binding, p. 155B; Jour. Am. Ceram. Soc., Ceramic Abs., vol. 20, No. 1, January 1941, p. 29.
[3] Canadian Chemistry and Process Industries, vol. 24, No. 8, August 1940, p. 404.

erating with the Bureau of Customs, is understood to be preparing a court case to effect this change in classification.[4]

The glass industry continues to be the chief market for nepheline. Research, however, gradually is broadening its field of usefulness, and fine-grinding for the pottery and enamel trades is increasing. Flotation followed by a final magnetic separation to remove traces of finely divided magnetite has produced good results, according to the Canadian Bureau of Mines.[5]

The use, advantages, and behavior of nepheline syenite in various classes of ceramic manufactures were described by Koenig.[6] The higher fluxing action of nepheline compared to feldspar in hotel chinaware of commercial body specification permitted a lower firing temperature, reduced the quantity of the principal flux, and curtailed or eliminated the auxiliary flux, according to Koenig.[7] An investigation of the effect of using nepheline syenite in enamel frits and in ground-coat enamels on sheet-steel was reported.[8] A resultant lighter color and semimat surface obtained by the use of nepheline syenite in ground coats are offset by smoother enamel coats, less tendency to reboil, and better control of maturing temperature. Nepheline syenite does not decrease adherence, shock resistance, or marketability, if properly used.[9] Using 17 percent nepheline syenite in ground-coat compositions, Cook [10] effected a saving in cost amounting to about ¾ cent per pound or approximately 60 cents per 1,000 square feet of ware. The color of the fired enamel altered but slightly, and no problems in draining, blistering, or reboiling were encountered. Increased percentages of nepheline syenite may affect adherence, but Cook used up to 20 percent without trouble. Nepheline syenite also produces a base ground coat that makes more stable white coats in continuous furnace firing.

TECHNOLOGIC DEVELOPMENTS

The gradual exhaustion of the better-grade deposits and the relatively high cost of small-scale mining as practiced in many feldspar-producing States have tended more or less inevitably to encourage new enterprises utilizing larger-scale operations in the extraction of their raw material. The successful competition of aplite from Virginia and nepheline syenite from Ontario are outstanding examples of these newer methods of operation. Considerable research also has been undertaken in the extraction of feldspar from so-called lower-grade materials, in the recovery of feldspar as a byproduct of other mining or processing operations, and in the development of substitutes or various mixtures of feldspar and other ceramic raw materials for specified uses. Feldspathic waste from titanium operations, consisting mainly of sodic plagioclase, quartz, and iron-bearing gedrite, with an Fe_2O_3 content of about 5.3 percent, was reduced by magnetic concen-

[4] Oil, Paint and Drug Reporter, vol. 138, No. 12, September 16, 1940, p. 5.

[5] Department of Mines and Resources, Ottawa, Canada (reported in Bureau of Mines Mineral Trade Notes, vol. 12, No. 2, February 20, 1941, p. 25).

[6] Koenig, C. J., Nepheline Syenite in Ceramic Ware: Ohio State Univ. Eng. Exp. Sta. Bull. 103, 1939, 74 pp.; Jour. Am. Ceram. Soc., Ceramic Abs., vol. 19, No. 7, July 1940, p. 167.

[7] Koenig, C. J., Nepheline Syenite in Hotel China Bodies: Paper presented at 43d Ann. Meeting, Am. Ceram. Soc., April 3, 1941; abs. Bull. Am. Ceram. Soc., vol. 20, No. 3, March 1941, p. 108.

[8] Koenig, C. J., Use of Nepheline Syenite in Sheet-steel Enamels: Paper presented at 42d Ann. Meeting, Am. Ceram. Soc., April 11, 1940; abs. Bull. Am. Ceram. Soc., vol. 19, No. 4, March 1940, p. 134.

[9] Petersen, Fred A., Nepheline-syenite as Mill Addition in Ground-coat Enamels: Proc. Porcelain Enamel Inst. Forum, 5th Forum, October 1940, pp. 109–112.

[10] Cook, H. L., Use of Nepheline-syenite in Porcelain Enameling: Proc. Porcelain Enamel Inst. Forum, 5th Forum, October 1940, pp. 107–108.

tration to a feldspar-quartz mixture containing 0.81 percent Fe_2O_3. Recovery of 85 to 90 percent of the spar with an iron content of 0.41 to 0.52 percent Fe_2O_3 was achieved by agglomerate tabling and flotation, with a lower limit of 0.36 Fe_2O_3 possible under present methods.[11] An investigation of mixtures of soda spar, potash spar, and spodumene as fluxes in vitreous and semivitreous whiteware bodies showed that considerable reduction in maturing temperatures and flux content was possible through their use.[12] It has been found that zircon added to talc whiteware bodies increases resistance to breakage, while the moisture expansion of feldspar bodies is reduced when zircon is added.[13] A glass-batch ingredient consisting of a mixture of pyrophyllite and feldspar was the subject of a patent granted to Peddrick.[14] A new method for determining quickly the quartz content in feldspars utilizing the polarizing microscope has been devised by McIntyre and Bozsin [15] of the Ferro-Enamel Corporation.

OTHER DEVELOPMENTS

An interesting cooperative venture is the Western North Carolina Feldspar Market established recently at Sylva, N. C. A nonprofit organization, sponsored by the Sylva Chamber of Commerce, Feldspar Market Committee, A. F. Clouse, chairman, it is modeled somewhat after the pattern of the farm cooperatives. The object is to encourage development of the feldspar deposits in Swain, Macon, and Jackson Counties by supplying a ready cash market for producers in this region. The plan provides for the purchase of feldspar from many small miners, sorting and blending of the spar, and shipping in carlots. A site convenient to highway and railroad has been procured, and arrangements have been made for buyers representing different companies to be present on designated periodic "feldspar-market" days. The farmers or other small producers are then assured a fair competitive price for their feldspar. According to a recent informant the venture seems to be functioning successfully, and the erection of a grinding mill is under consideration.

A detailed account of the mining and milling operations and history of the West Paris plant of the United Feldspar & Minerals Corporation appeared during the year.[16] A historical summary, including a chronological index of the principal events in the feldspar industry, was published.[17] The feldspar and other mineral deposits in the Black Hills, South Dakota, were described in a comprehensive report listing mines and prospects in this region.[18] The anorthosites of

[11] Smith, D. I., O'Meara, R. G., and McVay, T. N., Concentration of Feldspathic Waste from a Titanium Mine near Roseland, Va.: Jour. Am. Ceram. Soc., vol. 23, No. 11, November 1940, pp. 339–341.

[12] Schurecht, H. G., Shapiro, Joseph K., and Zabawsky, Zeno, Use of Mixtures of Soda Feldspar, Potash Feldspar, and Spodumene in Whiteware Bodies: Paper presented at 43d Ann. Meeting, Am. Ceram. Soc., April 3, 1941; Abs. Bull. Am. Ceram. Soc., vol. 20, No. 3, March 1941, p. 108.

[13] McMahon, J. F., and Fossaceca, Samuel A., Influence of Zircon, Talc, and Feldspar Mixtures on Some Properties of Whiteware Bodies: Abs. Bull. Am. Ceram. Soc., vol. 20, No. 3, March 1941, p. 106.

[14] Peddrick, C. H., Jr. (assigned to Feldspathic Research Corporation), Mineral Composition for Use in Glass Manufacture: U. S. Patent 2,210,254, August 6, 1940; Jour. Am. Ceram. Soc., Ceramic Abs., vol. 19, No. 10, October 1940, p. 234.

[15] McIntyre, G. H., and Bozsin, M., Rapid Determination of Quartz in Feldspar: Ind. Eng. Chem., anal. ed., vol. 12, No. 6, June 15, 1940, pp. 326–328.

[16] Pit and Quarry, Maine Feldspar Plant Has Doubled Capacity Twice Since Starting: Vol. 32, No. 12, June 1940, pp. 49–50.

[17] DuBois, H. B., Development and Growth of the Feldspar Industry: Bull. Am. Ceram. Soc., vol. 19, No. 6, June 1940, pp. 206–213.

[18] Guiteras, Joseph R., Mining of Feldspar and Associated Minerals in the Southern Black Hills of South Dakota: Bureau of Mines Inf. Circ. 7112, 1940, 104 pp.

Minnesota were the subject of a report by Grout and Schwartz.[19] Kennedy [20] described the feldspar of Scotland.

IMPORTS [21]

Feldspar.—Imports of crude feldspar in 1940 nearly reached the 1937 level, totaling 12,522 long tons valued at $80,274 compared with 12,956 tons valued at $91,885 in 1937. Although over 60 percent greater than in 1938 and 1939 the tonnage imported in 1940 approximated only about half that received in many previous years. All shipments originated in Canada. No receipts of ground feldspar were reported in 1940.

Feldspar imported for consumption in the United States, 1936–40

Year	Crude		Ground		Year	Crude		Ground	
	Long tons	Value	Short tons	Value		Long tons	Value	Short tons	Value
1936	10,786	$68,198	132	$1,276	1939	7,460	$52,141	2	$54
1937	12,956	91,885			1940	12,522	80,274		
1938	7,651	56,126							

Cornwall stone.—Despite wartime restrictions, imports for consumption of unmanufactured Cornwall stone, all from the United Kingdom, climbed to 2,261 long tons valued at $20,812 in 1940 (the highest figure reported since 1930) compared with the recent low in 1938 of 513 tons worth $4,976. The tonnage of ground Cornwall stone imported in 1940, however, dropped to 228 long tons, or less than the 1938 figure, although the average value increased from $11.39 a ton in 1939 to $12.10 in 1940. As in former years, imports of ground Cornwall stone also were from the United Kingdom.

Cornwall stone imported for consumption in the United States, 1936–40

Year	Unmanufactured		Ground		Year	Unmanufactured		Ground	
	Long tons	Value	Long tons	Value		Long tons	Value	Long tons	Value
1936	2,061	$18,402	357	$4,730	1939	1,684	$17,233	348	$3,965
1937	1,899	16,864	323	4,267	1940	2,261	20,812	228	2,758
1938	513	4,976	233	1,797					

WORLD PRODUCTION

Feldspar sold or used in the United States represents the greater portion of this mineral produced or marketed in the world, according to available data. In addition, usually over half of the production

[19] Grout, Frank F., and Schwartz, George M., Geology of Anorthosites of the Minnesota Coast of Lake Superior: Minnesota Geol. Survey Bull. 28, 1939, 119 pp.; Jour. Am. Ceram. Soc., Ceramic Abs., vol. 19, No. 9, September 1940, p. 223.

[20] Kennedy, W. O., The Feldspars of Scotland: Stone Trades Jour. (London), vol. 63, No. 8, August 1940, pp. 116-118. (Extracts from Geol. Survey of Great Britain, Dept. of Sci. and Ind. Research, Wartime Pamphlet 2.)

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

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(shipments) of Canadian crude is ground in the United States. Data for 1940 show a 76-percent gain over 1939 in total Canadian shipments—19,894 metric tons in 1940 compared with 11,306 tons in 1939—and a substantial increase in United States output.

Feldspar produced in Sweden, Norway, and Finland in normal times is exported largely to the United Kingdom, Germany, and other European destinations. Small but steady outputs of spar are reported from other widely separated regions, including Argentina, Brazil, India (British), and Australia.

World production of feldspar, 1936–40, insofar as figures are available, appears in the following table.

World production of feldspar, 1936–40, by countries, in metric tons

[Compiled by L. P. Lounsbery]

Country [1]	1936	1937	1938	1939	1940
Argentina (shipments)	1,082	1,346	620	1,051	(2)
Australia:					
New South Wales [3]	101	162	178	(2)	(2)
South Australia [3]	553	669	502	615	(2)
Western Australia (exports)	3,097	3,031	2,919	3,853	(2)
Brazil	(2)	8,400	(2)	(2)	(2)
Canada (shipments)	16,190	19,365	12,753	11,306	19,894
China (Manchuria)	1,403	(2)	(2)	(2)	(2)
Egypt	45	158	199	74	(2)
Finland (exports)	2,520	3,232	5,046	5,596	(2)
France	----------	8,900	(2)	(2)	(2)
Germany (Bavaria)	9,524	9,986	10,419	(2)	(2)
India, British	798	495	702	501	(2)
Italy	8,620	13,437	13,391	(2)	(2)
Norway (exports)	29,985	32,555	21,761	21,282	(2)
Rumania	1,960	2,587	1,690	(2)	(2)
Sweden	56,799	49,140	45,111	40,792	(2)
United States (sold or used)	248,654	272,842	199,267	257,534	295,430

[1] In addition to countries listed, feldspar is produced in Czechoslovakia. Official figures of output are not available, but it is estimated that the annual production is approximately 30,000 metric tons (Stat. Comm. Czechoslovak Ceram. Soc.).
[2] Data not yet available.
[3] Includes some china stone.

ASBESTOS

By Oliver Bowles and K. G. Warner

SUMMARY OUTLINE

Sales of domestic asbestos attained an all-time high of 20,060 short tons in 1940, a 30-percent increase over 1939, which was a record year. Their value was 32 percent more than in 1939. Consumption was 3 percent greater than in 1939 but 17 percent less than in 1937. Sales from domestic mines totaled less than 8 percent of domestic requirements. Asbestos produced in the United States is predominantly of the shorter grades, hence domestic production of the longer and more essential grades is considerably less than 8 percent of requirements.

During recent years there has been a marked increase in imports of asbestos from Africa. Some of the African fibers are interchangeable with Canadian fibers and compete with them upon a price basis. Other kinds, particularly the amosite and blue asbestos, obtainable in quantity only in Africa, with certain grades of Rhodesian chrysotile, are utilized in special products for which no other fibers are suitable. Consequently, it is highly desirable that imports of such kinds and grades should continue. Although importers and users were concerned to some extent over possible delays, there was no evidence of interruptions to shipping because of war conditions; in fact, importations from Africa in 1940, amounting to more than 17,000 short tons, were the highest on record, exceeding those of 1939 by 54 percent.

The famous asbestos deposits of Quebec, Canada, have for many years furnished the United States with a large part of its supplies of both long and short fibers. Imports from Canada were a little higher in 1940 than in 1939. As Canada has lost all of her continental European asbestos markets, there is no shortage of the supply available for United States needs.

During recent years domestic production has been centered chiefly in the extensive deposits of slip fiber near Hyde Park, Vt. A somewhat similar occurrence of slip fiber in serpentine has been noted in Somerset County, Maine, but no development work has been done and no data are available on the extent of the deposit. Excellent fiber is obtainable in Arizona, and a moderate increase in activity is to be noted in this area.

Because of its resistance to chemicals and high temperatures, amphibole asbestos is well-adapted for certain special products, such as acid filters and coatings for welding rods. Small quantities are shipped from various States. During 1940 there was a growing demand for information on new sources of supply of high-grade anthophyllite and tremolite.

The following table of salient statistics compares 1940 data with those of 1939. Comparable figures are given for 1890–1938 in Minerals Yearbook, 1939, page 1311. Of special interest is the upward trend in domestic production. Consumption of raw asbestos and value of exports of asbestos products show small increases.

Salient statistics of the asbestos industry in the United States, 1939–40

	1939		1940	
	Short tons	Value	Short tons	Value
Domestic asbestos—				
Produced:				
Chrysotile	14,686	(1)	17,481	(1)
Amphibole	450	(1)	1,693	(1)
Total produced	15,136	(1)	19,174	(1)
Sold or used by producers:				
Chrysotile	15,043	$503,097	18,672	$664,520
Amphibole	416	9,691	1,388	9,988
Total sold or used by producers	15,459	512,788	20,060	674,508
Imports (unmanufactured)	242,561	9,094,538	246,613	10,034,433
Exports (unmanufactured)	2,473	218,830	4,474	449,105
Apparent consumption [2]	255,547	9,388,496	262,199	10,259,836
Exports of asbestos products	(1)	3,354,920	(1)	3,473,246

[1] Figures not available.
[2] Quantity sold or used by producers, plus imports, minus exports.

The following table shows production of asbestos during recent years.

Asbestos sold or used by producers in the United States, 1936–40, by varieties

Year	Chrysotile		Amphibole		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1936	10,719	$302,301	345	$11,860	11,064	$314,161
1937	11,547	332,747	532	11,897	12,079	344,644
1938	(1)	(1)	(1)	(1)	10,440	247,264
1939	15,043	503,097	416	9,691	15,459	512,788
1940	18,672	664,520	1,388	9,988	20,060	674,508

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

REVIEW BY STATES

Arizona.—According to reports received by the Bureau of Mines, sales of asbestos in Arizona, which were considerably larger in 1940 than in 1939, were made by the following companies: Arizona Chrysotile Asbestos Co., Arizona Asbestos Corporation, Bear Canyon Asbestos Co., Emsco Asbestos Co., Arthur Enders, Roger Q. Kyle, and Guy Phillips, all of Globe, Gila County, Ariz.; and Johns-Manville Products Corporation, New York, N. Y. Several other producers sold small quantities to the larger operators.

California.—A small quantity of amphibole asbestos was mined near Lone Pine, Inyo County, by R. B. McIllroy.

Georgia.—Philip S. Hoyt produced amphibole asbestos near Clayton and the Powhatan Mining Co., the same variety near Dillard, both in Rabun County.

Maryland.—The Powhatan Mining Co., Woodlawn, Baltimore, Md., obtains a high-grade tremolite near Pylesville, Harford County. It is used chiefly for making chemical filters.

North Carolina.—Near Greenmountain and various other points in the State the Powhatan Mining Co. and Philip S. Hoyt mined small tonnages of amphibole asbestos.

Pennsylvania.—The Foote Mineral Co. obtained amphibole asbestos in Chester County.

Vermont.—The extensive slip-fiber chrysotile deposits near Eden, Lamoille County, were operated continuously during the summer months of 1940 by Vermont Asbestos Mines, division of the Ruberoid Co., 500 Fifth Avenue, New York, N. Y. Production is increasing steadily; and high-grade fibers, chiefly of shingle-, paper-, and cement-stock grades are becoming important factors in the United States market.

Trends in consumption.—The following table shows trends in the asbestos-products industries in the United States during recent years.

Raw asbestos consumed in the United States and asbestos products manufactured in and exported from the United States, 1935–40

Year	Raw asbestos—apparent consumption (short tons)	Asbestos products—Manufactured [1]	Asbestos products—Exported [2]	Year	Raw asbestos—apparent consumption (short tons)	Asbestos products—Manufactured [1]	Asbestos products—Exported [2]
1935	174,655	$62,420,944	$2,261,929	1938	187,150	(1)	$2,533,916
1936	250,922	(1)	2,479,273	1939	255,547	$97,944,735	3,354,920
1937	316,263	96,347,570	3,047,078	1940	262,199	(1)	3,473,246

[1] Figures of Bureau of the Census (collected biennially for odd years) include value of certain gaskets, packing, and similar products in which little asbestos was employed.
[2] Compiled from records of Bureau of Foreign and Domestic Commerce.

The consumption of asbestos depends chiefly on the manufacture of automobiles, on building construction, and on certain types of industrial activity. All kinds of automotive transport equipment require large quantities for brake bands and clutch facings. Building construction employs many products in which asbestos is an important constituent; these include asbestos-cement shingles and siding, wallboard, and various heat-insulation and fireproofing materials. Consumption of asbestos bears a definite relationship to the manufacture of steam engines and similar equipment, because it is used extensively for packings and gaskets and also for heat insulation in the form of boiler lagging and pipe covering. Figure 1 shows the relationship of asbestos consumption to these three major activities for a period of years.

Market conditions.—Markets were depressed because of war uncertainties during the most of 1940; but in the fourth quarter demands became more active owing to the national defense program.

Prices.—All prices for asbestos are quoted on a short-ton basis from Metal and Mineral Markets, published by the McGraw-Hill Publishing Co., Inc., New York City. Canadian prices are f. o. b. Quebec mines, tax and bags included; Rhodesian, South African, and Russian prices, c. i. f. New York; and Vermont prices, f. o. b. mines, Vermont.

Prices were constant throughout the year, except that for certain grades, where indicated in parentheses, they were advanced in August for the remainder of the year:

Canadian: Crude No. 1, $700–$750; Crude No. 2 and sundry crudes, $150–$350; spinning fibers, magnesia and compressed sheet fibers, $110–$200; shingle stock, $57–$78; paper stock, $40–$45; cement stock, $21–$25 (advanced to $22–$26); floats, $18–$20 (advanced to $19–$21);

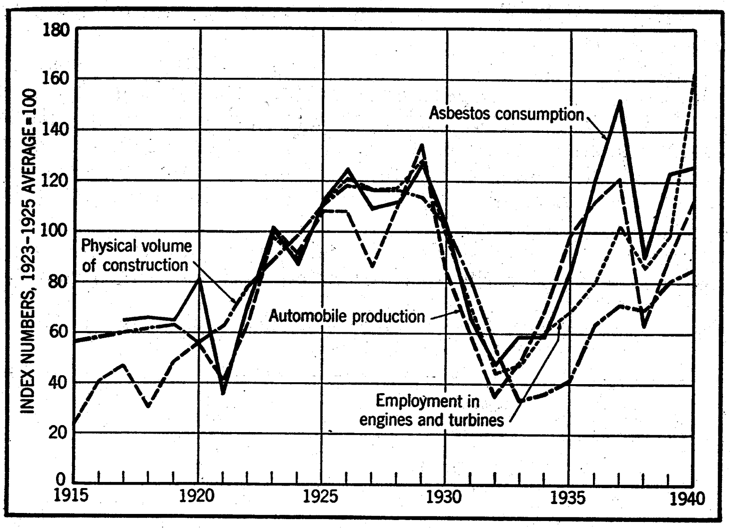

FIGURE 1.—Consumption of asbestos compared with automobile production, construction activity, and employment in engine and turbine manufacture in the United States, 1915–40. Units are reduced to percentages of the 1923–25 average. Statistics on automobiles are from the Bureau of the Census, physical volume of construction from the Bureau of Foreign and Domestic Commerce, and employment in engine and turbine manufacture from the Bureau of Labor Statistics.

and shorts, $12–$16.50 (advanced to $13–$17.50). Canadian quotations are in American dollars rather than Canadian dollars.

Rhodesian: Crude No. 1, $300; and Crude No. 2, $260.

South African: Amosite: Grade B 1 (white), $140 (advanced to $150); Grade B 3 (dark), $120. Transvaal Blue: Grade B (long fiber), $400; Grade S (short fiber), $140 (advanced to $150).

Russian: Crude AA $750; Crude No. 1, $275; Crude No. 2, $240; and shingle stock, $67.50 and up.

Vermont: Shingle stock, $57; paper stock, $40; cement stock, $25; and shorts and floats, $12–$18 (advanced to $13–$18).

NEW DEVELOPMENTS

Interest has been revived in the blue asbestos deposits of the Cochabamba district of Bolivia, which have been known for some years. Fibers from this area examined at the Bureau of Mines are somewhat lower in strength and flexibility than South African blue. It is reported that Japan purchased several hundred tons of this fiber during recent years and that small quantities have reached the United States market.

After 5 years of laboratory research, Germany has developed brake linings that can be substituted for those consisting essentially of asbestos. The new lining consists of aluminum or steel wool, incorporated with synthetic rubber as a binder. It is said to have good braking power and to resist wear and heat.

Much interest has centered recently in a deposit of chrysotile near Cuddapah in the Madras Presidency about 125 miles northwest of Madras, British India. A specimen received by the Bureau of Mines is light amber, resembling closely the fiber mined in Arizona. The maximum fiber length of this sample is 3½ inches; the material is exceptionally soft and silky and has superior strength and flexibility. No information is yet available as to the nature or extent of the occurrence. Small quantities have reached the United States market.

FOREIGN TRADE [1]

The following table shows imports of unmanufactured asbestos into the United States in 1939 and 1940, by countries and classes. Total imports in 1940 increased 2 percent in quantity and 10 percent in value over 1939. Imports from Africa (including that which comes via United Kingdom) were 50 percent greater than in 1939. In view of disturbed conditions in the Mediterranean it is surprising that imports from Cyprus were only 17 percent less in 1940 than in 1939. No asbestos was obtained in 1940 from the U. S. S. R.

Asbestos (unmanufactured) imported for consumption in the United States, 1939–40, by countries and classes

Country	Crude (including blue fiber)		Mill fibers		Short fibers [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1939								
Africa:								
Union of South Africa	6,359	$656,543					6,359	$656,543
"Other British"	4,836	593,596					4,836	593,596
Australia	53	11,000					53	11,000
Canada	3,068	547,425	73,511	$4,378,887	147,261	$2,650,886	223,840	7,577,198
Finland					46	1,324	46	1,324
Italy	31	23,167			536	12,133	567	35,300
Malta, Gozo, Cyprus					3,940	69,426	3,940	69,426
U. S. S. R.			2,611	109,516	(2)	5	2,611	109,521
United Kingdom	298	40,580					298	40,580
Venezuela					11	50	11	50
	14,645	1,872,311	76,122	4,488,403	151,794	2,733,824	242,561	9,094,538
1940								
Africa:								
Union of South Africa	8,752	835,649					8,752	835,649
"Other British"	8,462	1,005,844					8,462	1,005,844
Australia	28	7,569					28	7,569
Bolivia	1	118					1	118
Canada	1,572	400,501	81,631	4,960,416	142,653	2,721,871	225,856	8,082,788
India, British	1	647					1	647
Italy	17	13,031			170	3,453	187	16,484
Malta, Gozo, Cyprus					3,266	80,057	3,266	80,057
Netherlands Indies	19	1,738					19	1,738
United Kingdom	18	3,239					18	3,239
Venezuela					23	300	23	300
	18,870	2,268,336	81,631	4,960,416	146,112	2,805,681	246,613	10,034,433

[1] Asbestos, n. e. s., containing not over 15 percent of foreign matter.
[2] Less than 1 ton.

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

Figure 2 shows, for a period of years, the principal sources of supply of asbestos used in the United States. Canadian fiber dominates the picture because most of our requirements of short fiber originate there. As a source of spinning, magnesia and compressed sheet fibers, Canada occupies a less-dominant, though still important place.

The following table shows imports and exports of unmanufactured asbestos for the 5-year period, 1936–40.

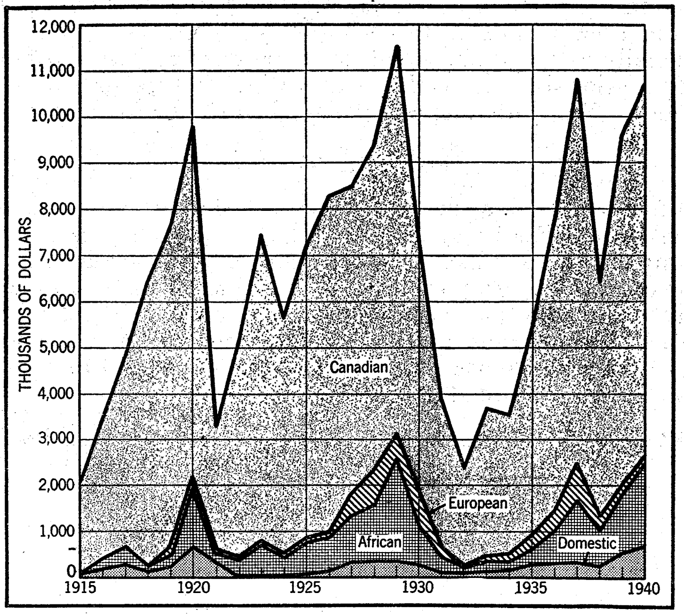

FIGURE 2.—Sources of asbestos consumed in the United States, 1915–40. Data on imports from Bureau of Foreign and Domestic Commerce. Material classified as European includes in some years small quantities from other sources.

Asbestos (unmanufactured) imported for consumption in and exported from the United States, 1936–40

Year	Imports		Exports	
	Short tons	Value	Short tons	Value
1936	243, 602	$7, 524, 937	3, 744	$310, 197
1937	307, 188	10, 470, 208	3, 004	253, 734
1938	179, 490	6, 160, 602	2, 780	288, 617
1939	242, 561	9, 094, 538	2, 473	218, 830
1940	246, 613	10, 034, 433	4, 474	449, 105

The following table shows exports of asbestos products in 1939 and 1940.

Manufactured asbestos products exported from the United States, 1939–40, by kinds

Product	1939		1940	
	Quantity	Value	Quantity	Value
Brake lining:				
Molded and semimolded	(1)	$714,679	(1)	$635,425
Not molded ... linear feet	886,069	178,393	638,037	139,146
Clutch facing ... number	326,493	129,144	411,958	147,167
Paper, millboard, and roll board ... short tons	819	122,543	1,231	196,232
Pipe covering and cement ... do	2,213	251,912	1,667	171,558
Textiles, yarn, and packing ... do	901	965,923	1,124	1,028,229
Asbestos roofing ... squares	54,634	284,643	70,505	413,735
Other asbestos manufactures, except roofing ... short tons	2,315	398,960	2,956	515,769
Magnesia and manufactures ... do	1,483	308,723	1,373	225,985

[1] Quantity not recorded.

WORLD PRODUCTION

The following table shows world production of asbestos, by countries, from 1936 to 1940, so far as figures are available.

World production of asbestos, 1936–40, by countries, in metric tons [1]

[Compiled by L. P. Lounsbery]

Country [1]	1936	1937	1938	1939	1940
Argentina				110	(2)
Australia:					
South Australia	81	123	49	46	(2)
Tasmania		2	4		(2)
Western Australia	162	43	123	279	(2)
Bolivia	(3)	21	21	(2)	(2)
Brazil			120	45	(2)
Bulgaria				(2)	(2)
Canada [4]	273,322	371,967	262,894	330,642	313,504
China (Manchuria)	69	(2)	(2)	(2)	(2)
Chosen	69	70	(2)	(2)	(2)
Cyprus (exports)	9,659	11,892	5,668	9,970	(2)
Czechoslovakia	2,700	(2)	(2)	(2)	(2)
Finland	3,963	3,330	(2)	(2)	(2)
France	405	250	(2)	(2)	(2)
Greece	1	2	85	(2)	(2)
India, British	57	102	90	266	(2)
Indochina	5	5		(2)	(2)
Italy	6,113	6,393	6,860	(2)	(2)
Japan (approximate)	1,000	1,000	1,000	1,000	1,000
Kenya Colony			5	(2)	(2)
Southern Rhodesia	51,116	51,722	53,352	52,900	(2)
Swaziland				7,233	(2)
Turkey	119	157	668	88	(2)
Uganda			53	(2)	(2)
Union of South Africa	22,894	25,975	21,025	19,988	(2)
U. S. S. R.	125,117	125,000	86,000	(2)	(2)
United States (sold or used by producers)	10,037	10,958	9,471	14,024	18,198
Venezuela	71	(2)	(2)	(2)	(2)

[1] In addition to countries listed, a small quantity of asbestos is produced in Madagascar.
[2] Data not available.
[3] Less than 1 ton.
[4] Exclusive of sand, gravel, and stone (waste rock only), production of which is reported as follows: 1936, 2,815 tons; 1937, 3,611 tons; 1938, 2,975 tons; 1939, 3,535 tons; 1940, data not available.

CANADA

Sales of asbestos in Canada were a little lower in 1940 than in 1939. Exports to the United States show a small gain, but this is more than offset by the loss of all the continental European markets. Because of wartime restrictions on publication of statistics, data are less complete for 1940 than for previous years.

For some time interest has centered in a deposit of good-quality chrysotile in Bannockburn Township, Ontario. A small tonnage was produced in 1939, but there is no report of production in 1940. However the Johnson's Company, a pioneer producer in the Thetford Mines district of Quebec, has acquired an interest in the Rahn Lake Mines Corporation, Ltd., and has taken steps toward more systematic development of the property. It is possible therefore that Ontario may become an important asbestos producer.

Sales of asbestos in Canada, 1939–40

	1939			1940		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Grade:						
Crudes	3,121	$938,718	$300.68	2,076	(1)	(1)
Fibers	193,992	12,049,539	62.12	181,890	(1)	(1)
Shorts	167,359	2,870,955	17.15	161,615	(1)	(1)
	364,472	15,859,212	43.51	345,581	$15,620,000	$45.20
Sand, gravel, and stone (waste rock only)	3,897	2,930	.75	(1)	(1)	(1)
Total asbestos and waste rock	368,369	15,862,142		(1)	(1)	
Rock mined	6,650,416			(1)		
Rock milled	5,548,765			(1)		

1 Data not available.

AFRICA

Southern Rhodesia.—Beginning with June 1940, publication of figures for production of asbestos were discontinued for the duration of the war. In the following table production for 1940 includes only the first 5 months. Production for the same period in 1939 was 24,296 tons valued at £448,451.

Asbestos produced in Southern Rhodesia, 1936–40

Year	Short tons	Value	Year	Short tons	Value
1936	56,346	£836,469	1939	58,313	£1,088,782
1937	57,014	840,025	1940 [1]	24,391	474,617
1938	58,811	1,020,921			

1 Figures cover period January–May.

Union of South Africa.—Data for only 9 months of 1940 are available at the time of writing. Figures for the corresponding period in 1939 were: Transvaal, 11,761 short tons; and Cape Province, 4,611 short tons. Total value, £364,132.

Asbestos produced in the Union of South Africa, 1936–40, by sources

Year	Short tons				Total[1] value
	Transvaal	Cape Province	Natal	Total	
1936	21,188	4,048	(2)	[2] 25,236	£337,229
1937	23,921	4,712	(2)	[2] 28,633	431,212
1938	16,505	6,484	[2] 187	[2] 23,176	416,401
1939	15,811	6,143	79	22,033	509,278
1940	[3] 15,303	[3] 4,653	(4)	[3] 19,956	[3] 360,111

[1] Value of local sales plus value of exports.
[2] Small production in Natal in December 1936 and in 1937 included in 1938 figures.
[3] Figures cover period January–September.
[4] Data not available.

The following table shows the tonnage of each variety produced from 1936 to 1940 but includes only the first 9 months of 1940. Figures for the corresponding 9 months of 1939 are as follows: Amosite (Transvaal), 8,229 short tons; chrysotile (Transvaal), 444; blue (Transvaal), 3,088; and blue (Cape), 4,611.

Asbestos produced in the Union of South Africa, 1936–40, by varieties and sources, in short tons

Variety and source	1936 [1]	1937 [2]	1938 [2]	1939 [2]	1940 [2,3]
Amosite (Transvaal)	4,823	6,531	8,793	11,378	12,628
Chrysotile (Transvaal)	16,149	16,855	[4] 5,573	[4] 582	374
Blue (Transvaal)	216	535	2,326	3,930	2,301
Blue (Cape)	4,048	4,712	6,484	6,143	4,653
	25,236	28,633	23,176	22,033	19,956

[1] Data from Government Mining Engineer, Union of South Africa, Department of Mines, Annual Report.
[2] Data from Union of South Africa, Department of Mines, Monthly Reports.
[3] Figures cover period January–September.
[4] Includes 187 short tons in 1938 and 79 tons in 1939 produced in Natal.

Swaziland.—The Havelock mine, which began production in June 1939, has become an important factor in the asbestos industry of Africa. Publication of data on production was discontinued for the duration of the war, beginning with August 1940. For the first 7 months of 1940 production amounted to 13,125 short tons compared with 7,973 for the entire year 1939.

CYPRUS

No data are available on production of short-fiber chrysotile in Cyprus during 1940, but imports into the United States from that source were about four-fifths as great as in 1939.

Asbestos exported from Cyprus, 1936–40

Year	Long tons	Value	Year	Long tons	Value
1936	9,506	£80,343	1939	9,813	(1)
1937	11,704	126,371	1940	(1)	(1)
1938	5,578	88,290			

[1] Data not available.

U. S. S. R.

No recent data are available on the Russian asbestos industry. An increasingly large proportion of the output is used for domestic asbestos-products manufacture.

Asbestos produced in and exported from U. S. S. R., 1936–40, in metric tons

Year	Production	Exports	Year	Production	Exports
1936	125,117	[1] 26,147	1939	(3)	(3)
1937	125,000	[2] 27,299	1940	(3)	(3)
1938	86,000	(3)			

[1] U. S. Bureau of Foreign and Domestic Commerce, Foreign Trade Notes.
[2] Statistics of the Foreign Trade of the U. S. S. R.
[3] Data not available.

BARITE, WITHERITE, AND BARIUM CHEMICALS

By Bertrand L. Johnson and K. G. Warner[1]

SUMMARY OUTLINE

New all-time peaks were again reached in 1940 for domestic production of crude barite (390,462 short tons), domestic crude barite sold or used by producer (409,353 tons), and reported consumption of domestic and imported crude barite (404,388 tons). The apparent new supply (barite sold or used by producer plus imports) was greater in 1940 than in 1939 but did not reach that of 1937, when an exceptionally large quantity of crude barite was imported. A new record was also set for the total value of domestic crude barite sold or used by producers ($2,596,743). This was accompanied by a rise in the average value a ton from $6.11 in 1939 to $6.34 in 1940. Increased demands for crude barite came from the ground- (and crushed-) barite and barium chemical industries. There was a slightly decreased demand for crude barite for lithopone manufacture. Imports of crude barite in 1940 were considerably less than in 1939 and came entirely from Cuba; the average value, however, rose quite sharply from $4.83 in 1939 to $5.59 in 1940. Imports of witherite were slightly less in 1940 than in 1939.

Total sales of barium chemicals[2] were higher than in 1939 or 1938 but did not reach the figure for 1937. The value of total sales was higher in 1940 than in 1939 but less than for 1937 and 1936. The quantities of lithopone, blanc fixe, artificial barium carbonate, and "other barium chemicals" sold or used by producers in 1940 were all greater than in 1939.

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

[2] Data for "barium chemicals" not comparable directly with those for "barium products" in previous Minerals Yearbooks because of separation of data for "ground (and crushed) barite" and "witherite," given separately in this chapter.

Salient statistics of the barite, witherite, and barium chemical industries in the United States, 1936–40

	1936	1937	1938	1939	1940
Barite:					
Crude:					
Produced short tons	274,062	360,877	335,433	365,870	390,462
Sold or used by producers:					
Short tons	283,160	355,888	309,663	383,609	409,353
Value: [1]					
Total	$1,674,631	$2,240,970	$2,004,521	$2,344,103	$2,596,743
Average	$5.91	$6.30	$6.47	$6.11	$6.34
Imports for consumption:					
Short tons	33,843	64,992	24,845	11,588	7,391
Value: [2]					
Total	$170,316	$327,224	$151,235	$55,985	$41,342
Average	$5.03	$5.03	$6.09	$4.83	$5.59
Apparent new supply [3] short tons	317,003	420,880	334,508	395,197	416,744
Domestic percent	89.3	84.6	92.6	97.1	98.2
Reported consumption (total) short tons	303,449	383,982	364,985	391,683	404,388
Ground (and crushed):					
Sold or used by producers:					
Short tons	69,102	129,777	161,422	170,695	184,390
Value	$1,217,818	$2,249,612	$2,786,823	$2,902,973	$3,697,806
Imports for consumption:					
Short tons	2,873	3,313	1,700	1,590	314
Value	$28,397	$35,046	$15,466	$14,999	$3,299
Witherite:					
Imports for consumption:					
Short tons	2,464	4,556	2,115	3,819	3,584
Value	$44,475	$82,341	$43,568	$64,106	$70,126
Barium chemicals:					
Sold or used by producers: [4]					
Short tons	194,708	202,408	165,680	183,748	198,201
Value	$15,081,630	$14,992,899	$12,085,012	$12,791,269	$12,868,417
Imports for consumption:					
Short tons	5,742	6,550	4,519	3,205	191
Value	$338,925	$368,133	$254,874	$172,490	$9,045
Exports of lithopone:					
Short tons	2,538	2,671	1,734	4,845	14,298
Value	$229,942	$231,622	$153,567	$392,798	$1,112,362

[1] F. o. b. mine shipping point.
[2] Declared value f. o. b. foreign market.
[3] Barite sold or used by producers plus imports.
[4] 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.

BARITE

CRUDE

Production.—Barite was mined in 1940 in 10 States—Arkansas, California, Colorado, Georgia, Missouri, Nevada, South Carolina, Tennessee, Texas, and Virginia—compared with 11 in 1939. States productive in 1939 but not in 1940 were Alabama, Arizona, and Montana. Added producers were Arkansas and Texas. Mine production in 1940 totaled 390,462 short tons, a 7-percent increase from that of 1939 (365,870 tons).

Sales.—A new peak was made in 1940 in the quantity of crude barite sold or used by producers in the United States—409,353 short tons—and the total value was higher than ever before ($2,596,743). Missouri continued to lead in sales of crude barite in 1940, with Georgia second; both States had increases over 1939.

Prices.—The market quotation for crude barite from Georgia, f. o. b. mines, has remained unchanged at $7 a long ton from 1935 to 1940, inclusive, according to the Engineering and Mining Journal Metal and Mineral Markets.

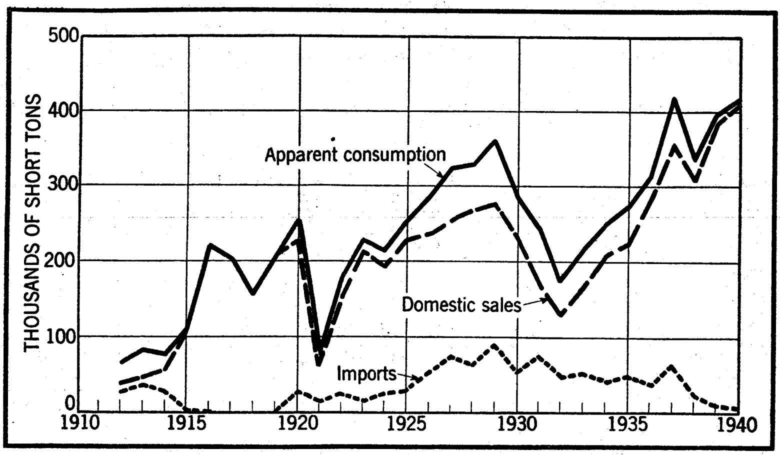

FIGURE 1.—Trends in domestic sales, imports, and apparent consumption of crude barite, 1912–40.

Crude barite sold or used by producers in the United States, 1939–40, by States

State	1939		1940	
	Short tons	Value	Short tons	Value
Georgia	86,589	$438,378	92,302	$464,590
Missouri	171,642	1,163,870	179,455	1,216,069
Tennessee	57,140	372,348	70,767	503,204
Other States [1]	68,238	369,507	66,829	412,880
	383,609	2,344,103	409,353	2,596,743

[1] 1939: Alabama, Arizona, California, Colorado, Montana, Nevada, South Carolina, and Virginia; 1940: Arkansas, California, Colorado, Nevada, South Carolina, Texas, and Virginia.

The price of Missouri crude barite (95 percent $BaSO_4$, less than 1 percent iron) was quoted at $6.50 to $7.00 a short ton from January 1, 1940, to August 15, 1940, after which the quotations were $6.25 to $7.00 a ton. The 93-percent-grade quotations remained at $6.00 to $6.50 a ton throughout 1940.

The average value, f. o. b. mine shipping point, of crude barite for the entire United States rose from $6.11 in 1939 to $6.34 in 1940.

Consumption.—The following tables show the consumption of crude barite by uses and by States.

Crude barite (domestic and imported) used in the manufacture of ground barite and barium chemicals in the United States, 1936–40, in short tons

Year	In manufacture of—			Total	Year	In manufacture of—			Total
	Ground barite	Lithopone	Barium chemicals			Ground barite	Lithopone	Barium chemicals	
1936	83,990	167,014	52,445	303,449	1939	[1] 192,112	141,556	58,015	391,683
1937	148,930	162,681	72,371	383,982	1940	[1] 200,899	136,885	66,604	404,388
1938	[1] 193,728	117,007	54,250	364,985					

[1] Includes crushed barite as follows: 1938, 7,121 short tons; 1939, 11,678 tons; 1940, 11,601 tons.

Crude barite (domestic and imported) used in the manufacture of ground barite and barium chemicals in the United States in 1940, by States

State	Product manufactured	Plants	Barite used (short tons)
Missouri	Ground barite and chemicals	3	116,400
Delaware, New Jersey, and Pennsylvania	Lithopone and chemicals	5	81,391
California	Ground barite, lithopone, and chemicals	8	47,545
Illinois	do	7	41,254
Colorado	Chemicals	1	106,197
Rhode Island	do	1	
West Virginia	do	2	
Kansas	Lithopone	1	
Maryland	do	1	
Georgia	Ground barite and chemicals	2	
New York	do	2	
South Carolina	Ground barite	1	
Louisiana and Texas	do	3	
		[1] 37	[2] 404,388

[1] A plant producing more than 1 product is counted but once in arriving at State totals.
[2] Includes 11,601 short tons of crushed barite not separable by States.

Deposits and technology.—Several articles descriptive of barite deposits and technology [3] appeared in 1940.

Foreign trade.—All of the imports of crude barite into the United States in 1940 came from Cuba; they were 36 percent below those of 1939 in quantity and 26 percent lower in total value. The average value a ton of the crude barite imported increased from $4.83 in 1939 to $5.59 in 1940. Exports of crude barite from the United States are not separately recorded.

Crude barite imported for consumption in the United States, 1939–40, by countries

Country	1939		1940	
	Short tons	Value	Short tons	Value
Algeria	51	$161		
Canada	1	7		
Cuba	11,536	55,817	7,391	$41,342
	11,588	55,985	7,391	41,342

World production.—Few figures are available for 1940 regarding the barite production of the various barite-producing countries.

K. V. Hicks, in two consular reports,[4] and W. S. Dyer, Toronto, Canada, in a letter to the author, state that a large barite deposit was discovered in October 1940 near Walton, Nova Scotia, at an elevation of about 300 feet above sea level and 3 miles from tidewater.

[3] Adams, G. I., and Jones, W. B., Barite Deposits of Alabama: Alabama Geol. Survey Bull. 45, June 1940, 38 pp.
Gianella, V. P., Barite Deposits of Northern Nevada: Am. Inst. Min. and Met. Eng., Tech. Pub. 1200, 1940, Mining Technol., vol. 4, No. 4, July 1940, 6 pp.
Heck, E. T., Barium in Appalachian Salt Brines: Bull. Am. Assoc. Petrol. Geol., vol. 24, 1940, pp. 486–493.
Harding, A. C., Ground Barytes for Weighting Drilling Mud: Eng. and Min. Jour., vol. 142, No. 1, January 1941, pp. 33–36.
Julihn, C. E., and Horton, F. W., Mineral Industries Survey of the United States—California. Tuolumne and Mariposa Counties, Mother Lode District (South). Mines of the Southern Mother Lode Region. Part II—Tuolumne and Mariposa Counties: Bureau of Mines Bull. 424, 1940, 179 pp.
[4] Hicks, K. V., United States consul, Halifax, N. S., Discovery and Survey of Apparently Large Deposits of High-grade Barite Near Windsor, Nova Scotia: Report December 21, 1940, 3 pp.; partly reported in Bureau of Mines Mineral Trade Notes, vol. 12, No. 2, February 20, 1941, pp. 18–19. Deposits of High-grade Barite in Nova Scotia: Report February 10, 1941, 1 p.; partly reported in Bureau of Mines Mineral Trade Notes, vol. 12, No. 3, March 20, 1941, p. 18.

World production of barite, 1936–40, by countries, in metric tons

[Compiled by L. P. Lounsbery]

Country [1]	1936	1937	1938	1939	1940
Algeria	----------	2,137	3,069	(2)	(2)
Argentina	----------	----------	----------	768	(2)
Australia:					
New South Wales	149	268	322	(2)	(2)
South Australia	2,009	2,736	2,909	3,886	(2)
Tasmania	34	77	----------	----------	(2)
Victoria	----------	71	----------	----------	(2)
Brazil (exports)	----------	600	(2)	(2)	(2)
Chosen	5,113	8,400	(2)	(2)	(2)
Cuba	----------	3,849	----------	12,000	16,105
Egypt	30	51	20	31	(2)
France	22,200	19,850	(2)	(2)	(2)
Germany:					
Austria	1,663	855	373	(2)	(2)
Baden	17,800	21,653	36,305	(2)	(2)
Bavaria	11,175	11,832	26,748	(2)	(2)
Prussia [3]	392,103	410,634	401,906	(2)	(2)
Saxony	467	432	230	(2)	(2)
Thuringia	450	6,790	15,315	(2)	(2)
Württemburg	1,000	192	----------	(2)	(2)
Greece	31,336	39,343	34,700	24,055	(2)
India, British	5,196	15,941	8,205	9,404	(2)
Indochina	40	45	50	155	185
Italy	36,671	45,202	48,169	(2)	(2)
Japan	3,837	(2)	(2)	(2)	(2)
Norway	408	70	----------	(2)	(2)
Portugal	10	101	24	(2)	(2)
Southern Rhodesia	----------	----------	91	50	(2)
Union of South Africa	583	570	491	439	766
United Kingdom	74,242	74,485	77,543	(2)	(2)
United States	248,624	327,380	304,298	331,910	354,219

[1] In addition to the countries listed, barite is produced in Canada, China, Czechoslovakia, Spain, and the U. S. S. R.
[2] Data not available.
[3] Official figures which, it is reported, cover only output of mines included under the mining law.

The geology of the area adjacent on the west has been described in Memoir 155 of the Canadian Geological Survey, The Horton-Windsor District, by W. A. Bell, published in 1929, and a sketch of a vertical section of the barite deposit has recently been published.[5] The barite deposit lies near the contact of the gently dipping sedimentary Horton and Windsor series of the Upper Carboniferous. Sixteen drill holes have shown an eastward-pitching ore body at least 600 feet long, 200 feet wide, and over 100 feet thick, with reported reserves of over 1,500,000 tons of barite. The barite is of medium-grained crystalline texture, and its color is reddish. It is reported to have an average specific gravity of 4.41. A composite surface sample is said to have contained over 98 percent $BaSO_4$ and less than 1 percent ferric oxide. About 3,000 tons of barite had been taken out by May 1941 and shipped for treatment to the mill site at Walton, where a grinding plant is to be installed to prepare the barite for use as a weighting material in the Trinidad oil wells. The property is owned by the Springer Sturgeon Gold Mines, Ltd., of Toronto, Canada.

Cuban barite deposits are being developed further, and a grinding plant is under construction at Regla, Havana Bay, to treat barite from the Province of Pinar del Rio.

GROUND (AND CRUSHED)

Sales.—The quantity of ground barite sold or used by producers in the United States in 1940 reached a new high of 184,390 short tons,

[5] Northern Miner, Springer Sturgeon Drilling Quickly Indicates Huge Tonnages: May 8, 1941, p. 7

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with a total sales value of $3,697,806—a marked increased over 1939. The number of plants producing ground or crushed barite increased from 13 in 1939 to 16 in 1940 (see accompanying table).

Ground (and crushed) barite sold or used by producers in the United States, 1936–40

	1936	1937	1938	1939	1940
Plants	13	12	14	13	16
Short tons	69,102	129,777	161,422	170,695	184,390
Value	$1,217,818	$2,249,612	$2,786,823	$2,902,973	$3,697,806

Ground (and crushed) barite sold or used by producers, 1938–40, by consuming industries

Industry	1938		1939		1940	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Well drilling	126,697	78	125,560	74	138,055	75
Paint	8,227	5	9,750	6	11,056	6
Glass	7,963	5	12,586	7	12,697	7
Rubber	2,944	2	3,319	2	4,283	2
Undistributed	15,591	10	19,480	11	18,299	10
	161,422	100	170,695	100	184,390	100

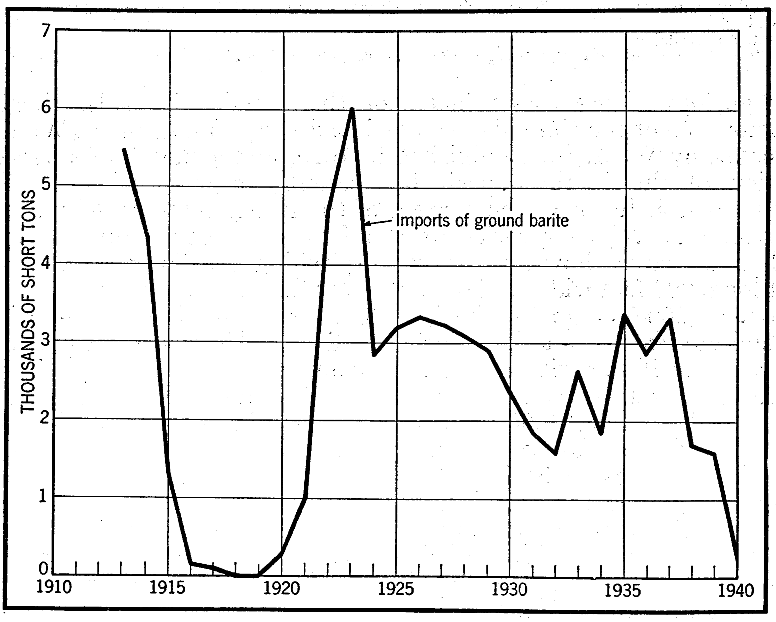

FIGURE 2.—Imports of ground barite into the United States, 1913–40.

The preparation and use of ground barite for weighting drilling muds have been described by Harding [6] and Stern.[7]

[6] Harding, A. C., Work cited in footnote 3.
[7] Stern, A. G., Role of Clay and Other Minerals in Oil-Well Drilling Fluids: Bureau of Mines Rept. of Investigations 3556, 1941, 88 pp.

Prices.—Prices quoted from The Chemical Industries, New York, for ground barite, carlots, 350-pound barrels, works, were $25.15 a short ton for 1940 compared with $23.65 for 1939.

Foreign trade.—Considerable ground barite is exported from the United States, but the data regarding these exports are not separately recorded. A few thousand tons of ground barite have been imported annually. (See fig. 2.)

Ground barite imported for consumption in the United States, 1936–40

[Value at port of shipment]

Year	Short tons	Value	Year	Short tons	Value
1936	2,873	$28,397	1939	1,590	$14,999
1937	3,313	35,046	1940	314	3,299
1938	1,700	15,466			

WITHERITE

Production.—Productive deposits of witherite occur in England and in the United States. The English deposits yield a nearly pure witherite and the American deposits a barite-witherite mixture. In England there are but two producing companies—The Owners of Settlingstones Mines, Ltd., in Northumberland County, and The Holmside & South Moor Collieries, Ltd., in County Durham. Details of these operations are given in a booklet recently issued jointly by the two producing companies.[8] In the United States there is but one producer, the Baroid Sales Division of the National Lead Co., which operates a barite-witherite mine near El Portal, Calif.[9] Current witherite-production figures are combined with those of barite in the production statistics.

Prices.—Prices of ground witherite in 1940, according to The Chemical Industries, New York, ranged from $43.00 to $47.00 in carlots, bags, works, for the 90-percent grade.

Foreign trade.—Imports of witherite into the United States come entirely from England and total only a few thousand tons a year. (See fig. 3.)

Exports of witherite from the United States, if any, are not separately recorded in the foreign trade statistics.

Witherite, crude, unground, imported for consumption in the United States, 1936–40

[Value at port of shipment]

Year	Short tons	Value	Year	Short tons	Value
1936	2,464	$44,475	1939	3,819	$64,106
1937	4,556	82,341	1940	3,584	70,126
1938	2,115	43,568			

BARIUM CHEMICALS

Sales.—Both the total quantity and the value of barium chemicals sold or used by producers in 1940 were greater than in 1939. Greater quantities of lithopone, blanc fixe, artificial barium carbonate, and

[8] Holmside & South Moor Collieries, Ltd., and Owners of Settlingstones Mines, Ltd., Witherite (Natural Barium Carbonate) and Its Industrial Uses: Newcastle-upon-Tyne, 1940, 56 pp.
[9] Julihn, C. E., and Horton, F. W., Work cited in footnote 3, pp. 168–170.
Harding, A. C., Work cited in footnote 3.

other barium chemicals were sold, but no new records were made except for artificial barium carbonate (chemically precipitated). An increase in value was attained only in the sales of blanc fixe.

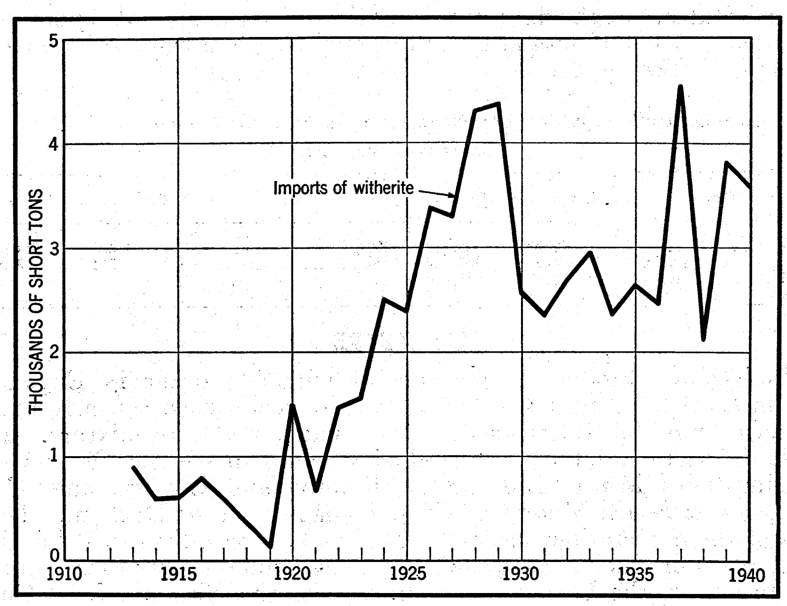

FIGURE 3.—Imports of witherite, crude, unground, into the United States, 1913–40.

Barium chemicals sold or used by producers in the United States, 1936–40 [1]

Chemicals	1936	1937	1938	1939	1940
Lithopone: [2]					
Plants	11	11	11	11	11
Short tons	158, 319	154, 771	125, 746	142, 759	151, 802
Value	$12, 976, 754	$12, 069, 790	$9, 975, 012	$10, 461, 102	$10, 197, 897
Blanc fixe (precipitated barium sulfate):					
Plants	6	7	7	6	6
Short tons	16, 149	28, 250	19, 428	18, 653	22, 247
Value	$890, 310	$1, 614, 764	$921, 203	$898, 198	$1, 250, 303
Artificial barium carbonate (chemically precipitated):					
Plants	3	3	4	5	5
Short tons	11, 347	10, 755	9, 543	12, 478	13, 339
Value	$515, 624	$511, 357	$459, 901	$617, 799	$616, 331
Other barium chemicals: [3]					
Plants	7	6	5	7	7
Short tons	8, 893	8, 632	10, 963	9, 858	10, 813
Value	$698, 942	$796, 988	$728, 896	$814, 170	$803, 886
Total barium chemicals:					
Short tons	194, 708	202, 408	165, 680	183, 748	198, 201
Value	$15, 081, 630	$14, 992, 899	$12, 085, 012	$12, 791, 269	$12, 868, 417

[1] To avoid duplication, the barium chemicals reported here do not include the output of firms that make these chemicals from such products as barium chemicals and imported barite and witherite purchased in the open market.

[2] Does not include cadmium lithopones.

[3] Figures cover chemicals, in order of value, as follows: 1936 and 1938: Chloride, dioxide, sulfide, hydroxide, and oxide; 1937: Chloride, dioxide, sulfide, and hydroxide; 1939: Chloride, dioxide, hydroxide, sulfide, and oxide; 1940: Chloride, dioxide, hydroxide, sulfide, oxide, and nitrate.

Lithopone is used principally in the paint industry, which took 77 percent of the total sold or used by producers in 1940.

Lithopone [1] sold or used by producers, 1938–40, by consuming industries

Industry	1938		1939		1940	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Paints, enamels, and lacquers	101,924	81	113,995	80	117,075	77
Floor coverings and textiles	15,400	12	17,429	12	18,738	13
Rubber	3,148	3	3,189	2	3,387	2
Other	5,274	4	8,146	6	12,602	8
	125,746	100	142,759	100	151,802	100

[1] Does not include cadmium lithopone.

Prices.—Quoted prices for domestic and high-strength lithopones in 1940 were lower than those for 1939. The prices for titanated lithopones in 1940 were the same as the lowest prices of 1939. Prices for precipitated barium carbonate in 1940 were \$45 to \$62.50 a short ton compared with \$52.50 to \$62.50 in 1939. There was no change in barium chloride prices. Barium chlorate prices were up considerably in 1940—20 to 45 cents a pound as against 16½ to 25 cents in 1939. Barium dioxide ranged from 10 to 12 cents a pound in 1940 compared with 11 to 12 cents in 1939. Barium hydrate prices ranged from 5½ to 7 cents in 1940 and from 4½ to 5½ cents in 1939. Barium nitrate prices ranged only between 9½ and 10½ cents in 1940 compared with 6¾ and 10½ cents in 1939. Blanc fixe was quoted at \$50.00 to \$80.00 in 1940, a slightly narrower range than that of 1939—\$40.00 to \$80.00.

Range of quotations on barium chemicals, 1938–40 [1]

	1938	1939	1940
Lithopone:			
Domestic, ordinary, delivered, bags ..... pound	\$0.04⅛–\$0.04⅝	\$0.03¾ \$0.04⅛	\$0.03⅗
Do ..... barrels ..... do	.04⅜– .04⅞	.04 – .04⅜	.03¾
High strength, bags ..... do	.05⅝– .06⅛	.05¼– .05⅝	.05
Do ..... barrels ..... do	.05⅞– .06⅜	.05½– .05⅞	.05¼
Titanated, bags ..... do	.05⅝– .06⅛	.05¼– .05⅝	.05¼
Do ..... barrels ..... do	.05⅞– .06⅜	.05½– .05⅞	.05½
Barium carbonate, precipitated, 200-pound bags, works ..... short ton	52.50 – 62.50	52.50 – 62.50	45.00 – 62.50
Barium chlorate, 112-pound kegs, New York pound	.16½– .17½	.16½– .25	.20 – .45
Barium chloride, barrels, delivered zone 1 ..... short ton	77.00 – 92.00	77.00 – 92.00	77.00 – 92.00
Barium dioxide (binoxide or peroxide), 88 percent, 600-pound drums ..... pound	.11 – .12	.11 – .12	.10 – .12
Barium hydrate, 500-pound barrels ..... do	.04¾– .05½	.04½– .05½	.05½– .07
Barium nitrate, barrels ..... do	.06¾– .08¼	.06¾– .10½	.09½– .10½
Barium sulfate, precipitated (blanc fixe), 400-pound barrels, works [2] ..... short ton	40.00 – 75.00	40.00 – 80.00	50.00 – 80.00

[1] Chemical Industries (formerly Chemical Markets), New York (monthly).
[2] Lowest price for pulp grade, highest for high-grade precipitated.

Foreign trade.—The only barium chemicals imported into the United States in 1940 were barium nitrate, barium hydroxide, and "barium compounds (n. e. s.)"; imports of all these were much less, both in quantity and value, than in 1939.

Exports of lithopone in 1940 nearly tripled those of 1939 and were accordingly greater than in any year since 1922 when exports of barium products were first recorded separately. The average value of the exports in 1940 (\$77.80) was less than in 1939 and the lowest ever recorded.

Barium chemicals imported for consumption in the United States, 1936–40

[Value at port of shipment]

Year	Lithopone		Barium dioxide		Blanc fixe (precipitated barium sulfate)		Barium carbonate (precipitated)	
	Short tons	Value	Pounds	Value	Short tons	Value	Short tons	Value
1936	4,781	$273,571	1,392	$223	123	$6,971	30	$889
1937	5,601	302,417	229	34	109	7,617	30	848
1938	3,932	207,121	100	13	106	5,102	(1)	32
1939	2,641	130,893	350	51	38	1,891		
1940								

Year	Barium chloride		Barium nitrate		Barium hydroxide		Barium oxide		Barium compounds (n. e. s.)	
	Short tons	Value	Short tons	Value	Short tons	Value	Pounds	Value	Short tons	Value
1936	244	$10,355	185	$19,107	370	$25,423	287	$155	8	$2,231
1937	315	13,761	157	15,836	310	21,004	298	161	28	6,455
1938	69	2,351	126	12,061	236	16,874			50	11,320
1939	39	1,329	100	11,094	360	19,975	22	13	27	7,244
1940			18	1,427	151	3,332			22	4,286

[1] 110 pounds.

Lithopone exported from the United States, 1936–40

Year	Short tons	Value: Total	Value: Average	Year	Short tons	Value: Total	Value: Average
1936	2,538	$229,942	$90.60	1939	4,845	$392,798	$81.07
1937	2,671	231,622	86.72	1940	14,298	1,112,362	77.80
1938	1,734	153,567	88.56				

POTASH

By J. H. Hedges

SUMMARY OUTLINE

The upward trend of production by potash mines and plants in the United States continued in 1940. An output of 658,249 short tons of merchantable salts containing approximately 379,679 tons of K_2O represents a gain over 1939 of 20 percent in material produced and 22 percent in K_2O. Producers sold 677,892 tons containing about 393,058 tons of K_2O, the average grade being 57.98 percent. A 7-percent increase in sales was proportionately less than the 15-percent rise in consumption, because gains by producers in the domestic market were partly offset by voluntary restriction of exports to conserve supplies in anticipation of reduced imports. Resales for export, by customers of the producers, of salts containing around 32,000 tons of K_2O tended to defeat this program; in consequence, potash was placed under export-license control by an Executive order of January 10, 1941, effective February 3, 1941. Producers and importers sold 477,495 tons of K_2O for use in agriculture and industry in the United States and its possessions; American producers supplied 77 percent (366,344 tons). This figure includes 32,000 tons resold for export.

Contrary to expectation, imports (K_2O content) increased 19 percent from the 18-year low of 1939, owing to heavy shipments from France during the first 5 months of the year. Fertilizer materials imported totaled 274,473 short tons containing 115,241 tons of K_2O valued at $5,148,852, and chemical materials totaled 14,564 tons containing 3,449 tons of K_2O valued at $2,411,919.

Exports of fertilizer materials decreased 32 percent, to 93,060 short tons containing 55,836 tons of K_2O valued at $3,141,170. Chemical materials exported increased fourfold to 14,180 tons valued at $3,096,909. The increase represented shipments to the United Kingdom and British possessions of salts normally obtained from European sources.

The potash industry developed in the United States since the World War of 1914–18 through coordinated efforts of Government and private agencies has ended definitely the dependence on foreign supplies that plagued consumers for 20 years after cartelization of the German industry under Government control in 1910. The serious shortage that developed during the war years 1915 to 1918 sent the prices of meager supplies skyrocketing and further stimulated the study of domestic resources. Government investigations of all phases of the industry have demonstrated its stability and economic soundness. In recent years it has supplied up to 70 percent of expanding domestic needs, and during 1940 produced all grades of salts in ample quantities to supplement dwindling receipts from foreign sources. Although output exceeded that of any previous year by a wide margin, the ultimate capacity of existing mines and plants has not been reached. The third mine to be opened in the Carlsbad (N. Mex.) district, which began operations in late 1940, will be in full production in 1941, adding materially to the domestic supply. The statistical position, with respect to the potential supply and the probable demand in 1941, is set forth in the following table:

Estimated capacity of domestic plants and requirements for 1941

	Short tons of K_2O
Requirements—1941	
Consumption—1940	
United States and possessions	445, 705
Canada	21, 203
Cuba	2, 504
Total consumption—1940	469, 412
10-percent increase for 1941	46, 941
Anticipated consumption—1941	516, 353
Other Western Hemisphere	2, 000
Britain and British possessions	10, 000
Total American market—1941	528, 353
Available supply—1941	
Domestic capacity—7 plants	
Refined salts	475, 000
Run-of-mine (25 percent K_2O)	50, 000
Imports (sodium-potassium nitrate from Chile)	8, 000
Total supply—1941	533, 000

In addition to the prospective new supply indicated above, stocks in the hands of producers and importers at the beginning of the year totaled about 45,000 short tons of K_2O, and run-of-mine ore averaging 25 percent K_2O could be produced at the rate of 150,000 tons of K_2O annually if necessary. Thus it appears that no shortage is likely to develop in 1941. Three companies are now producing sulfate on a large scale and one plant is turning out sulfate of potash-magnesia, so that these salts, formerly available only from abroad, now can be supplied in quantity adequate to meet domestic needs.

Receipts of potash from German and French sources virtually ceased immediately after the outbreak of hostilities in September 1939. During the last quarter of that year imports from Europe totaled only 23,000 short tons of salts in contrast to 180,000 tons entered in the corresponding period of 1938. However, the French took advantage of the stalemate on the western front that characterized the early months of 1940 to resume operation of the Alsatian mines that had been seriously hampered in the confusion of mobilization. Before access to the sea was cut off by the German drive in May, they had shipped 186,000 tons of potash salts to the United States. Later in the year a number of cargoes, aggregating 30,882 tons, were imported from Spain, but these shipments likewise ceased in November and had not been resumed when this chapter was written (April 1941).

Except for crude nitrate from Chile, receipts of potash salts from abroad are likely to be inconsequential in 1941. As indicated above, the industry doubtless can meet domestic needs, but the exportable surplus of high-analysis salts may fall below the requirements of neighbors who will look to the United States for supplies. Up to a certain point, deficiencies can be made up from run-of-mine salts without inconvenience to users. This material can be employed without disadvantage in certain low-analysis fertilizer mixtures where it simply replaces some of the inert filler customarily used, and in some of the higher mixtures part of the potash can be supplied in this form. By these expedients domestic requirements should be met and a large enough quantity made available for essential exports.

More than 99 percent of the 1940 output of potash was derived from natural brines and bedded saline deposits. The four major companies (American Potash & Chemical Corporation, United States Potash Co., Potash Company of America, and Union Potash & Chemical Co.) produced over 97 percent of the total. Bonneville, Ltd., reported a small increase in production from brine of the Salduro marsh near Wendover, Utah, and the North American Cement Corporation and United States Industrial Chemicals recovered a small quantity of potash salts as a byproduct of their operations.

Salient statistics of the potash industry in the United States for 1939 and 1940 are summarized in the following table.

Salient statistics of the potash industry in the United States, 1939–40

	1939	1940
Production:		
Potassium salts (merchantable)...short tons..	[1] 546,757	658,249
Approximate equivalent, K_2O...do....	[1] 312,201	379,679
Sales by producers:		
Potassium salts...do....	634,014	677,892
Approximate equivalent, K_2O...do....	366,287	393,058
Value at plant...	$12,028,195	$12,562,050
Average per ton...	$18.97	$18.53
Imports:		
Fertilizer materials...short tons..	237,236	274,473
Approximate equivalent, K_2O...do....	94,297	115,241
Value...	$5,752,225	$5,148,852
Chemical materials...short tons..	18,576	14,564
Approximate equivalent, K_2O...do....	5,832	3,449
Value...	$2,406,109	$2,411,919
Exports:		
Fertilizer materials...short tons..	136,750	93,060
Approximate equivalent, K_2O...do....	82,000	55,836
Value...	$4,446,853	$3,141,170
Chemical materials...short tons..	3,579	14,180
Approximate equivalent, K_2O...do....	1,800	7,000
Value...	$807,987	$3,096,909

[1] Revised figures.

PRICES

Price schedules issued by producers and importers in June 1939 for the 1939–40 fertilizer season governed all transactions up to May 31, 1940. Schedules for the 1940–41 season issued in June 1940 retained unchanged the base price, ex-vessel at Atlantic, Gulf, and Pacific ports, of 53½ cents a unit for muriate and $36.25 a ton for sulfate but advanced the price of manure salts 1½ cents, to 60 cents a unit. The long-established seasonal discounts of 12 and 6 percent were changed as follows: 8 percent on orders accepted before July 26, 1940, for delivery in June or July or for delivery of the total order in substantially equal monthly quantities from August 1, 1940, to January 31, 1941, and 4 percent additional upon acceptance of the entire tonnage under contract by January 31, 1941; 4 percent on orders accepted before November 1, 1940, for spot delivery or for delivery of the total order in substantially equal monthly quantities from November 1, 1940, to January 31, 1941, and 2 percent additional upon acceptance of the entire tonnage under contract by January 31, 1941. On orders accepted on or after November 1, 1940, no discount was allowed. The split-discount method of pricing is designed to discourage the tendency to overorder by penalizing cancelations and rewarding acceptance of the full tonnage under contract. The burden of balancing the supply with a fluctuating demand is thus divided between producers and their customers. Cancelations, long a bugbear of the industry, doubtless will be kept at a minimum by this expedient.

In addition to the prices quoted ex-vessel at the customary coastal basing points, the 1940–41 schedules offer salts f. o. b. cars at Carlsbad, N. Mex., at 11.2 cents a unit below net ex-vessel port prices, and at Trona, Calif., at 8 cents below the net ex-vessel price at Pacific coast ports. The net ex-vessel price is the base ex-vessel price less the appropriate seasonal discount. This multiple price system and the revised multiple discount system were adopted as a corollary of the investigation of the industry by the United States Department of Justice, on recommendation of the United States Department of Commerce, after an extended economic study of the potash industry. The effect of pricing f. o. b. Carlsbad and Trona in addition to the customary coastal basing points, at a suitable differential, is to reflect in lower delivered prices the natural advantage of those consumer areas that are nearer freightwise to the points of production than to the base points on the coast. It is expected to eliminate certain relatively higher price inland areas, where the f. o. b. mill price plus rail freight from the nearest source of supply will be much less than the port price plus transportation from the nearest base port. A saving of $1 to $2 a ton should accrue to consumers west of the Alleghenies, while prices in the so-called watershed areas representing over 60 percent of consumption will not be affected.

Importers of French and Spanish potash offered muriate, sulfate, and kainite in limited amounts at established prices and customary terms. Importers of German potash announced to the trade in June that on account of the war in Europe they were not in a position to offer any potash salts for shipment from Europe and therefore would postpone issuing price lists until such shipments could be resumed.

The following table shows the prices prevailing during 1940 in accordance with published schedules and discounts.

Prices f. o. b. Carlsbad were $5.60 a ton less than port prices for 50-percent muriate and $3.36 less for 30-percent manure salts. The f. o. b. Trona price for 50-percent muriate was $4.00 a ton below the port price.

Ex-vessel port prices per ton of potash salts in the United States in 1940

Period	Muriate of potash, 50 percent K_2O, in bulk	Sulfate of potash, 90 percent K_2SO_4, in bags	Manure salts, 30 percent K_2O, in bulk	Kainite, 20 percent K_2O, in bulk
January to May, inclusive	$26.75	$36.25	$17.55	$12.75
June 1 to July 25	23.54	31.90	15.84	10.78
July 26 to October 31	25.14	34.07	16.92	11.51
November and December	26.75	36.25	18.00	12.25

CONSUMPTION AND USES

Producers and importers of potash salts sold and delivered approximately 477,000 short tons of potash in 1940 for consumption in the United States and its possessions, of which 366,344 tons (77 percent) came from domestic sources. About 32,000 tons of this material were resold for export, hence domestic consumption appears to have been about 442,000 tons of agricultural salts and muriate of chemical grade; 92 percent was for fertilizer and 8 percent for industrial use. In addition, 14,564 tons of chemical salts containing 3,449 tons of K_2O were imported for consumption in the United States, bringing the total used in this country to approximately 446,000 tons of K_2O. Apparent consumption, calculated by subtracting exports (62,836 tons) from the sum of imports (118,690 tons) and producers' sales (393,058 tons), was 448,912 tons of K_2O.

The following table gives as accurate a picture of sales of potash of domestic and foreign origin for consumption in the United States and for export as can be drawn by combining information from numerous sources adjusted to a comparable basis.

Sales of primary potash in the United States for consumption and export, 1939–40, in short tons of K_2O

	1939	1940
Deliveries of potash of domestic and foreign origin reported by American Potash Institute—		
In United States and possessions:		
Agricultural	340,765	417,943
Chemical	24,284	37,815
For export	77,675	24,046
	442,724	479,804
Imports not included above plus sales of nonmember producers	28,500	21,737
	471,224	501,541
Total exports	83,800	55,836
Actual sales for consumption in the United States	387,424	445,705

PRODUCTION AND SALES

Mines and plants in the United States produced more marketable potash salts in 1940 than ever before, recording a 20.4-percent gain over 1939 in gross tonnage and a 21.6-percent gain in K_2O. Sales increased 7.3 percent, exceeding production by 13,379 tons of K_2O.

The refining processes employed by the major producers yield muriate of 95 to 98 percent purity. Other grades for which there is a gradually abating demand are manufactured by blending this high-grade salt with run-of-mine to produce the desired mixture.

Production and sales of marketable potassium salts and stocks in the hands of producers for the last 5 years are summarized in the following table. Only the final weight of marketable salts after refining or mixing is shown.

Potassium salts produced, sold, and in producers' stocks in the United States, 1936–40

Year	Production			Sales				Producers' stocks		
	Operators	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)	Operators	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)	Value f. o. b. plant	Operators	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)
1936	7	431,470	247,340	7	396,690	222,810	$6,969,190	5	73,139	34,000
1937	7	486,090	284,497	7	466,933	266,938	9,019,534	5	105,900	55,620
1938	9	534,945	316,951	9	498,189	286,437	9,748,290	6	158,540	87,440
1939	6	[1] 546,757	[1] 312,201	6	634,014	366,287	12,028,195	5	54,233	29,440
1940	7	658,249	379,679	7	677,892	393,058	12,562,050	7	35,060	16,370

[1] Revised figures.

GOVERNMENT ACTIVITIES

Prosecution of the three major producers and the principal importer of potash by the United States Department of Justice on an indictment returned May 26, 1939, charging a combination to fix prices and otherwise restrain trade was concluded when the Department, on May 21, 1940, submitted to the court a proposed civil decree dismissing the indictment and terminating the litigation. The decree absolves the defendants from violation of the antitrust laws charged in the indictment but prohibits them from agreeing (1) to fix prices or terms and conditions of sale; (2) to refrain from competing with each other; or (3) to refuse to sell potash to individual consumers, farm cooperatives, or fertilizer mixers not approved by all the defendants.

Following the indictment in May 1939 the United States Department of Commerce, at the suggestion of the United States Department of Justice, undertook an economic study of the potash industry to examine its performance and to recommend such changes in practice as appeared to be in the public interest. The three companies concerned and the importer cooperated fully in this study. In a report submitted to the Department of Justice by the Department of Commerce and published in May 1940 certain changes in merchandising practices were recommended. These recommendations were agreed to by the companies and formed the basis of the consent decree.

The changes recommended and subsequently adopted included establishment of prices f. o. b. Carlsbad, N. Mex., and Trona, Calif., at suitable differentials below the price at the seaboard, permitting the customer to purchase f. o. b. point of production at the differential price or on a delivered basis; establishment of a multiple discount system to encourage advance purchases and discourage concellations; and modification of the sales policy to permit consumers to purchase direct from producers in carload lots for their own use at regular prices and discounts. These conditions were embodied in the new price schedules issued in June 1940.

The congressional investigation of the potash industry by a subcommittee of the Senate Committee on Public Lands under the chairmanship of the late Senator Pittman, begun in 1936, now doubtless will be concluded by the issuance of a report. Except during the early stages this investigation has not been pressed but has been kept alive by continuing resolutions in each succeeding Congress extending the time for submission of a final report. The committee was interested primarily in determining the extent and manner of foreign ownership and control of the major companies.

The question of discovery and valuation for depletion allowance of a potash deposit in New Mexico was argued at length before the United States Board of Tax Appeals during the summer of 1940. The Bureau of Internal Revenue claimed that two holes drilled into the deposit showing the presence of potash constituted discovery and that the price received shortly thereafter for an interest in the property established its value. The company, on the other hand, contended that discovery was not made until the existence of a workable deposit was proved by sinking a shaft to the potash-bearing formation and carrying out extensive underground development. The hearing was concluded last fall, but as yet no decision has been rendered in the case.

REVIEW BY STATES

California.—The American Potash & Chemical Corporation, operating at Trona continuously since 1915 on Searles Lake brine to produce muriate of potash, turned out a considerable tonnage of sulfate in the first complete year's operation of the sulfate plant begun in 1939. Borax, soda ash, salt cake, sodium-lithium phosphate, and bromine are other products of the Trona plant.

Maryland.—United States Industrial Chemicals, Baltimore, and North American Cement Corporation, Hagerstown, again produced the only byproduct potash offered on the market.

New Mexico.—In the Carlsbad area, a third mine which has been under development since 1936, attained productive status in October when the plant of the Union Potash & Chemical Co. began operation. The products of this plant are muriate and sulfate of potash and double sulfate of potash-magnesia. This is the first time that the double sulfate, for which there is a moderate demand, has been available from a domestic source. In spite of inevitable new plant adjustments a substantial tonnage of salts was made and sold in the final quarter of the year. The Union Potash & Chemical Co. is controlled and operated by International Agricultural Corporation, which is reported to own 95 percent of the preferred and 56 percent of the common stock. A proposed merger of the two companies awaits approval of minority stockholders. Both the United States Potash Co. and the Potash Co. of America stepped up their output notably. This was accomplished, without plant enlargement, by increased efficiency and more continuous operation. The tonnage of crude ore mined in the Carlsbad area passed 1,200,000 tons in 1940 to establish a new high record in the continuing upward trend. The mines are equipped to handle around 2,000,000 tons a year, but output is restricted to the capacity of concentrating and refining plants and the moderate demand for manure salts for direct shipment or blending. The ore as mined averages around 25 percent K_2O.

Utah.—Bonneville, Ltd., 540 West Seventh South, Salt Lake City, recovers potash from Salduro marsh brine at its plant near Wendover.

Solar evaporation is utilized to purify the brine through successive concentration and crystallization to a crystalline mixture of potassium and sodium chlorides, which are then separated by flotation. The final product is high-grade muriate of potash. Technical difficulties experienced during early stages of development have been largely overcome, and increased output is anticipated in the near future. The Bonneville company is the only producer of potash in the State.

FOREIGN TRADE [1]

Imports.—The quantity, average grade, and total declared value of the various potash salts imported in 1939 and 1940, the countries from which shipments were made in 1940, and the approximate K_2O equivalent of imports are shown in the following tables.

Potash materials imported for consumption in the United States, 1939–40

Material	Approximate equivalent as potash (K_2O) (percent)	1939				1940			
		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	301	42	(1)	$1,923	---	---	---	---
	20.0	20,591	4,118	4.1	153,233	36,175	7,235	6.1	$231,426
Manure salts	31.4	2,078	652	.7	22,216	442	139	.1	4,432
Muriate (chloride)	56.4	94,417	53,251	53.2	2,313,574	152,494	86,007	72.5	2,835,765
Potash-magnesia sulfate	27.0	12,610	3,405	3.4	270,563	3,900	1,053	.9	59,793
Potassium nitrate, crude	40.0	9,463	3,785	3.8	401,111	1,308	523	.4	57,478
Potassium-sodium nitrate mixtures, crude	14.0	55,164	7,723	7.7	1,235,078	55,016	7,702	6.5	1,366,131
Sulfate	50.0	42,463	21,232	21.2	1,353,326	25,013	12,507	10.5	592,318
Other potash fertilizer material [2]	60.0	149	89	.1	1,201	125	75	.1	1,509
Total fertilizer		237,236	94,297	94.2	5,752,225	274,473	115,241	97.1	5,148,852
Used chiefly in chemical industries:									
Bicarbonate	46.0	121	56		19,456	14	6		2,996
Bitartrate:									
Argols	20.0	8,685	1,737		1,216,940	11,903	2,381		2,086,867
Cream of tartar	25.0	3	1		828	---	---		---
Carbonate	61.0	217	132		24,106	9	5		1,116
Caustic	80.0	332	266		61,930	46	37		20,164
Chlorate and perchlorate	36.0	5,978	2,152		662,618	1,789	644		198,373
Cyanide	70.0	51	36	5.8	35,886	10	7	2.9	6,967
Ferricyanide (red prussiate)	42.0	210	88		90,063	31	13		15,307
Ferrocyanide (yellow prussiate)	44.0	28	12		4,885	---	---		---
Iodide	28.0	(3)	(3)		14	(3)	(3)		81
Nitrate, refined	46.0	2,604	1,198		191,446	616	283		41,317
Permanganate	29.0	91	26		17,547	(3)	(3)		13
All other	50.0	256	128		80,390	146	73		38,718
Total chemical		18,576	5,832	5.8	2,406,109	14,564	3,449	2.9	2,411,919
Grand total		255,812	100,129	100.0	8,158,334	289,037	118,690	100.0	7,560,771

[1] Less than one-tenth of 1 percent.
[2] Chiefly wood ashes from Canada.
[3] Less than 1 ton.

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

Potash materials imported for consumption in the United States in 1940, by countries, in short tons [1]

[Figures in parentheses in column headings indicate, in percent, approximate equivalent as potash (K_2O)]

Country	Muriate (chloride) (56.4)	Sulfate (50)	Potash-magnesia sulfate (27)	Manure salts (31.4)	Kainite (20)	Bitartrate (argols or wine lees) (20)	Caustic (80)	Carbonate (61)
Algeria						877		
Argentina						2,460		
Belgium	56	487						
Brazil						6		
Canada	12					2		
Chile						555		
China								2
France	124,939	23,860		442	36,175	174	5	
Germany								6
Hong Kong								1
Hungary		166						
Italy						1,457		
Japan								
Morocco						237		
Netherlands		500	3,900					
Peru						6		
Portugal						2,391		
Spain	27,487					3,395		
Sweden							41	
Switzerland								
Tunisia						340		
U. S. S. R.								
United Kingdom						3		
	152,494	25,013	3,900	442	36,175	11,903	46	9

Country	Cyanide (70)	Nitrate (saltpeter), crude (40)	Nitrate (saltpeter), crude (14)	Chlorate and perchlorate (36)	All other (48)	Total: Short tons	Total: Value
Algeria						877	$152,949
Argentina						2,460	392,185
Belgium					261	804	32,329
Brazil						6	1,603
Canada				2	125	141	2,934
Chile			55,016			55,571	1,457,686
China						2	319
France	1	34		506	121	186,257	3,207,169
Germany		1,274		11	335	1,626	77,942
Hong Kong						1	146
Hungary						166	8,092
Italy					31	1,488	292,934
Japan				4		4	540
Morocco						237	32,794
Netherlands					25	4,425	83,345
Peru						6	1,357
Portugal						2,391	404,327
Spain						30,882	1,179,051
Sweden				543		584	88,314
Switzerland				723		723	78,339
Tunisia						340	40,687
U. S. S. R.					2	2	185
United Kingdom	9				32	44	25,544
	10	1,308	55,016	1,789	932	289,037	7,560,771

[1] Changes for 1939 in Minerals Yearbook, 1940, p. 1396: Imports of sulfate should read 42,463 short tons (Germany, 24,444). Total should read 255,812 short tons (Germany, 91,184). Value not affected.

Exports.—Shipments of fertilizer materials to countries outside the immediate American market, which is considered by producers to include Canada and Cuba, were restricted voluntarily by the producers to protect consumers from shortage due to cessation of imports. Actually receipts of European potash were much greater than anticipated, and the supply was adequate. Customers of the producers sold abroad material containing the equivalent of about 32,000 tons of K_2O or more than half of the total quantity exported. Most of this went to Japan.

Potash materials exported from the United States, 1936–40

Year	Fertilizer		Chemical		Year	Fertilizer		Chemical	
	Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
1936	103,031	$3,049,822	2,333	$487,347	1939	136,750	$4,446,853	3,579	$807,987
1937	103,031	3,278,895	2,094	484,450	1940	93,060	3,141,170	14,180	3,096,909
1938	84,137	2,599,772	2,616	485,672					

Exports, by countries, of fertilizer and chemical potash materials in 1939 and 1940 are shown in the following table. The K_2O equivalent of the tonnage shown was approximately 83,800 tons in 1939 and 55,836 in 1940.

Potash materials exported from the United States, 1939–40, by countries

Country	Fertilizer				Chemical			
	1939		1940		1939		1940	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Argentina	28	$848	140	$8,210	122	$30,262	657	$151,824
Australia			1,203	45,020	232	40,367	1,064	241,495
Belgium	9,257	300,320			17	3,314	12	5,315
Brazil	3	160	1,812	81,694	202	41,016	676	166,809
Canada	24,874	695,425	39,096	1,188,868	886	167,365	1,663	268,399
Chile					23	6,582	270	85,155
Colombia			319	12,341	80	19,471	156	43,841
Costa Rica			21	1,079	8	3,216	11	3,414
Ecuador	11	213			14	6,251	55	19,771
Egypt					84	13,418	168	48,077
Honduras	207	5,333	35	1,217	15	3,509	10	3,071
India, British			99	3,440	87	24,432	670	212,719
Japan	59,098	2,136,908	27,654	933,315	3	1,780	27	8,347
Liberia	20	819			(1)	12	(1)	4
Mexico	183	8,663	201	15,760	191	44,321	509	110,637
Mozambique	56	2,596	22	1,004	3	1,235	73	14,715
Netherlands	4,386	156,827			131	24,285	1	991
Netherlands Indies			711	23,817	24	4,634	173	55,200
New Zealand			1,454	55,880	12	3,546	128	27,261
Norway	4,389	143,361			27	5,460	9	4,625
Philippine Islands	678	21,177	656	22,226	58	20,989	68	22,254
Sweden	8,501	352,762			34	16,573	38	21,175
Union of South Africa	242	9,052	2,529	96,121	102	30,077	328	109,224
United Kingdom	17,211	345,314	10,988	439,164	895	167,348	6,241	1,030,490
Venezuela	223	8,358	273	13,854	43	11,235	111	24,348
West Indies:								
British:								
Barbados	3,870	149,760	775	29,241	(1)	125	(1)	14
Jamaica	1	36	290	10,210	2	1,147	2	473
Trinidad and Tobago			109	4,176	9	2,462	8	2,928
Other British	158	5,999	263	10,156	1	295	2	1,007
Cuba	3,348	102,549	4,387	142,368	27	10,460	43	16,087
Haiti	(1)	33	10	549	2	461	3	796
Other countries	6	340	13	1,460	245	102,339	1,004	396,443
	136,750	4,446,853	93,060	3,141,170	3,579	807,987	14,180	3,096,909

[1] Less than 1 ton.

WORLD PRODUCTION

No authentic data on world production of potash salts are available for either 1939 or 1940. The following table presents a compilation of all the official statistics that have been issued for 1936–40, inclusive.

World production of potash minerals and equivalent K_2O, 1936–40, by countries, in metric tons

[Compiled by L. P. Lounsbery]

Country and mineral [1]	1936		1937		1938		1939		1940	
	Output	Equivalent K_2O	Output	Equivalent K_2O	Output	Equivalent K_2O	Output	Equivalent K_2O	Output	Equivalent K_2O
North America: United States, potassium salts	391,421	224,382	440,971	258,090	485,291	287,532	496,007	283,223	597,241	344,437
Europe:										
France (Alsace), crude potassium salts	2,123,540	[2] 368,880	2,883,502	489,801	3,374,811	581,790	(3)	(3)	(3)	(3)
Germany, crude potassium salts:										
Carnallite [4]	1,415,731	145,160	1,672,417	170,550	1,874,375	} 1,861,000	(3)	(3)	(3)	(3)
Kainite, sylvinite, and hartsalz	10,348,821	1,477,490	12,787,735	1,797,866	14,567,896		(3)	(3)	(3)	(3)
Italy, alunite	3,976	477	3,500	420	2,778	333	(3)	(3)	(3)	(3)
Poland, crude potassium salts:										
Kainite	89,187	8,919	111,357	11,136	120,100	12,010	(3)	(3)	(3)	(3)
Sylvite	336,317	73,990	395,885	87,095	427,200	93,984	(3)	(3)	(3)	(3)
Langbeinite	8,553	1,026	14,241	1,709	19,644	2,358	(3)	(3)	(3)	(3)
Spain, crude potassium salts	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
U. S. S. R., crude potassium salts	1,800,000	225,000	2,400,000	266,000	(3)	(3)	(3)	(3)	(3)	(3)
Asia:										
China, potassium carbonate [5]	68	(3)	32	(3)	14	(3)	4	(3)	(3)	(3)
Chosen, alunite	114,569	(3)	149,000	(3)	(3)	(3)	(3)	(3)	(3)	(3)
India (British), nitrate of potash [6]	8,800	4,200	9,000	4,300	8,200	4,000	(3)	(3)	(3)	(3)
Palestine, crude potassium salts [7]	23,456	11,727	36,467	18,234	58,118	29,059	(3)	(3)	(3)	(3)
Africa: Eritrea, niccoli salts [8]	300	80	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Australia, alunite	758	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)

[1] In addition to countries listed, Chile and Iran are reported to produce a small quantity of potash salts, but statistics of production are not available.
[2] Content of merchantable products.
[3] Data not available.
[4] Includes some natural kieserite.
[5] Exports.
[6] Estimated production (Imperial Institute, London).
[7] Extracted from waters of the Dead Sea.
[8] Extracted from waters of the Red Sea.

FOREIGN DEVELOPMENTS

France.—No statistics on production of the Alsatian potash mines have been published since August 1939; however, it is known that, although operation of the mines was disrupted by the confusion of mobilization and the induction of many of the operating staff into the army when war broke out in September, the staff was reorganized and the mines began working on a substantial scale by the end of the year. The French Potash Co., afterward changed to the French Potash & Import Co., was established in New York to handle the sale of French potash in the United States. The mines were thought to be too near the Maginot line to permit continued commercial exploitation. Nevertheless, during the early months of 1940, 30,000 to 50,000 short tons a month of potash salts were shipped to the United States. Some may have come from accumulated stocks, but the bulk is believed to have been new production. The total thus exported to the United States in 5 months was 186,257 tons and comprised muriate, sulfate, manure salts, and kainite.

Since 1919, when Alsace—a German province for nearly 50 years—was returned to France at the close of the World War, its potash deposits have been exploited by the State-controlled Mines Domaniales de Potasse d'Alsace and the privately owned Mines de Kali Sainte-Thérèse. For a few years after the war the German and French mines competed strongly for the business of importing countries until in 1924 they reached an agreement fixing sales quotas in the world market at 70 percent for the German Potash Syndicate and 30 percent for the French. Between that time and the outbreak of the present war the French and Germans collaborated closely to control the market through an international cartel. As new sources of potash were developed in Poland, Spain, Russia, and Palestine the producers in those countries were induced to make agreements with or to join the cartel, which was enabled thereby effectively to control the international potash trade. The N. V. Potash Export My. was established in 1927 in Amsterdam as a sales agency to handle the export business of German and French producers.

When war came in 1939 the mutual sales agency was dissolved; with the fall of France in June 1940 Alsace was reincorporated into the German Reich, and it is supposed that the potash mines will be returned to the control of their former German owners. Deposits near Bordeaux, hitherto unexploited, remain to France. Elaborate plans for developing these deposits, announced several years ago, apparently have not been carried out, and their extent and importance are not known. Early announcements predicted that production would begin about 1941.

Germany.—The potash reserves of Germany have been vastly increased by reacquisition of the Alsatian mines, which doubtless will have post-war economic repercussions. Cut off from overseas markets for surplus potash, Germany is understood to be making strenuous efforts to increase its use in conquered countries and others within its sphere of influence, for the double purpose of disposing of potash and increasing the yield of sorely needed crops. The shortage of manpower for cultivating the fields may be partly overcome by increasing the fertility of the soil through liberal use of fertilizer. The British blockade appears to have been effective in stopping exports to overseas destinations. In the United States the Pioneer Potash Co. was formed to import and sell potash of German origin, but since the war began only a few thousand tons have been received in this country, and none has been reported since April 1940.

Japan.—Difficulty experienced in obtaining supplies of potash from the usual European and American sources led Japanese importers to purchase a quantity of potassium-sodium nitrate from Chile and caused the Japanese Government to explore the possibility of a trade pact with Spain to exchange Japanese raw silk and camphor for Spanish potash salts and mercury. Restriction of exports from the United States reduced shipments of potash salts to Japan 53 percent—from 59,098 short tons in 1939 to 27,654 in 1940. Now that export licenses are required for all shipments of potash to foreign countries, exports outside the Western Hemisphere are likely to be reduced still further.

Norway.—The United States commercial attaché at Oslo reports that a fairly large plant is being erected by a Norwegian hydroelectric company for experiments concerned with the economic recovery of potash salts from sea water. The process is said to involve the use of certain reagents that yield insoluble potassium salts precipitated in the form of a filterable compound. This intermediate product is then treated for recovery of the reagents. More detailed information is withheld by the company pending the granting of patents.

Palestine.—Exports of potassium chloride rose to 63,527 metric tons in 1939. Since the outbreak of war export movement of potash salts has been closely guarded, and all information regarding shipments is considered confidential. However, London newspapers have carried the statement that exports have more than doubled. The destination of exports in 1939 has not been published; but in 1938 they were widely distributed, the chief recipients being the United Kingdom, United States, Japan, Australia, Netherlands, Belgium, and Ceylon. Palestine Potash, Ltd., operating plants at both ends of the Dead Sea for the recovery of potash salts and bromine from the brine, is the only producer in Palestine and the only important producer in the British Empire.

Spain.—Potash production, which ceased in 1936 soon after the outbreak of the Spanish civil war in spite of the efforts of a workers' committee to operate the mines, was resumed late in 1939 by the three operating companies, Union Española de Explosivos, Minas de Potasa de Suria, and Potasas Ibericas, S. A. Stocks on hand at Barcelona at the end of 1939 totaled about 12,000 metric tons of potash, and stocks available at the mines amounted to about 30,000 tons. Despite these generous supplies, augmented by current production, shipments in late 1939 and early 1940 were small. One of the producers explained that the low export price prevailing for potash salts, combined with the unfavorable exchange rate, did not yield enough pesetas to pay for the cost of mining and transportation and leave a margin for profit; hence, more attention is being given to the domestic market.

Operation of the mines is hampered by a number of difficulties growing out of the destruction of machinery and equipment at the mines and of bridges and rolling stock of the railroads during the civil war. Replacements for this lost equipment are difficult to obtain; and although the railroads are in operation, a main bridge at Monistrol was still being rebuilt in early 1940, and there is a shortage of rolling stock. The port in Barcelona is reportedly in normal condition, and by the end of April about 30,000 tons of potash salts had accumulated in the warehouse there.

Since the Franco-German cartel is no longer operative, the three Spanish companies have made an agreement for the regulation of exports. It is understood to allot 65 percent of exports to Union Española de Explosivos and 35 percent to Potasas Ibericas, while the output of Minas de Potasa de Suria is reserved for local consumption.

The Spanish Government in commercial agreements has sought to provide an outlet for Spanish potash. Thus a Norwegian agreement signed in 1939 and continuing in effect until July 31, 1940, provided for the exportation of potash fertilizers valued at £20,000. What effect later events may have had on this arrangement is not known. More recently, a trade treaty with Japan has been under consideration to provide for exchange of potash for Japanese products. During the first quarter of 1940 exports to Sweden, Norway, Great Britain, and Japan were reported.

Beginning in July, about 30,000 tons of potash salts were exported to the United States. Cessation of these shipments in November was said to be due to the fact that better prices could be obtained in other markets. Producers estimate that 1941 output may be as much as 250,000 tons.

United Kingdom.—The use of available supplies of fertilizer potash is directed by the British Ministry of Agriculture to insure its application only to soils deficient in potash and to essential crops. Control measures, including price fixing, likewise have been applied to caustic potash and carbonate of potash. The possibility of recovering potash from blast-furnace and cement-flue dusts, as was done during the World War, is being investigated.

U. S. S. R.—Reserves of potash under control of the Soviet Government were greatly increased by acquisition of the Polish mines in the agreement reached by Germany and Russia after the German conquest of Poland. Heretofore, Russia has not been much of a factor in world trade in potash because most of the potash salts produced at Solikamsk has been required for local consumption. If post-war readjustments find Russia still in possession of the Polish mines and previously announced plans for increasing output from deposits in the Urals are accomplished, it may be possible to produce a substantial surplus for export in competition with other major sources of world supply.

MICA

By Paul M. Tyler and K. G. Warner

SUMMARY OUTLINE

The apparent consumption of sheet mica in the United States during 1940 exceeded all previous records. Notwithstanding a 100-percent increase over 1939, domestic production fell a little short of the 1937 total and was much less than it was during earlier boom years, but imports were half again as large as in 1937 and roughly 20 percent larger than in 1929 or 1920, previous peak years. The built-up-mica industry was working to capacity toward the end of the year, and the consumption of mica splittings in 1940 was almost 44 percent greater than in 1939 and topped the previous record of 1937 by a wide margin. Consumption of scrap and production of ground mica failed to make new records, but even this branch of the industry was active in 1940.

It is difficult to distinguish civilian from military uses of mica, and many of the ordinary industrial uses of mica in the electrical machinery and communications industries, and even for passenger automobiles and trucks, are essential to the defense program; however, a substantial portion of the greatly increased consumption of high-grade sheet mica and much of that of splittings was for use directly in airplanes, tanks, and other military equipment.

Unmanufactured mica is marketed in a bewildering variety of qualities and sizes that range in price from a fraction of a cent a pound for small or imperfect crystals to $20 or more a pound for large, clear, flat sheets. Mineralogically most of the mica consumed is white mica or muscovite, and the greater part of the remainder is amber mica or phlogopite. Dark-stained muscovite, used for ordinary electrical purposes, is locally called "black mica" in North Carolina, but only insignificant quantities of biotite are used in industry. By far the largest proportion of the tonnage of mica used in the United States is classed as scrap, which is the raw material for making both wet- and dry-ground mica. This category includes byproduct mica recovered in washing kaolin or kyanite, as well as an increasing quantity of mica produced from schists. Although substantial tonnages of scrap mica have been imported, chiefly from British India, such mica is not classed as strategic because ample supplies could be produced domestically at relatively short notice and because many of its uses are not essential to a major military effort. Vermiculite, an altered variety of mica used chiefly for heat insulation, is not included in the Bureau of Mines figures for mica and is discussed in the Minor Nonmetals chapter.

Salient statistics of the mica industry in the United States, 1936–40

	1936	1937	1938	1939	1940
Domestic mica sold or used by producers:					
Total uncut sheet and punch:					
Pounds	1,319,233	1,694,538	939,507	813,708	1,625,437
Value	$203,879	$285,244	$139,333	$138,963	$291,685
Average per pound	$0.15	$0.17	$0.15	$0.17	$0.18
Scrap:[1]					
Short tons	20,955	25,196	20,257	24,672	22,386
Value	$260,594	$354,737	$256,382	$311,895	$314,565
Average per ton	$12.44	$14.08	$12.66	$12.64	$14.05
Total sheet and scrap:[1]					
Short tons	21,615	26,043	20,727	25,079	23,199
Value	$464,473	$639,981	$395,715	$450,858	$606,250
Total ground:[1]					
Short tons	25,585	27,245	27,086	30,924	27,984
Value	$722,416	$839,812	$924,554	$1,156,333	$1,016,628
Consumption of splittings:[2]					
Pounds	3,518,058	4,347,435	1,667,806	3,423,044	4,918,861
Value	$846,393	$1,257,645	$612,465	$1,089,683	$1,725,522
Imports for consumption:					
Total uncut sheet and punch:					
Pounds	860,253	1,004,950	391,125	902,598	1,534,188
Value	$239,378	$296,235	$113,403	$271,072	$576,565
Scrap:					
Short tons	3,893	6,723	4,450	4,279	3,061
Value	$22,666	$36,355	$28,590	$29,493	$22,611
Total sheet and scrap:					
Short tons	4,323	7,226	4,646	4,730	3,828
Value	$262,044	$332,590	$141,993	$300,565	$599,176
Manufactured:					
Short tons	2,355	4,113	1,115	1,550	3,860
Value	$943,524	$1,735,009	$522,426	$758,745	$1,884,952
Total imports:					
Short tons	6,678	11,339	5,761	6,280	7,688
Value	$1,205,568	$2,067,599	$664,419	$1,059,310	$2,484,128
Exports (all classes of mica):					
Short tons	1,478	1,795	1,772	1,827	903
Value	$170,011	$216,858	$183,889	$226,364	$191,550

[1] Includes mica recovered from kaolin and mica schists, as follows: 1936, 8,258 tons, $127,343; 1937, 10,536 tons, $149,931; 1938, 6,550 tons, $86,602; 1939, 10,011 tons, $108,899; 1940, 9,674 tons, $138,148.
[2] Exclusive of a nominal quantity of splittings produced in the United States and South America.

In respect to mica required for the most essential and strategic uses, the United States is by no means as well-situated as its production and foreign trade statistics may imply. Domestic mines supply almost enough punch and circle sizes (sheet mica under about 2 square inches but over 1 square inch in area, used for making washers and small radio stampings) but seldom as much as one-third of our requirements of larger sizes. In respect to the qualities of mica used for such highly important items as radio-transmitter condensers or high-tension magneto condensers, which are indispensable to the functioning of squadrons of airplanes, tanks, ships, and other mobile mechanical instruments of modern warfare, the United States has depended for its past requirements almost entirely on British India. Only a fraction of the mica produced, even in that country, is of a quality suitable for the most exacting requirement of high-grade condensers, but fortunately South American mica has begun to be accepted for these purposes. It is doubtful whether the United States could produce all its sheet-mica needs, even under the stimulus of greatly increased prices, and there is no doubt that it could not supply its requirements of condenser sheet because its present-day needs of these high qualities are much larger in proportion to its total mica requirements than the normal ratio of such mica to run-of-mine production of sheet mica, even in India. Careful analysis shows that the proportion of punch and small sheet is quite large in domestic mine production.

As regards splittings, the United States depends almost wholly on imports, as domestic production normally supplies less than 2 percent of requirements. British India dominates the field of muscovite splittings, not so much because of its abundant supplies of raw mica as because of its experienced coolie labor, which can produce them at a fraction of their cost elsewhere. Madagascar holds a somewhat similar position in respect to supplies of amber splittings, although these are also produced in Canada; as these can be split mechanically whereas muscovite cannot, they may be produced to an increasing extent in the United States. Muscovite splittings can be produced in this country but only at a cost several times greater than the normal cost of Indian splittings.

Amber mica is not mined in the United States, and known deposits are scarce and seemingly unworkable.

DOMESTIC PRODUCTION

Sheet mica.—Following the slump in 1939 mica mining picked up rapidly during the early months of 1940 and by midsummer began to show symptoms of a boom. In North Carolina many of the small feldspar miners were producing mica, and mica mines that had been inactive for years were being reopened. Interest was revived in prospects and abandoned mines in other States. As would be expected during the early stages of a revival and especially in view of the posting of relatively higher prices on smaller sizes, the main increase in domestic production was of punch and circle mica, the output of which in 1940 was greater than in any preceding year since 1929, and totaled 1,405,305 pounds valued at $116,087 compared with 665,755 pounds valued at only $39,207 during 1939. The output of larger sizes of sheet mica increased sharply to 220,132 pounds valued at $175,598 from 147,953 pounds, $99,756 in 1939 but fell short of the 1937 figures. Total sales of sheet mica by domestic producers were 1,625,437 pounds valued at $291,685 in 1940 compared with 813,708 pounds, $138,963 in 1939 and 1,694,538 pounds, $285,244 in 1937. The value of the 1940 output was greater than that of any other year since 1926.

Production statistics on mica have been published annually since 1880, when American mines produced 81,669 pounds of sheet mica valued at $127,825. After rising to 147,410 pounds valued at $368,525 in 1884 the output declined rapidly as a result of competition from Indian mica, which began to be imported in 1885. The low point was 35,943 pounds valued at $43,793 in 1894, after which the growing demand for electrical uses initiated an upturn that culminated in a volume peak of 2,476,190 pounds in 1910. Value figures for earlier years are not strictly comparable, because values for cut mica and semifinished products formerly were included in the returns of miners who operated their own cutting plants. No segregation of punch and circle from larger sheet mica was made in the statistics before 1924. (See fig. 1.)

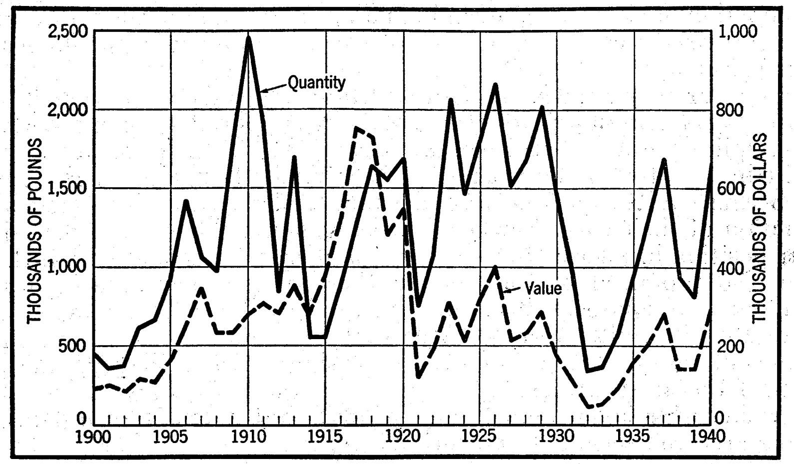

FIGURE 1.—Sheet mica produced and sold by producers in the United States, 1900–1940 (statistical data for 1908–39 tabulated in Minerals Yearbook, 1940, p. 1405, and for 1880–1916 in Mineral Resources of the United States, 1916, part II, p. 292).

Mica sold or used by producers in the United States, 1925–40

Year	Sheet mica						Scrap mica and mica recovered from kaolin and schists		Total	
	Uncut punch and circle mica [1]		Uncut mica larger than punch and circle		Total uncut sheet mica					
	Pounds	Value	Pounds	Value	Pounds	Value	Short tons	Value	Short tons	Value
1925–29 (average)	1,433,684	$117,702	405,400	$172,679	1,839,084	$290,381	11,687	$215,632	12,607	$506,013
1930–34 (average)	589,668	25,764	153,433	69,930	743,101	95,694	10,869	145,097	11,241	240,791
1935–39 (average)	888,313	46,408	252,411	139,306	1,140,724	185,714	21,986	285,512	22,557	471,226
1937	1,312,900	70,493	381,638	214,751	1,694,538	285,244	25,196	354,737	26,043	639,981
1938	774,121	45,566	165,386	93,767	939,507	139,333	20,257	256,382	20,727	395,715
1939:										
Connecticut	218,472	13,768	61,036	45,404	279,508	59,172	213	3,483	353	62,655
New Hampshire	41,535	2,088	2,135	1,650	43,670	3,738	105	1,592	127	5,330
North Carolina	320,616	18,629	80,554	50,715	401,170	69,344	13,913	184,377	14,114	253,721
Other States [2]	85.132	4,722	4,228	1,987	89,360	6,709	10,441	122,443	10,485	129,152
	665,755	39,207	147,953	99,756	813,708	138,963	24,672	311,895	25,079	450,858
1940:										
Connecticut	244,981	14,849	40,709	25,467	285,690	40,316	300	4,900	443	45,216
New Hampshire	167,969	10,747	(3)	(3)	[3] 167,969	[3] 10,747	(3)	(3)	[3] 84	[3] 10,747
North Carolina	848,663	78,214	153,983	139,940	1,002,646	218,154	11,595	173,327	12,096	391,481
Other States [2]	143,692	12,277	[3] 25,440	[3] 10,191	[3] 169,132	[3] 22,468	[3] 10,491	[3] 136,338	[3] 10,576	[3] 158,806
	1,405,305	116,087	220,132	175,598	1,625,437	291,685	22,386	314,565	23,199	606,250

[1] Includes small quantities of splittings in certain years.
[2] 1939: Arizona, California, Colorado, Georgia, Maine, New Mexico, New York, South Dakota, Vermont, Virginia, and Wyoming; 1940: Alabama, Arizona, California, Colorado, Georgia, Maine, New Mexico, New York, South Carolina, South Dakota, Vermont, and Virginia; includes also "Uncut mica larger than punch and circle" and scrap for New Hampshire.
[3] "Uncut mica larger than punch and circle" and scrap for New Hampshire included with "Other States."

Scrap.—Production of "scrap mica" from domestic sources declined to 22,386 short tons valued at $314,565 in 1940 compared with 24,672 tons, $311,895 in 1939 and the all-time record of 25,196 tons, $354,737 in 1937, but it exceeded that of any other year. In addition to mine scrap these figures include mica recovered in washing kaolin or kyanite or by milling schist, amounting to 9,674 tons valued at $138,148 in 1940, 10,011 tons, $108,899 in 1939, and 10,536 tons, $149,931 in 1937.

Ground mica.—The output of both dry-ground and wet-ground mica in the United States declined in 1940, totaling 27,984 short tons valued at $1,016,628 compared with 30,924 tons worth $1,156,333 in 1939. The 1940 output of dry-ground mica was somewhat larger than that of any other year except 1939, and that of wet-ground mica was ahead of that of all other years except 1938 and 1939. Of the total decline in 1940 (2,940 tons), approximately 800 tons represented reduction in exports, which comprised 3 percent of sales in 1940 compared with 5 percent in 1939.

The output of ground mica includes the products made from mine scrap, factory scrap, byproduct mica, and schist mica of all kinds.

Ground mica sold by producers in the United States, 1936–40, by methods of grinding

Year	Dry-ground [1]		Wet-ground		Total [1]	
	Short tons	Value	Short tons	Value	Short tons	Value
1936	20,800	$457,042	4,785	$265,374	25,585	$722,416
1937	21,150	457,879	6,095	381,933	27,245	839,812
1938	19,757	466,959	7,329	457,595	27,086	924,554
1939	23,222	547,539	7,702	608,794	30,924	1,156,333
1940	21,809	515,930	6,175	500,698	27,984	1,016,628

[1] Includes mica from kaolin and schist.

Ground mica sold by producers in the United States to various industries, 1939–40

Industry	1939			1940		
	Quantity		Value	Quantity		Value
	Short tons	Percent of total		Short tons	Percent of total	
Roofing [1]	19,255	62	$406,522	18,359	66	$385,720
Wallpaper	3,586	12	265,359	2,915	10	220,995
Rubber	2,539	8	204,977	1,731	6	144,202
Paint	1,916	6	144,235	1,874	7	141,192
Miscellaneous [2]	3,628	12	135,240	3,105	11	124,519
	30,924	100	1,156,333	27,984	100	1,016,628

[1] Includes mica from kaolin and schist.
[2] Includes mica used for molded electric insulation, house insulation, Christmas-tree snow, manufacture of axle greases and oil, annealing, pipe-line enamel, plastic specialties, textiles, coating levee mattresses, and other purposes.

MICA SPLITTINGS

The consumption of splittings increased to 4,918,861 pounds valued at $1,725,522 in 1940 from 3,423,044 pounds, $1,089,683 in 1939. The previous record consumption was 4,347,435 pounds valued at $1,257,645 in 1937 and was followed by a sharp slump in demand for built-up mica, which developed even before the end of the year. In 1940, however, activity was well-maintained throughout the fourth quarter, and early in 1941 the industry's factories were speeded up to operate faster than ever before.

Stocks of splittings at the end of 1940 were larger than in any previous year, aggregating 5,412,801 pounds compared with 3,480,625 pounds at the close of the preceding year and a previous record of 4,744,627 pounds on December 31, 1938.

Owing to the British blockade of Madagascar, deliveries of amber splittings failed toward the end of the year to pace the greatly increased consumption. Relatively small quantities of amber splittings are obtained from Canada. Whereas muscovite splittings have never been produced successfully, except by hand, some Canadian amber mica has been split mechanically. The possibility of expanding such operations may be investigated should it become impracticable to obtain enough Madagascar splittings, and perhaps split Canadian mica may even serve as a substitute for Indian splittings.

Since war tempo rose in May 1940 a good deal of attention has been devoted to producing splittings from domestic and South American mica. Plenty of small block mica is available in the Western Hemisphere, but much of the domestic mica does not seem to split quite as readily as Indian mica, and American workers not only are paid several times as much an hour as coolie labor gets a day but are not temperamentally suited to such work.

Consumption and stocks of mica splittings in the United States, 1936–40, by sources, as reported by the consumers

Year	India		Canada		Madagascar		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Consumption: [1]								
1936	3, 051, 824	$649, 982	102, 766	$44, 566	363, 468	$151, 845	3, 518, 058	$846, 393
1937	3, 721, 594	965, 418	98, 618	51, 960	527, 223	240, 267	4, 347, 435	1, 257, 645
1938	1, 446, 349	511, 674	41, 100	20, 401	180, 357	80, 390	1, 667, 806	612, 465
1939	2, 995, 626	905, 763	107, 101	44, 065	320, 317	139, 855	3, 423, 044	1, 089, 683
1940	4, 252, 120	1, 358, 534	54, 044	28, 491	612, 697	338, 497	4, 918, 861	1, 725, 522
Stocks in consumers' hands Dec. 31:								
1936	1, 280, 517	304, 036	52, 014	19, 048	223, 357	101, 711	1, 555, 888	424, 795
1937	3, 920, 730	1, 094, 414	77, 130	33, 722	444, 762	195, 976	4, 442, 622	1, 324, 112
1938	4, 057, 681	1, 128, 075	55, 827	24, 378	631, 119	273, 926	4, 744, 627	1, 426, 379
1939	2, 754, 748	857, 656	52, 523	17, 697	673, 354	273, 465	3, 480, 625	1, 148, 818
1940	4, 620, 934	1, 776, 974	53, 378	35, 581	738, 489	410, 068	5, 412, 801	2, 222, 623

[1] Exclusive of a nominal quantity of splittings produced in the United States and South America.

BUILT-UP MICA

National defense orders piled upon a broad increase in civilian consumption have boosted the output of built-up mica to an all-time record. Various products used in electrical equipment for airplane, truck, and passenger-automobile engines and for miscellaneous industrial apparatus and household appliances are made from board prepared by pasting together tissue-thin splittings of mica, only about a thousandth of an inch thick.

The total output of built-up mica, as reported by manufacturers to the Bureau of Mines, jumped to 4,413,000 pounds valued at $5,811,000 in 1940 compared with 3,425,395 pounds, $4,730,000 in 1939 and only 1,757,654 pounds, $2,200,000 in 1938. Available figures for earlier years were given in Minerals Yearbook, 1940.

Built-up mica produced in the United States, 1939–40, by kind of product

Product	1939		1940[1]	
	Pounds	Value	Pounds	Value
Molding plate	1,099,066	$1,090,000	1,315,000	$1,410,000
Segment plate	1,135,555	1,610,000	1,510,000	2,024,000
Heater plate	369,677	815,000	561,000	878,000
Flexible (cold)	239,582	290,000	330,000	383,000
All other (tape, etc.)	581,515	925,000	697,000	1,116,000
	3,425,395	4,730,000	4,413,000	5,811,000

[1] Partly estimated.

PRICES

The prices of India mica remained virtually unchanged during 1940, although there was a tendency toward upward revision of condenser splits, because of heavy demand, and of the lower-priced block and splittings, owing to wartime freight and ocean insurance rates. Better acceptance of South American mica by consumers resulted in reducing the discounts and thus increasing the prices paid for high-grade Brazilian mica, and a similar trend in respect to domestic mica was accelerated by the deliberate policy of leading buyers (especially in North Carolina) to stimulate domestic production by paying higher prices. The highest prices were paid during the latter half of the year, and later they were shaded off, with the result that in May 1941 good punch mica was worth about 12 cents a pound compared with a peak of 15 cents in 1940, the pre-war (August 1939) price of 5 to 7 cents, and a depression level of 3 to 5 cents.

Trade-journal quotations and average sales value of domestic uncut sheet mica per pound in 1940

Size	Trade-journal quotations[1]		Average value[2]	
	Dec. 14, 1939	Dec. 12, 1940	Clear	Stained or spotted
Punch	$0.05–$0.06	$0.08–$0.15	$0.087	$0.090
Circle			.109	.100
1½ by 2 inches	.25– .30	.45– .60	.429	.269
2 by 2 inches	.40– .50	.60– .80	.780	.275
2 by 3 inches		.90– 1.20	1.182	.577
3 by 3 inches	1.00– 1.20	1.25– 1.50	1.582	.721
3 by 4 inches	1.30– 1.40	1.50– 1.75	1.925	1.151
3 by 5 inches	1.60– 1.70	1.75– 2.25	2.750	1.443
4 by 6 inches	2.60– 2.70	2.75– 3.50	3.372	1.504
6 by 8 inches	4.00– 4.50	4.25– 4.75	4.817	2.012
8 by 10 inches	7.50–10.00	8.50– 8.75	10.284	2.318

[1] Engineering and Mining Journal (Metal and Mineral Markets) quotations for No. 1 or No. 2 quality, f. o. b. North Carolina; stained qualities take 25 to 50 percent discount.

[2] Calculated from reports of 1940 sales by domestic producers to the Bureau of Mines.

FOREIGN TRADE [1]

Imports.—In 1940 the total imports of all kinds of mica increased to 7,688 short tons valued at $2,484,128 from 6,280 tons valued at $1,059,310 in 1939. Compared with the record of 1937—11,339 tons valued at $2,067,599—it is significant that imports of scrap in 1940 were less than half as large but that those of uncut sheet and punch were over 50 percent larger. Compared with the 1939 poundage notable increases occurred in imports of untrimmed phlogopite (210 percent on this small item), untrimmed muscovite (60 percent), thin splittings (191 percent), and condenser and other films over 0.0012 inch thick (38 percent). British India continued to be the largest source of splittings, but South American countries (chiefly Brazil) furnished 88 percent of the cheaper block mica and 48 percent of the better qualities of block mica (worth over 15 cents a pound) imported into the United States in 1940 compared with 6 percent and 43 percent, respectively, from British India.

Imports supply virtually all the splittings, most of the sheet mica larger than punch, and a variable proportion of the small sheet and scrap mica used in this country. Available data on imports for the period 1909–39 were summarized in Minerals Yearbook, 1940 (p. 1413).

Mica imported for consumption in the United States in 1940, by kinds and by countries

Country	Unmanufactured									
	Waste and scrap, valued not more than 5 cents per pound				Untrimmed phlogopite mica from which no rectangular piece exceeding in size 1 inch by 2 inches may be cut (duty, 15 percent)		Other			
	Phlogopite (duty, 25 percent)		Other (duty, 25 percent)				Valued not above 15 cents per pound n. e. s. (duty, 4 cents per pound)		Valued above 15 cents per pound (duty, 4 cents per pound+25 percent)	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Africa:										
Madagascar							441	$53	7,805	$7,012
Union of South Africa			573,285	$3,041						
Argentina							105,154	14,681	104,690	43,283
Brazil							226,925	27,104	354,808	169,269
Canada	1,224,796	$5,649			189,960	$20,171	21,316	1,892	45,727	22,937
Colombia							325	32	75	21
India, British			4,324,650	13,921			22,156	2,749	410,579	225,764
Iraq									3,808	835
Mexico									226	36
Peru							3,298	188	2,459	563
United Kingdom							2,008	41	32,428	39,934
Total: 1940	1,224,796	5,649	4,897,935	16,962	189,960	20,171	381,623	46,740	962,605	509,654
1939	1,662,827	7,895	6,895,656	21,598	61,288	5,338	241,145	28,499	600,165	237,235

[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 1940, by kinds and by countries—Continued

Country	Manufactured—Films and splittings							
	Not cut or stamped to dimensions				Cut or stamped to dimensions (duty, 45 percent)		Total films and splittings	
	Not above 12 ten-thousandths of an inch in thickness (duty, 25 percent)		Over 12 ten-thousandths of an inch in thickness (duty, 40 percent)					
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Africa: Madagascar	646,410	$161,216					646,410	$161,216
Brazil	5	3	5,289	$3,609			5,294	3,612
Canada	79,550	47,530			249	$136	79,799	47,666
France	5,509	1,610					5,509	1,610
India, British	6,283,139	1,357,440	343,235	196,482	19,410	23,213	6,645,784	1,577,135
Japan			455	161			455	161
Rumania	954	140					954	140
United Kingdom	1,099	543	1,076	3,377	17	464	2,192	4,384
Total: 1940	7,016,666	1,568,482	350,055	203,629	19,676	23,813	7,386,397	1,795,924
1939	2,412,937	548,402	253,498	126,093	17,142	10,662	2,683,577	685,157

Country	Manufactured—Cut or stamped to dimensions, shape, or form						Manufactured—Other [1]			
	Cut (duty, 40 percent)		Disks (duty, 40 percent)		Other (duty, 40 percent)		Mica plates and built-up mica (duty, 40 percent)		Ground or pulverized (duty, 20 percent)	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Brazil	556	$1,497	1,100	$311						
Canada	123	95	309	120	40	$50			239,280	$3,846
India, British	42,812	52,522	28,145	13,310	2,825	977	6,205	$10,076		
United Kingdom					100	759	10,400	4,925		
Total: 1940	43,491	54,114	29,554	13,741	2,965	1,786	16,605	15,001	239,280	3,846
1939	45,005	28,556	23,022	11,753	2,572	1,449	21,034	22,053	318,895	4,622

[1] In addition, 540 pounds valued at $540 of "All manufactures of which mica is the component material of chief value (duty, 40 percent)" were imported in 1940, and 4,953 pounds valued at $5,155 in 1939.

Exports.—Owing to the elimination of continental European markets after the battle of Flanders and curtailment of shipments to the United Kingdom, exports of mica and its manufactures from the United States were over 50 percent less in quantity during 1940 than during 1939 and smaller than in any other year since 1924. Exports of mica to Canada were greater during 1940 than during 1939 under all categories, and those to many Latin American countries also increased. As usual, ground mica was the chief item, but the aggregate exports of other manufactures of mica greatly surpassed ground mica in value in 1940 and increased in total value compared with the preceding year.

Mica and its manufactures were included with other strategic materials under the first export-control proclamation dated July 2, 1940. The revised schedule specified that none of the following items should be exported unless and until a license was obtained:

Natural raw mica:

- Unprocessed block mica, including thumb-trimmed, knife-trimmed, and sickle-trimmed.
- Processed mica, including splittings of any thickness, condenser films, radio-tube supports, washers, wrappers, and punched or cut patterns or pieces.

Built-up mica and mica products, including sheets, tubes, rods, armature rings, commutator segments, tapes and coil wrappings, washers, and punched or cut patterns or pieces.
Articles in which mica is a component, except articles in which the mica component is incorporated in an electric motor, generator, or transformer, and except kitchen appliances for household use (report mica content in pounds and whether built-up or sheet mica).

The Administrator of Export Control subsequently determined that mica should be included in the list of 24 commodities for which licenses were required, even for individual shipments not exceeding $25 in value.

Mica and manufactures of mica exported from the United States in 1940, by countries

Country	Unmanufactured		Manufactured			
			Ground or pulverized		Other	
	Pounds	Value	Pounds	Value	Pounds	Value
North America:						
Canada	285,775	$1,678	682,334	$26,132	51,519	$91,206
Cuba			13,600	458	667	1,732
Mexico	4,190	193	7,685	406	1,494	2,249
Other North America			387	24	923	1,113
South America:						
Argentina			46,648	1,854	5,357	6,638
Brazil			16,000	475	4,203	4,644
Chile					3,779	6,896
Venezuela					59	133
Other South America			2,700	143	1,470	2,031
Europe:						
Belgium			46,920	1,840	20	12
France			44,000	865	30	275
Netherlands			72,240	2,730	2,202	4,837
United Kingdom			326,688	12,886	113	45
Other Europe			2,700	85	278	1,106
Asia:						
China			200	16	281	830
India, British	1,800	77	29,500	813	79	331
Netherlands Indies	8,800	221	72,200	1,872	1,171	3,490
Other Asia			4,087	518	1,761	4,437
Africa	15,000	355	34,420	937	1,032	2,217
Oceania			10,000	230	2,029	2,520
Total: 1940	315,565	2,524	1,412,309	52,284	78,467	136,742
1939	564,230	6,717	3,000,793	110,568	88,488	109,079

WORLD PRODUCTION

Tonnage figures afford a progressively less valid measure of the relative importance of different countries as sources of mica, now that other nations than the United States have begun to produce substantial quantities of scrap or waste mica. Even when the output of scrap can be segregated the characteristic differences in size, quality, and degree of preparation of sheet mica itself virtually vitiate any purely statistical comparison. However, the British Empire, principally India, still produces 75 percent or more of the world's high-grade sheet mica, although its position in this field now is based in large part upon the production of splittings. Brazil and other South American countries are becoming increasingly important. Canada is a large potential source of amber mica, but most of the world supply of this variety of mica has recently come from Madagascar. Deposits in that island have been described recently.[2] Promising de-

[2] Lacroix, Alfred, Phlogopite Deposits of South Madagascar: Compt. rend., vol. 210, 1940, pp. 273-276; Chem. Abs., vol. 34, No. 9, May 10, 1940, p. 2744.

posits of mica are reported in the Northern Territory of Australia and on August 28, 1940, the Commonwealth Government virtually commandeered the product.[3] Exports of mica from India were brought under Government control in July 1940.

In Canada phlogopite mica has been produced chiefly from properties in the Hull-Buckingham district of Quebec and the Kingston-Perth area of eastern Ontario. Muscovite has been produced in recent years in both Quebec and Ontario but chiefly as a byproduct of feldspar mining and never in large amounts. Ground mica is produced from mica schist (sericite) in British Columbia.

World production of mica, 1936–40, in metric tons

[Compiled by L. P. Lounsbery]

Country	1936	1937	1938	1939	1940
North America:					
Canada (sales)	726	857	470	790	(1)
United States (sold or used by producers)[2]	19,609	23,626	18,803	22,751	21,046
South America:					
Argentina[3]	210	225	250	298	(1)
Bolivia (exports)	-------	9	4	-------	1
Brazil (exports)	237	330	521	435	1,117
Peru	-------	5	24	9	4
Europe:					
Italy	12	24	122	(1)	(1)
Norway (exports)	43	42	104	(1)	(1)
Rumania	67	27	22	(1)	(1)
Sweden	125	68	131	126	(1)
Asia:					
Ceylon (exports)	(4)	1	(4)	(4)	(1)
Chosen	70	[5] 70	(1)	(1)	(1)
India, British (exports)	9,026	15,106	8,896	10,104	(1)
Africa:					
Eritrea	4	(1)	(1)	(1)	(1)
Madagascar	410	583	677	(1)	(1)
Nigeria	-------	-------	3	(1)	(1)
Portuguese East Africa	-------	-------	-------	17	(1)
Rhodesia:					
Northern	3	4	4	2	(1)
Southern	9	17	13	6	(1)
Tanganyika Territory	44	71	37	36	(1)
Union of South Africa (Transvaal)	495	1,740	1,116	972	1,252
Oceania:					
Australia:					
Northern Territory	21	42	49	34	32
South Australia	-------	43	-------	-------	(1)
Western Australia	-------	-------	-------	(4)	(1)

[1] Data not available.
[2] Includes following quantities recovered from kaolin and schists: 1936, 7,491 tons; 1937, 9,558 tons; 1938, 5,942 tons; 1939, 9,082 tons; 1940, 8,776 tons.
[3] Rail and river shipments.
[4] Less than 1 ton.
[5] Official estimate.

QUALITY OF DOMESTIC MICA

There is no geologic or mineralogic reason why domestic mica should differ from Indian mica of similar chemical composition and physical appearance, yet the claim has been made that domestic muscovite is so inferior to Bengal ruby in its essential electrical and other physical properties that it cannot be employed for making condensers or for other uses requiring high-grade mica. Much domestic mica has, admittedly, been ill prepared; however, it would be unduly wasteful of a valuable national resource if domestic mica were as closely trimmed as Indian mica, because such trimming would eliminate material that can be utilized as sheet mica. Thorough tests, nevertheless, have

[3] Zapf, L. C. (United States consul, Sydney), Consular Rept., September 19, 1940; abs., Bureau of Mines Mineral Trade Notes: Vol. 11, No. 5, November 22, 1940, p. 29.

indicated that selected mica from American mines is equal in quality to the best imported mica. No notable differences were observed in dielectric strength, change on heating, and power factor; other properties, such as flexibility and hardness, may be duplicated in comparable grades.

Although the results of these tests were published by both the Bureau of Mines [4] and the National Bureau of Standards [5] the prejudice persisted against employing domestic mica for condensers, certain kinds of radio tubes, and even less exacting uses. A somewhat similar prejudice existed against South American mica, which sold at discounts compared with similar grades and sizes of Indian mica; although frequently these discounts were not as heavy as those charged against domestic mica, they were quite substantial a few years ago and have not yet disappeared.

In connection with the present emergency the Geological Survey examined several hundred American mines and later collected samples from more than 150. Through a joint arrangement between the Survey, the Bureau of Mines, and the National Bureau of Standards these samples were tested for power factor. Previous tests had proved beyond reasonable doubt that dielectric strength and heat resistance could be judged by physical appearance, and the additional tests demonstrated that sound domestic mica free from mineral staining was as good as the best Bengal ruby in respect to power factor.

Admitting that the inherent electrical properties of domestic mica were fully as good as those of imported mica, it did not follow that domestic mica could be employed commercially in radio-transmitter or high-tension magneto condensers. From a manufacturing standpoint other factors were involved, such as uniformity, splitting quality, behavior in punching, flexibility, soundness, and freedom from pinholes or waviness. To obtain information on these points the Bureau of Mines obtained the cooperation of a leading supplier who furnished three 10-pound samples of mica from each of two domestic mines. These samples were tested by three leading manufacturers, who made them up into condensers of various types and subjected them to the most rigorous tests. All these manufacturers agreed that these samples of domestic mica were suitable for use in condensers, the only qualification being the observation by one company that the domestic mica did not split as readily as the Indian mica and hence that the losses during splitting were greater.

In view of the successful outcome of these tests of domestic mica in the actual fabrication of condensers a proposed investigation of possible inherent differences in the chemical or structural characteristics of domestic muscovite crystals has been suspended indefinitely. Apparently there is no fundamental difference that cannot be observed by ordinary inspection and routine laboratory tests.

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[4] Horton, F. W., Mica: Bureau of Mines Inf. Circ. 6822, 1935, pp. 30–54.

[5] Lewis, A. B., Hall, E. L., and Caldwell, F. R., Some Electrical Properties of Foreign and Domestic Micas and the Effect of Elevated Temperatures on Micas: Nat. Bureau of Standards Research Paper 347 (Jour. of Research, vol. 7), 1931, pp. 403–418.

SALT

By A. T. Coons and F. E. Harris

SUMMARY OUTLINE

The total salt output reported to the Bureau of Mines by producers again set a new high record in 1940. Evaporated or manufactured salt, salt in brine for the manufacture of chemicals, and rock salt from 13 States and Puerto Rico aggregated 10,003,448 short tons valued at $26,118,107 in 1940 compared with 9,277,911 tons valued at $24,509,680 in 1939. Of the 83 plants of 66 companies that reported salt production in 1940 compared with (revised figures) 81 plants of 67 companies in 1939, 60 plants produced evaporated salt, 22 plants rock salt, and 10 plants (7 companies) salt in brine. Pressed blocks were made by 19 evaporated-salt plants and 8 rock-salt plants.

Salient statistics of the salt industry in the United States, 1930–34 (average), 1935–39 (average), and 1939–40

	1930–34 (average)	1935–39 (average)	1939	1940
Sold or used by producers:				
Manufactured (evaporated) short tons	2,251,226	2,507,374	2,658,577	2,782,741
In brine do	3,333,391	4,205,587	4,584,177	4,955,159
Rock salt do	1,822,889	1,947,254	2,035,157	2,265,548
Total:				
Short tons	7,407,506	8,660,215	9,277,911	10,003,448
Value [1]	$22,331,641	$23,405,612	$24,509,680	$26,118,107
Average per ton [1]	$3.01	$2.70	$2.64	$2.61
Imports for consumption:				
For curing fish short tons	20,360	21,250	15,461	12,965
Value	$34,492	$43,722	$27,700	$25,174
In bags, barrels, etc. short tons	2,620	1,385	2,121	1,024
Value	$24,796	$11,813	$14,977	$6,601
In bulk short tons	16,721	24,131	28,451	16,413
Value	$37,579	$55,876	$58,540	$59,029
Total:				
Short tons	39,701	46,766	46,033	30,402
Value	$96,867	$111,411	$101,217	$90,804
Exports:				
Short tons	88,662	90,214	124,273	147,044
Value	$642,384	$521,652	$610,501	$699,340
Apparent consumption short tons	7,358,545	8,616,767	9,199,671	9,886,806

[1] Values are f. o. b. mine or refinery and do not include cost of cooperage or containers.

The per capita consumption of salt, most of which is used industrially, continues to increase. Per capita data for 1910–36, with information regarding the distribution of salt consumption, have been summarized in Bureau of Mines Information Circular 7062.[1] In 1938 (including salt or brine) it was about 123 pounds a person; in 1940, according to the latest census of population figures, it averaged about 151 pounds a person.

Salt is being used in many indirect ways for national defense work. About half of the total production is employed in the form of brine in the manufacture of chemicals. The heavy chemicals made from salt are used for processing a wide range of products that now are increasingly necessary for military purposes. The other half of the output is marketed as dry salt; the largest use for it normally is food preparation (including canning, preserving, and the manufacture of flours and similar articles), the importance of which is enhanced by the present emergency. According to the Census of Manufactures, 1939, salt used only in bread, biscuits, crackers, and pretzels in 1939 totaled 94,603 short tons valued at $1,859,337. Displacement of articles formerly imported by synthetic products has had its effect on the size of total output of salt. These synthetics include such items as salt cake,[2] rubberlike materials, and silk substitutes.

Salt sold or used by producers in the United States, 1938–40, by States

State	1938		1939		1940	
	Short tons	Value	Short tons	Value	Short tons	Value
California	349, 856	$1, 940, 449	404, 689	$1, 980, 777	469, 354	$2, 200, 640
Kansas	597, 909	2, 565, 447	641, 752	2, 591, 934	684, 053	2, 710, 847
Louisiana	958, 186	2, 775, 384	1, 072, 540	2, 830, 331	1, 132, 594	2, 804, 406
Michigan	2, 078, 612	6, 151, 154	2, 408, 872	6, 726, 912	2, 506, 523	7, 123, 393
New Mexico	(1)	(1)	(1)	(1)	13, 915	41, 573
New York	1, 717, 064	5, 467, 077	2, 041, 492	5, 855, 422	2, 117, 671	6, 523, 775
Ohio	1, 489, 270	2, 562, 620	1, 794, 788	2, 647, 355	2, 080, 133	2, 781, 599
Puerto Rico	12, 508	61, 917	13, 325	57, 707	11, 724	62, 645
Texas	324, 449	624, 096	352, 008	604, 633	402, 165	792, 214
Utah	61, 959	192, 495	68, 100	202, 244	71, 472	191, 263
West Virginia	129, 568	721, 490	144, 727	773, 988	144, 312	701, 953
Other States [2]	306. 387	180, 432	335, 618	238, 377	369, 532	183, 799
	8, 025, 768	23, 242, 561	9. 277, 911	24, 509, 680	10, 003, 448	26, 118, 107

[1] Included under "Other States."
[2] 1938–39: Colorado, New Mexico, Oklahoma, and Virginia; 1940: Colorado, Oklahoma, and Virginia.

Salt sold or used by producers in the United States, 1939–40, by methods of manufacture

Method of manufacture	1939		1940	
	Short tons	Value	Short tons	Vlaue
Evaporated:				
Bulk:				
Open pans or grainers	499, 331	$4, 225, 088	505, 491	$4, 247, 212
Vacuum pans	1, 615, 838	9, 434, 587	1, 667, 273	9, 753, 419
Solar	391, 287	1, 403, 680	457, 710	1, 634, 603
Pressed blocks	152, 121	1, 136, 527	152, 267	1, 193, 237
Rock:				
Bulk	1, 995, 915	6, 233, 507	2, 225, 377	7, 102, 404
Pressed blocks	39, 242	263, 300	40, 171	282, 435
Salt in brine (sold or used as such)	4, 584, 177	1, 812, 991	4, 955, 159	1, 904, 797
	9, 277, 911	24, 509, 680	10, 003, 448	26, 118, 107

Evaporated salt.—Salt is evaporated by several methods—in open pans or grainers, in vacuum pans, and by the sun. Most table salt is evaporated salt because most salt as recovered needs refining.

[1] Harris, F. E., Marketing of Salt: Bureau of Mines Inf. Circ. 7062, 1939. 56 pp.
[2] Bureau of Mines Mineral Trade Notes: Vol. 10, No. 4, April 20, 1940, p. 32.

Evaporated salt sold or used by producers in the United States, 1939–40, by States

State	1939		1940	
	Short tons	Value	Short tons	Value
California	396,479	$1,943,698	462,403	$2,172,666
Kansas	232,985	1,717,995	231,896	1,732,079
Louisiana	(1)	(1)	57,868	320,127
Michigan [2]	922,645	5,019,674	964,491	5,232,409
New York	365,899	3,496,414	372,049	3,683,490
Ohio	395,913	2,337,282	419,054	2,436,929
Puerto Rico	13,325	57,707	11,724	62,645
Texas	39,096	198,051	(1)	(1)
Utah	62,177	183,422	(1)	(1)
West Virginia [2]	144,727	773,988	144,312	701,953
Other States [3]	85,331	471,651	118,944	486,173
	2,658,577	16,199,882	2,782,741	16,828,471

[1] Included under "Other States."
[2] Includes a quantity of salt contained in brine for chemical use reported as evaporated salt with value as evaporated salt.
[3] 1939: Colorado, Louisiana, New Mexico, and Oklahoma; 1940: Colorado, New Mexico, Oklahoma, Texas, and Utah.

Rock salt.—As in the past, the output of rock salt came mainly from four States, although several others contributed to the total.

Rock salt sold by producers in the United States, 1936–40

Year	Short tons	Value	Year	Short tons	Value
1936	2,009,579	$6,003,054	1939	2,035,157	$6,496,807
1937	2,030,432	6,447,648	1940	2,265,548	7,384,839
1938	1,901,861	6,252,081			

Brine.—The production of salt in brine in 1940, as in 1939, increased the most of the three types of salt, overtopping its previous high record, that for 1937. More common salt is used in the manufacture of chemicals than any other basic material. According to the Federal Reserve Index, production of chemicals in 1940 averaged 115 (1935–39 = 100) compared with 102 in 1939 and 96 in 1938.

Blocks.—Both sodium and chlorine are indispensable to animal life, and common salt meets the requirements most readily. Pressed blocks have been found to be the best way to serve most livestock. In addition to blocks weighing about 50 to 60 pounds and a certain quantity of a smaller size for sheep, some manufacturers now make very small (3-ounce) blocks for small pet animals; these are known as "petlicks." Several producers who market loose crude salt for use by cattle reported a decline in the demand because of the increasing use of blocks of salt; however, this is not apparent to any great extent, as the production of pressed blocks showed only a slight gain in both types of salt consumed.

Pressed-salt blocks sold by original producers of the salt in the United States, 1936–40

Year	From evaporated salt		From rock salt		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1936	134,586	$965,114	34,489	$222,864	169,075	$1,187,978
1937	120,061	966,812	28,981	240,251	149,042	1,207,063
1938	136,699	1,116,272	36,258	281,109	172,957	1,397,381
1939	152,121	1,136,527	39,242	263,300	191,363	1,399,827
1940	152,267	1,193,237	40,171	282,435	192,438	1,475,672

MARKETING

Prices.—On January 1, 1940, the quoted price for bagged vacuum fine salt in carlots delivered at New York was $15.30 a short ton, which held until March 25, when it advanced to $15.70 a ton. In less than carlots salt of this type was priced within the same range throughout the year—$16.60 to $19.70 a ton. Rock salt in bags, in carlots delivered at New York, was quoted at $13.20 to $13.80 a ton on January 1, 1940, changed to $13.20 to $13.38 a ton in May, and advanced to $13.70 a ton in October. Bagged rock salt in less than carlots was $15 to $15.60 a ton in January 1940 and remained at this price until October 10, when it advanced 50 cents or to a basis of $15.50 to $16.10 a ton.

For the most part the demand was steady throughout the year. Shipments were regular, except in midsummer. In December it was reported that cold weather stimulated the demand for salt for ice control, while other consumers showed good interest.

Salt producers in some sections of the West and South reported that wages and cost of materials had increased but prices had not advanced. None reported strikes in the salt industry, but some said that the industry was affected by strikes in other industries, such as canneries. Certain producers reported exports of salt to Japan for the first time in their experience.

Market grades and packages.—During 1940 the Standing Committee in charge of Simplified Practice Recommendation R70, Salt Packages,[3] completed revision of the standards originally formulated in 1927 and reaffirmed in 1931 and 1933. The National Bureau of Standards reported on March 28, 1941, that the producers of salt had already recorded their approval of the 1940 revision to an extent representing more than 90 percent of the industry's volume.

The standards define the sizes, varieties, types, and grades of salt in blocks and bricks, dry solar fine-milled, dry solar kiln-dried, granulated salt, high-grade salt, packers salt, medium salt, special medium, rock salt, coarse grades, table salt, and Kosher salt. Two concise tables list the kind of salt, the net weight of the contents and the kind of primary container, and the capacity of and kind of shipping container. The first table gives the salt packages for the larger part of the United States, and the other comprises Pacific coast practice (including Washington, northern Idaho, Oregon, California, western Nevada, and Arizona).

It was impracticable to include much of the Pacific coast practice in the original recommendation of 1927 because of differences of packaging growing out of conditions peculiar to that region. The present recommendations have not attempted to reconcile the differences, but they do include Pacific coast practice.

Compared with the previous standards the present recommendation has reduced the number of sizes and capacities. Whereas nine capacities of pockets (trade term for cotton bags of 10 pounds or less capacity) were standard previously, this number has been cut to five; the number of different sizes of bags of either cotton or burlap has been cut from nine to four; square cartons have been reduced from six to four sizes. However, two new packages have been added—one size of round can and a hexagonal package, each of 1⅝-pound capacity.

[3] Composed of 8 members representing as many salt companies, in voluntary cooperation with the Division of Simplified Practice of the National Bureau of Standards.

Distribution (shipments) of evaporated and rock salt in the United States, 1939–40, by States of destination, in short tons

Destination	1939		1940	
	Evaporated	Rock	Evaporated	Rock
Alabama	7,174	31,801	6,975	31,253
Arizona	8,336	2,179	8,957	2,707
Arkansas	6,900	22,355	6,159	21,286
California	218,440	8,210	238,675	6,951
Colorado	24,225	11,575	25,612	11,671
Connecticut	13,247	4,930	13,973	6,008
Delaware	2,646	29,257	3,697	29,407
District of Columbia	4,590	1,191	4,473	1,339
Florida	6,595	19,213	6,429	16,706
Georgia	15,250	43,918	13,489	43,092
Idaho	11,457	1,316	9,816	3,698
Illinois	239,128	134,096	224,514	134,412
Indiana	64,293	41,615	63,358	49,451
Iowa	76,658	83,354	80,600	86,474
Kansas	26,577	131,449	36,825	162,612
Kentucky	45,583	15,106	34,706	16,897
Louisiana	5,809	55,002	5,898	54,683
Maine	8,189	20,818	7,743	26,346
Maryland	26,493	20,953	27,527	23,503
Massachusetts	52,375	34,871	51,281	43,999
Michigan	232,327	44,984	267,733	55,032
Minnesota	95,093	62,547	99,323	63,657
Mississippi	3,293	28,947	2,652	27,861
Missouri	57,273	52,471	63,640	51,609
Montana	14,690	2,077	15,881	2,718
Nebraska	25,254	46,110	25,275	55,616
Nevada	2,405	216	2,009	243
New Hampshire	5,348	30,448	6,063	33,074
New Jersey	74,776	124,312	72,245	129,842
New Mexico	5,550	10,983	5,572	13,244
New York	183,186	316,316	186,377	386,666
North Carolina	37,227	37,971	40,861	44,687
North Dakota	10,322	3,927	10,105	4,319
Ohio	133,817	63,803	148,901	74,332
Oklahoma	25,278	26,640	25,877	27,269
Oregon	22,803	464	23,806	279
Pennsylvania	125,927	83,536	121,217	88,320
Rhode Island	8,565	7,326	9,091	9,868
South Carolina	7,741	15,485	9,024	14,375
South Dakota	14,195	14,888	14,615	14,732
Tennessee	26,089	38,959	22,304	41,838
Texas	49,580	140,808	46,284	144,204
Utah	13,602	4,147	14,625	3,793
Vermont	5,807	5,793	5,179	5,702
Virginia	48,813	41,192	46,536	44,061
Washington	90,671	720	108,070	682
West Virginia	159,850	41,772	165,999	47,291
Wisconsin	107,017	27,207	113,613	22,451
Wyoming	7,434	2,833	6,920	2,443
Other [1]	200,679	45,066	232,237	82,845
	2,658,577	2,035,157	2,782,741	2,265,548

[1] Includes production of Puerto Rico (evaporated salt); exports to Africa, Asia, Canada, Central America, Mexico, South America, West Indies, and other countries; and shipments to unspecified destinations, including Alaska, Hawaii, and Puerto Rico.

Salt shipped to noncontiguous Territories of the United States, 1939–40, in short tons

Territory	1939		1940	
	Short tons	Value	Short tons	Value
Alaska	6,108	$109,517	5,631	$106,697
American Samoa	6	289	6	363
Canton and Enderbury Islands	1	32	1	14
Guam	29	1,104	64	2,170
Hawaii	2,265	61,153	2,306	63,258
Midway Island	1	33	1	26
Puerto Rico	1,288	35,241	951	25,840
Virgin Islands	16	829		
Wake Island	(1)	7	1	35
	9,714	208,205	8,961	198,403

[1] Less than 1 ton.

IMPORTS AND EXPORTS [4]

Salt imported for consumption in the United States, 1939–40, by countries

Country	1939 Short tons	1939 Value	1940 Short tons	1940 Value
North America:				
Canada	7,504	$25,503	3,818	$10,548
West Indies:				
British:				
Jamaica	26,230	42,247	10,972	22,788
Other British	314	1,741	15,481	55,575
French	4	41		
Netherlands: Curaçao	457	1,164	40	121
Europe:				
Sweden	1	74		
U. S. S. R.	(1)	298		
United Kingdom	154	2,559	91	1,772
Africa:				
Egypt	5,034	19,274		
Tunisia	6,335	8,316		
	46,033	101,217	30,402	90,804

[1] Less than 1 ton.

Salt exported from the United States, 1939–40, by countries

Country	1939 Short tons	1939 Value	1940 Short tons	1940 Value
North America:				
Bermuda	27	$624	11	$452
Canada	54,691	223,312	68,021	249,174
Central America:				
British Honduras	495	4,979	416	3,620
Guatemala	179	2,565	116	1,785
Honduras	135	2,705	165	3,512
Nicaragua	252	3,618	261	4,080
Panama:				
Republic of	87	1,259	11	447
Canal Zone	924	19,764	914	20,060
Mexico	3,220	44,547	4,388	58,494
Newfoundland and Labrador	307	1,328	315	2,176
West Indies:				
British	656	9,088	97	1,669
Cuba	9,037	99,019	8,098	98,010
Dominican Republic	215	4,984	192	3,970
Haiti	9	370	13	546
Netherlands: Curaçao	86	3,451	85	3,632
Other North America	46	957	1,708	16,855
South America:				
Argentina	117	1,180	126	1,154
Brazil	53	493	31	466
Colombia	13	267	14	584
Other South America	36	1,833	239	4,257
Europe:				
Ireland	7	1,500		
U. S. S. R.	1,408	5,029		
United Kingdom	17	1,486	30	281
Other Europe	68	2,670	32	733
Asia:				
China	6	834	1	197
Hong Kong	20	604	48	1,487
Japan	49,669	113,859	60,609	193,930
Philippine Islands	330	9,658	332	9,708
Other Asia	25	1,559	103	2,833
Africa:				
Liberia	74	2,046	130	3,483
Morocco	53	994	2	135
Other Africa	19	1,146	41	1,538
Oceania:				
British:				
Australia	1,234	24,393	47	891
New Zealand	523	13,621	286	5,313
Other			(1)	4
French	235	4,759	162	3,864
	124,273	610,501	147,044	699,340

[1] Less than 1 ton.

[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.

WORLD PRODUCTION

Unsettled world conditions and the inability to obtain official figures in many countries make it impossible to furnish more than fragmentary information on the salt industries abroad; however, because of continued interest in foreign salt fields and salt requirements, as evidenced by inquiries to the Bureau of Mines, such figures and statements as are available are set down here, even though incomplete.

Canada.—Preliminary figures show that 464,714 short tons of salt valued at $2,823,269 were sold in Canada in 1940 compared with 424,500 tons valued at $2,486,632 in 1939. A recent report [5] describes tests that had been made on the use of sodium chloride as a moisture retainer in the stabilization of roads in eastern Canada. Illustrations of roads so treated showed their hardness and smoothness, and the text discusses the advantages of low cost, easy application, good compaction obtained, and small maintenance required. Salt is finding wider use in Canada for stabilizing clay and gravel roads and runways at airports. Another Canadian use for salt is to mix it with sand piled along highways for application on icy surfaces, because the salt has the effect of keeping the sand loose and free-flowing, even in the coldest weather. Some of the railways in Canada have found that by salting their coal piles they can keep them free from lumping and caking in winter. A new plant costing $250,000 was built in a deposit in Alberta that is estimated to have 30,000,000 tons of salt; production is to proceed at the rate of 85 tons a day.

China.—New salt production at the Hanku field during the 1940 season was estimated at 300,000 metric tons, with a similar amount for the fields at Tangku, Hsinho, and Naukai combined, as reported in September 1940 by Consul Frederick W. Hinke of the Tientsin consular district, in which all of these fields occur. The current price of export salt at Hanku is said to have risen more than 70 percent above the 1939 price, owing to the necessity for improving the fields. Prices of industrial salt for local consumption likewise are said to have risen more than 66 percent in the last year.

Japan.—Information available in Tientsin, China, to Consul Frederick W. Hinke in September 1940 regarding purchases by Japan forecast roughly that 400,000 tons of salt would be exported from the Hanku field, China, to Japan in 1940, or about the same as in 1939. It is well-known that Japan has been seeking to supplement its imports of salt for some time past. Former sources of supply (such as northern Africa—Egypt, Eritrea, and Italian Somaliland) have been cut off by the war. Its chemical industry has suffered; the lack of salt also has crippled Japan's textile industries, and production has been cut down considerably. It was reported [6] in New York charter circles late in the summer of 1940 that commitments had been arranged for transportation of salt from New Orleans and West Indies to Japan on a freight rate of $13.50 a ton.

Netherlands Indies.—According to Consul Marcelis C. Parsons, Jr., Batavia, Java, a contract was signed by the Netherlands Indies Salt My. and representatives of Japanese buyers,[7] under whose terms Japan may buy annually 100,000 metric tons of salt over a period of 3 years.

[5] Picher, R. H., Stabilized Roads: Canada Dept. of Mines and Resources, Mines and Geology Branch, Bureau of Mines, No. 800, 1940, 41 pp.
[6] U. S. Dept. of Commerce, World Trade Notes: August 10, 1940, p. 520.
[7] Bureau of Mines Mineral Trade Notes: Vol. 12, No. 2, February 20, 1941, p. 29.

Salt exports from Netherlands Indies to Japan totaled 64,000 metric tons in 1938, 71,000 tons in 1939, and 5,000 tons in the first 10 months of 1940.

West Indies.—Although Turks and Caicos Islands have not exported much salt in recent years—averaging about 35,000 short tons—they are situated conveniently off the Atlantic seaboard of the United States, where salt is not produced. An ordinance approved by the Governor in March 1940, set up a Salt Industry Board with powers to market salt, allot quotas, and regulate and control the exportation of salt, all of which is affecting the salt industry of these islands. Details of the report by Consul General Hugh H. Watson, Kingston, Jamaica, as of June 21, 1940, were published by the Bureau of Mines.[8]

World production of salt, 1936–40, by countries, in metric tons

[Compiled by L. P. Lounsbery]

Country [1]	1936	1937	1938	1939	1940
North America:					
Canada	355,486	415,994	398,013	385,550	421,579
Costa Rica	3,500	4,287	4,740	6,822	(2)
Guatemala	8,053	12,610	10,465	(2)	(2)
Mexico	101,628	82,876	107,701	(2)	(2)
Panama	4,385	6,898	3,332	4,536	5,199
United States:					
Rock salt	1,823,050	1,841,967	1,725,330	1,846,254	2,055,260
Other salt	6,186,384	6,541,795	5,547,321	6,570,482	7,019,668
West Indies:					
British:					
Bahamas (exports)	------	5,003	4,830	(2)	(2)
Turks and Caicos Islands (exports)	41,899	50,833	35,578	47,389	(2)
Cuba	34,339	36,806	57,970	113,398	(2)
Netherlands (exports)	2,285	2,337	2,013	(2)	(2)
South America:					
Argentina [3]	247,433	290,084	264,150	303,321	(2)
Brazil	494,119	708,714	859,222	502,203	(2)
Chile	47,232	36,697	27,772	(2)	(2)
Colombia:					
Rock salt	5,571	4,211	4,010	(2)	(2)
Other salt	188,404	184,609	199,022	(2)	(2)
Ecuador:					
Rock salt	138	138	------	------	(2)
Other salt	16,632	13,800	13,800	16,145	29,900
Peru	36,110	39,010	38,451	39,669	(2)
Venezuela	25,128	26,298	22,658	20,473	(2)
Europe:					
Bulgaria:					
Rock salt	7,008	9,745	10,242	13,168	(2)
Other salt	47,000	43,602	66,258	(2)	(2)
Czechoslovakia	172,647	165,898	174,000	(2)	(2)
France:					
Rock salt and salt from springs	1,711,060	1,847,179	1,264,230	(2)	(2)
Other salt	202,040	490,906	346,046	(2)	(2)
Germany:					
Rock salt	2,383,825	2,757,242	2,694,984	(2)	(2)
Other salt	574,489	608,046	585,326	(2)	(2)
Austria:					
Rock salt	712	908	786	(2)	(2)
Other salt	191,294	169,883	93,576	(2)	(2)
Greece	74,447	102,285	102,057	(2)	(2)
Italy:					
Rock salt	499,798	603,798	613,870	(2)	(2)
Other salt	770,333	952,655	885,205	(2)	(2)
Malta	1,930	1,829	1,523	1,753	(2)
Netherlands: Rock salt	76,271	132,430	164,266	(2)	(2)
Poland	466,525	602,746	642,875	(2)	(2)
Portugal (exports)	73,944	4,633	6,096	(2)	(2)
Rumania:					
Rock salt	283,389	308,882	350,618	(2)	(2)
Other salt	1,750	2,077	1,140	(2)	(2)
Switzerland	81,177	81,969	84,049	90,000	(2)
U. S. S. R.	[4] 4,349,000	(2)	(2)	(2)	(2)
United Kingdom:					
Great Britain:					
Rock salt	17,569	18,666	19,974	(2)	(2)
Other salt	2,845,242	3,101,511	2,651,939	(2)	(2)

See footnotes at end of table.

[8] Bureau of Mines Mineral Trade Notes: Vol. 11, No. 2, August 20, 1940, pp. 18–21.

World production of salt, 1936–40, by countries, in metric tons—Continued

Country	1936	1937	1938	1939	1940
Europe—Continued.					
United Kingdom—Continued.					
Ireland, Northern:					
Rock salt	3,175	4,254	2,362	(2)	(2)
Other salt	12,297	8,818	5,757	(2)	(2)
Yugoslavia	45,205	46,323	52,634	54,213	(2)
Asia:					
Aden	361,098	360,866	282,510	294,077	(2)
Burma	32,790	54,677	39,319	(2)	(2)
Ceylon	40,332	38,815	36,490	37,556	(2)
China [5] [6]	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000
Chosen [6]	138,000	138,000	138,000	138,000	138,000
Cyprus [6]	3,000	3,000	3,000	3,000	3,000
India:					
British:					
Rock salt	175,020	190,103	191,395	196,503	(2)
Other salt	1,369,861	1,516,984	1,372,979	1,326,544	(2)
Portuguese	24,047	26,095	29,527	27,979	38,564
Indochina	192,237	193,558	193,050	213,526	166,000
Iraq	2,804	1,810	7,907	9,107	(2)
Japan:					
Japan proper [7]	518,859	535,775	(2)	(2)	(2)
Taiwan	189,777	210,471	(2)	(2)	(2)
Netherlands Indies	107,449	75,780	90,909	[8] 141,208	(2)
Palestine:					
Rock salt	755	727	444	645	(2)
Other salt	8,058	11,717	8,065	8,736	(2)
Philippine Islands	53,471	48,905	(2)	(2)	(2)
Syria [6]	10,000	10,000	10,000	10,000	10,000
Thailand (exports)	44,505	107,731	156,268	95,170	(2)
Turkey	220,500	262,226	247,293	(2)	(2)
U. S. S. R.	(4)	(2)	(2)	(2)	(2)
Africa:					
Algeria	62,400	63,767	74,630	(2)	(2)
Belgian Congo	920	1,004	1,013	(2)	(2)
Canary Islands [6]	2,000	2,000	2,000	2,000	2,000
Egypt (exports)	237,570	276,735	284,949	442,532	(2)
Eritrea	62,000	(2)	(2)	(2)	(2)
Ethiopia: Rock salt [6]	10,000	10,000	10,000	10,000	10,000
French West Africa	748	643	51	(2)	(2)
Kenya Colony	—	—	3,250	(2)	(2)
Libya (Italian Africa):					
Cyrenaica [6]	10,000	10,000	10,000	10,000	10,000
Tripolitania [6]	20,000	20,000	20,000	20,000	20,000
Mauritius [6]	1,500	1,500	1,500	1,500	1,500
Morocco, French	814	11,207	909	(2)	(2)
Nigeria [6]	400	400	400	400	400
Portuguese East Africa	2,520	2,605	6,448	6,628	(2)
Portuguese West Africa (Angola) [6]	25,000	25,000	25,000	25,000	25,000
Somaliland:					
British (exports)	1,509	950	353	(2)	(2)
French (exports)	21,985	85,273	(2)	(2)	(2)
South West Africa:					
Rock salt	467	669	641	751	1,125
Other salt	4,773	3,443	4,431	4,704	5,364
Sudan, Anglo-Egyptian	27,027	34,553	37,532	40,633	(2)
Tanganyika Territory	8,574	8,723	9,678	9,472	(2)
Tunisia	129,000	129,708	129,287	(2)	(2)
Uganda	3,405	3,133	3,169	2,626	(2)
Union of South Africa	97,904	106,338	(2)	(2)	(2)
Oceania:					
Australia:					
South Australia	67,391	74,739	76,013	80,759	(2)
Western Australia	4,295	3,729	3,850	(2)	(2)

[1] In addition to the countries listed, salt is produced in Bolivia, Gold Coast, Leeward Islands, Madagascar, Southern Rhodesia, Spain, and Australia (Victoria), but figures of production are not available.
[2] Data not available.
[3] Railway shipments.
[4] Output of U. S. S. R. in Asia included in U. S. S. R. in Europe.
[5] Includes Manchuria.
[6] Estimated annual production.
[7] Year ended Mar. 31 of year following that stated. The figures do not include output from salt beds which, although situated on Government beach lands, have no fixed areas.
[8] Incomplete data.

DIRECTORY OF SALT PRODUCERS IN THE UNITED STATES

Recent changes among producers.—Since the last printed list of salt producers in the United States (Minerals Yearbook, 1936), several additional localities have begun to supply commercial salt. A plant in a newly producing deposit in Colorado is operated by the United States Vanadium Corporation. Deposits have been discovered in the Gulf region of Texas, and production of that State expanded considerably. California, Utah, New Mexico, and Puerto Rico have added or reopened plants, and several States report one new operation each. In 1935, 74 plants representing 60 companies were listed; in 1940, 83 plants representing 66 companies. Otherwise the salt deposits in the United States that supply salt for commercial purposes (except for small deposits used for local supply) are confined to the same definite regions as in 1935. Michigan, New York, and Ohio in the northeastern section of the United States supplied 67 percent of total salt sold or used by producers in 1940. Louisiana and Kansas in the south central section are the next largest producers, and California leads in the western States.

Producers of salt in the United States in 1940

Company name and address	*Plant site*	*Nature of salt*
Carlos M. Ramirez Acosta, Box 12, San German, P. R.	Lajas (Salina Fortuna) Puerto Rico.	Solar-evaporated.
American Salt Co., Mt. Eden, Calif.	Mt. Eden, Alameda County, Calif.	Do.
American Salt Corporation, 630 New York Life Bldg., Kansas City, Mo.	Lyons, Rice County, Kans.	Evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt, rock salt, pressed blocks from rock salt.
Barton Salt Co., Hutchinson, Kans.	Hutchinson, Reno County, Kans.	Evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.
California Rock Salt Co., 2436 Hunter St., Los Angeles, Calif.	Amboy (Saltus), San Bernardino County, Calif.	Rock salt.
Carey Salt Co., Hutchinson, Kans.	Hutchinson, Reno County, Kans.	Evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.
Do	do	Rock salt, pressed blocks from rock salt.
Do	Lyons, Rice County, Kans.	Evaporated salt (vacuum pans), pressed blocks from evaporated salt, rock salt, pressed blocks from rock salt.
Do	Winnfield, Winn Parish, La.	Rock salt, pressed blocks from rock salt.
Cayuga Rock Salt Co., Inc., Myers, N. Y.	Myers, Tompkins County, N. Y.	Rock salt.
Colonial Salt Co., Akron, Ohio.	Kenmore, Summit County, Ohio.	Evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.
Crystal Salt Co., 730 Equitable Bldg., Denver, Colo.	Kanopolis, Ellsworth County, Kans.	Rock salt.
Crystal White Salt Co., 417 Templeton Bldg., Salt Lake City, Utah.	Grantsville, Tooele County, Utah.	Solar-evaporated.
I. N. Curtis, Quemado, N. M.	Salt Lake, Catron County, N. M.	Do.
Diamond Alkali Co., 535 Smithfield St., Pittsburgh, Pa.	Painesville, Lake County, Ohio.	Brine for manufacture of chemicals.
J. Q. Dickinson & Co., Malden, W. Va.	Malden, Kanawha County, W. Va.	Evaporated salt (open pans or grainers).
Dow Chemical Co., Midland, Mich.	Midland, Midland County, Mich.	Evaporated salt (vacuum pans).
Eklund-Blackmon Salt Co., Freedom, Okla.	Freedom, Woods County, Okla.	Solar-evaporated.
R. J. Emanuel, Erick, Okla.	Erick, Harmon County, Okla.	Do.
Excelsior Salt Works, Inc., Pomeroy, Ohio.	Pomeroy, Meigs County, Ohio.	Evaporated salt (open pans or grainers.)
General Foods Corporation, Diamond Crystal Salt Div., St. Clair, Mich., or 250 Park Ave., New York, N. Y.	St. Clair, St. Clair County, Mich.	Evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.
Great Western Salt Co., Redmond, Utah.	Redmond, Sevier County, Utah.	Rock salt, pressed blocks from rock salt.
Imperial Salt Co., 4000 East Washington Blvd., Los Angeles, Calif.	Niland, Imperial County, Calif.	Solar-evaporated.
Independent Salt Co., 33 S. Clark St., Chicago, Ill.	Kanopolis, Ellsworth County, Kans.	Rock salt.

Producers of salt in the United States in 1940—Continued

Company name and address	*Plant site*	*Nature of salt*
International Salt Co., Inc., Scranton Life Bldg., Scranton, Pa.	New Iberia (Avery works), Iberia Parish, La.	Evaporated salt (vacuum pans), rock salt.
Do	Detroit, Wayne County, Mich.	Rock salt.
Do	Geneseo (Retsof plant), Livingston County, N. Y.	Do.
Do	Ithaca (Cayuga works), Tompkins County, N. Y.	Evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.
Do	Watkins Glen (Glen works), Schuyler County, N. Y.	Do.
Irvine Co., Tustin, Calif.	Newport Beach, Orange County, Calif.	Solar-evaporated.
Jefferson Island Salt Mining Co., Inc., Columbia Bldg., Louisville, Ky.	New Iberia, Iberia Parish, La.	Evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt, rock salt, pressed blocks from rock salt.
Leslie Salt Co., 310 Sansome St., San Francisco, Calif.	Alvarado, Newark, Alameda County, Calif.	Solar-evaporated, vacuum pans, pressed blocks from evaporated salt.
Liverpool Salt Co., Hartford, W. Va.	Hartford, Mason County, W. Va.	Evaporated salt (open pans or grainers).
Long Beach Salt Co., Box 28, Long Beach, Calif.	Saltdale Plant, Mohave, Kern County, Calif.	Solar-evaporated.
Do	Long Beach (Anaheim Rd.), Los Angeles County, Calif.	Do.
Manistee Salt Works, 800 So. Vandeventer Ave., St. Louis, Mo.	Manistee, Manistee County, Mich.	Evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.
Marcelino Ramos, Box 196, Ensenada, P. R.	Guanica (Salinas Montalvo), P. R.	Solar-evaporated.
Mathieson Alkali Works, Inc., 60 E. 42d St., New York, N. Y.	Cameron (Hackberry wells), Cameron Parish, La.	Brine for manufacture of chemicals.
Do	Saltville, Smyth County, Va.	Do.
Michigan Alkali Co., Wyandotte, Mich.	Wyandotte, Wayne County, Mich.	Do.
Michigan Chemical Corporation, St. Louis, Mich.	St. Louis, Gratiot County, Mich.	Evaporated salt (vacuum pans).
Monterey Bay Salt Works, Box 43, Moss Landing, Calif.	Moss Landing, Monterey County, Calif.	Solar-evaporated.
Morton Salt Co., 310 South Michigan, Ave., Chicago, Ill.	Newark, Alameda County, Calif.	Solar-evaporated (vacuum pans), pressed blocks from evaporated salt. Salt used produced by Leslie Salt Co.
Do	Manistee, Manistee County, Mich.	Evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.
Do	Port Huron (Marysville), St. Clair County, Mich.	Do.
Do	Hutchinson, Reno County, Kans.	Do.
Do	Grand Saline, Van Zandt County, Tex.:	
	Kleer mine	Rock salt, pressed blocks from rock salt.
	Morton Works	Evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.
Do	Saltair, Salt Lake County, Utah.	Solar-evaporated, pressed blocks from evaporated salt.
Myles Salt Co., Ltd., 1048 Constance St., New Orleans, La.	Weeks, Iberia Parish, La.	Rock salt, pressed blocks from rock salt-evaporated salt (open pans or grainers, vacuum pans).
New Mexico Salt Co., Willard, N. Mex.	Willard, Torrance County, N. Mex.	Solar-evaporated.
Ohio Salt Co., Wadsworth, Ohio.	Rittman, Wayne County, Ohio.	Evaporated salt (open pans or grainers, vacuum pans).
Ohio River Salt Corporation, Mason, W. Va.	Mason (Dixie Works), Mason County, W. Va.	Evaporated salt (open pans or grainers).
Oliver Bros. Salt Co., Mt. Eden, Calif.	Mt. Eden, Alameda County, Calif.	Solar-evaporated.
Atanacio Pelaez, Artesia, N. Mex.	Artesia, Eddy County, N. Mex.	Do.
Pennsylvania Salt Mfg. Co., 1000 Widener Bldg., Philadelphia, Pa.	Wyandotte, Wayne County, Mich.	Evaporated salt (open pans or grainers), brine for manufacture of chemicals.
Pittsburgh Plate Glass Co. (Columbia Chemical Div.), Pittsburgh, Pa.	Barberton, Summit County, Ohio.	Evaporated salt (vacuum pans), brine for manufacture of chemicals.
Pomeroy Salt Corporation, Pomeroy, Ohio.	Minersville (White Rock Works), Meigs County, Ohio.	Evaporated salt (open pans or grainers).
Poulson Bros. Salt Co., Redmond, Utah.	Redmond, Sevier County, Utah.	Rock salt.

Producers of salt in the United States in 1940—Continued

Company name and address	*Plant site*	*Nature of salt*
Puerto Rico Salt Works, Inc., Mayaguez, P.R.	Boqueron, P. R.	Solar-evaporated.
Reeder Salt Co., 845 El Centro Ave., South Pasadena, Calif.	Rice, San Bernardino County, Calif.	Rock salt.
Royal Crystal Salt Co., 1406 1st Natl. Bank Bldg., Salt Lake City, Utah.	Axtell, Sanpete County, Utah.	Do.
Saginaw Salt Products Co., Box 707, Saginaw, Mich.	Carrollton, Saginaw County, Mich.	Evaporated salt (open pans or grainers).
Salinas Del Papayo, Inc., Marina Station, Mayaguez, P. R.	Lajas (El Papayo Works), P. R.	Solar-evaporated.
Salt Supply Co., Carlsbad, N. Mex.	Carlsbad, Eddy County, N. Mex.	Rock salt (salt recovered as part of process of refining potassium salts at plant of Potash Co. of America).
N. E. Snell, lessee, Gunnison Valley Salt Co., Redmond, Utah.	Redmond, Sevier County, Utah.	Rock salt.
Sobrinos de Gonzales & Co., Salinas, P. R.	Salinas (Las Mareas Works), P. R.	Solar-evaporated.
Southern Alkali Corporation, Corpus Christi, Tex.	Benavides, Duval County, Tex.	Evaporated salt (vacuum pans), brine for manufacture of chemicals.
Solvay Process Co., Syracuse, N. Y.	Plaquemine (Choctaw Dome works), Iberville Parish, La.	Brine for manufacture of chemicals.
Do	Delray, Wayne County, Mich.	Do.
Do	Plant at Solvay and wells at Tully, Onondaga County, N. Y.	Evaporated salt (vacuum pans), brine for manufacture of chemicals with refined salt as byproduct.
Stauffer Chemical Co., 624 California St., San Francisco, Calif.	Redwood City, San Mateo County, Calif.	Solar-evaporated.
D. Stockman, Vinson, Okla.	Vinson, Harmon County, Okla.	Solar-evaporated, used locally chiefly as cattle salt.
Strable Lumber & Salt Co., 2100 Holland Ave., Saginaw, Mich.	Saginaw, Saginaw County, Mich.	Evaporated salt (open pans or grainers).
Surprise Valley Salt Works, Cedarville, Calif.	Cedarville, Modoc County, Calif.	Solar-evaporated.
Union Potash & Chemical Co., Carlsbad, N. Mex.	Carlsbad, Eddy County, N. Mex.	Rock salt.
Union Salt Co., Addison Road, Cleveland, Ohio.	Cleveland Cuyahoga County, Ohio.	Evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.
United Salt Corporation, 630 M. & M. Bldg., Houston, Tex.	Hockley, Harris County, Tex.	Rock salt.
U. S. Vanadium Corporation, Uravan, Colo., or 30 E. 42d St., New York, N. Y.	Bedrock, Montrose County, Colo.	Evaporated salt (open pans, solar).
Watkins Salt Co., Inc., Watkins Glen, N. Y.	Watkins Glen, Schuyler County, N. Y.	Evaporated salt (open pans or grainers, vacuum pans).
Western Salt Co., 1245 National Ave., San Diego, Calif.	Chula Vista, San Diego County, Calif.	Solar-evaporated.
Westvaco Chlorine Products Corporation, South Charleston, W. Va.	South Charleston, Kanawha County, W. Va.	Brine used in manufacture of chemicals.
Worcester Salt Co., 40 Worth St., New York, N. Y.	Silver Springs, Wyoming County, N. Y.	Evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.

MAGNESIUM COMPOUNDS AND MISCELLANEOUS SALINES

By Alvin Schallis and A. T. Coons[1]

SUMMARY OUTLINE

Under the dual stimulus of increased demand generated by the national defense program and of somewhat reduced imports of foreign material, the magnesite industry of the United States greatly expanded its operations during 1940. Magnesite production in California was increased, and construction of a flotation plant at Chewelah, Wash., to be completed by the early summer of 1941, was commenced. Plans were completed for opening Nevada magnesite deposits to supply raw material for both metallic magnesium and refractories, and operations were begun early in 1941. Dolomite was employed for magnesia refractories, and the use of magnesitic dolomite refractories increased substantially in 1940.

Utilization of the sea as a source of raw materials increased rapidly during 1940. Owing to the pressing demands of the national defense program the recovery of bromine and magnesium compounds from sea water or bitterns was accelerated. Large-scale recovery of magnesium compounds for the production of magnesium metal from raw sea water was initiated at Freeport, Tex., by the Dow Chemical Co. during 1940, and capacity at this plant is already being enlarged. Valuable materials are being reclaimed from other natural brines at an increasing rate, and general stock-taking and investigation of plant wastes and of idle resources were under way throughout the country. The American Potash & Chemical Co. added liquid bromine to the list of products that it obtains from the brines of Searles Lake, and the Arizona Chemical Co. began to recover magnesium sulfate as a byproduct of its sodium sulfate operations in Texas. Still unutilized, but by no means ignored, are the large potential supplies of magnesium associated with the potash beds at Carlsbad, N. Mex.

Producers of natural salt cake in the Southwest operated at full capacity, furnishing the southern kraft pulp industry with material formerly supplied largely from European sources. The Desert Chemical Co. built a new plant to recover natural sodium sulfate at Dale Lake, Calif., but no production was recorded during 1940. The manufacture of "synthetic salt cake" on a large scale was begun during 1940 and an appreciable portion of the southern salt-cake market was acquired. Production of most materials, whether or not directly affected by war conditions, shared the general business improvement. Early in 1941 bromine, iodine, and borax were added to the export control list. Fortunately, no immediate shortage of these materials has been threatened in the United States.

[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.

MAGNESIUM COMPOUNDS

MAGNESITE

Fostered by external conditions similar to those at the time of its creation during the World War of 1914–18, the domestic magnesite industry attained an all-time record production during 1940 (see fig. 1). The estimated output of crude magnesite was 333,166 short tons valued at $2,487,969, representing a 67-percent increase in quantity and a 70-percent increase in value over the 1939 total of 198,980 tons valued at $1,465,190, and a 5-percent increase over the previous maximum quantity of 316,838 tons in 1917. Imports of all types of magnesite fell sharply during 1940 owing to the difficulty of obtaining shipments from German-occupied territories. However, despite the scarcity of ship bottoms, imports of dead-burned magnesite from Manchuria increased to the high level of 25,970 tons valued at $437,863.

Salient statistics of the magnesite industry in the United States, 1936–40

	1936	1937	1938	1939	1940
Crude:					
Mined:					
Short tons	207,119	203,437	[1] 97,000	[1] 198,980	[1] 333,166
Value [1]	$1,411,664	$1,483,492	[1] $725,000	[1] $1,465,190	$2,487,969
Sold by producers:					
Short tons	1,669	1,952	919	1,123	2,133
Value	$24,420	$29,203	$12,332	$15,752	$32,810
Average per ton [2]	$14.63	$14.96	$13.42	$14.03	$15.38
Imports for consumption:					
Short tons	59	34	36	569	22
Value	$1,130	$313	$777	$5,456	$761
Apparent new supply ...short tons	1,728	1,986	955	1,692	2,155
Percent domestic	96.6	98.2	96.2	66.4	99.0
Caustic calcined:					
Sold by producers:					
Short tons	7,998	10,031	7,400	10,157	16,261
Value	$221,410	$311,326	$228,498	$310,102	$512,607
Average per ton [2]	$27.68	$31.04	$30.88	$30.53	$31.52
Imports for consumption:					
Short tons	2,196	2,798	1,452	2,218	928
Value	$49,674	$62,420	$39,551	$51,884	$21,301
Apparent new supply ...short tons	10,194	12,829	8,852	12,375	17,189
Percent domestic	78.5	78.2	83.6	82.1	94.6
Dead-burned:					
Sold by producers:					
Short tons	89,979	83,204	38,738	86,077	140,668
Value	$1,713,527	$1,598,336	$730,978	$1,699,723	$2,802,537
Average per ton [2]	$19.04	$19.21	$18.87	$19.75	$19.92
Imports for consumption:					
Short tons	42,608	56,020	24,990	44,420	30,951
Value	$662,567	$795,047	$371,669	$800,664	$551,536
Apparent new supply ...short tons	132,587	139,224	63,728	130,497	171,619
Percent domestic	67.9	59.8	60.8	66.0	82.0

[1] Partly estimated; most of the crude is processed by the mining companies, and very little enters open market.
[2] Average receipts f. o. b. mine shipping point.

Sales of domestic dead-burned magnesite increased 63 percent in 1940 to 140,668 short tons valued at $2,802,537 from 86,077 tons valued at $1,699,723 in 1939. Increasing requirements of the steel and other industries for this material, especially toward the end of the year, taxed the ability of the magnesite producers to meet the demand. The situation with regard to supplies of high-grade magnesite and periclase may become critical as the national defense program develops.

The Westvaco Chlorine Products Corporation (405 Lexington Avenue, New York, N. Y.) operated its Patterson (Calif.) plant at capacity during 1940, processing the crude magnesite mined at its Bald Eagle mine near Gustine, Calif., and at its Western mine above Livermore, Calif., as well as some magnesite and brucite obtained from the mine of Basic Ores, Inc., near Luning, Nev. The sea-water plant of the Westvaco Chlorine Products Corporation was enlarged 50 percent during 1940 and was operated at capacity throughout the year. This company, in joint operation with the Permanente Corporation, has leased a large magnesite property in the Luning district of Nevada and is opening this deposit as quickly as possible with the

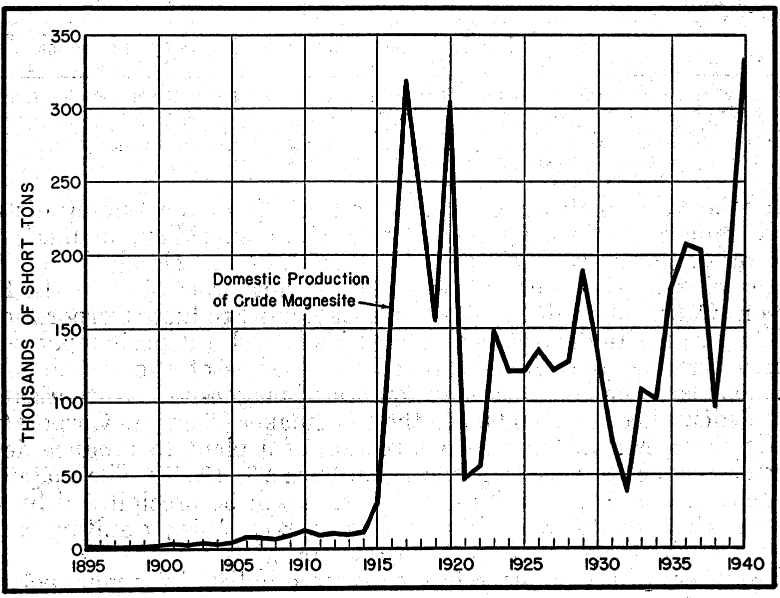

FIGURE 1.—Production of crude magnesite in the United States, 1895—1940.

expectation of producing magnesite from this source before the middle of 1941. Crude magnesite from this deposit will be shipped to Patterson, Calif., and also to Permanente, Calif., where it will be used in the production of magnesium metal by an electrothermal reduction process. The Westvaco Chlorine Products Corporation has also obtained a lease on the Double Eagle magnesite property near Valley, Wash. It is planned to maintain this property as a reserve until additional production of magnesite becomes imperative.

The Northwest Magnesite Co. (Farmers Bank Building, Pittsburgh, Pa.) operated four or five of its six kilns at Chewelah, Wash., for 12 months of 1940; both the Finch and the Allen-Moss quarries supplied the raw magnesite for them. Construction of a 300-ton daily capacity flotation plant to reduce the silica content and to produce a more satisfactory refractory-grade magnesite for brick manufacture from run-of-mine crude magnesite was begun in 1940 by the company, and the plant was expected to be completed by the early summer of 1941.

Magnesite imported for consumption in the United States in 1940, by countries and classes

County	Crude		Caustic-calcined				Dead-burned and grain and periclase	
			Lump		Ground			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Canada							346	$33,765
China							376	4,724
Czechoslovakia [1]							582	8,415
Germany [1]							2,313	39,846
Hungary [1]							115	1,731
India, British			611	$10,460			151	2,146
Kwantung							25,970	437,863
Netherlands	22	$761	24	817	135	$5,379		
U. S. S. R.[1]							1,098	23,046
United Kingdom					13	850		
Yugoslavia			145	3,795				
	22	761	780	15,072	148	6,229	30,951	551,536

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

A relatively small quantity of magnesite from the Luning district of Nevada was mined by Basic Ores, Inc., a subsidiary of Basic Refractories, (formerly Basic Dolomite, Inc.), of Cleveland, Ohio. The larger part of this material was shipped for processing to the Patterson (Calif.) plant of the Westvaco Chlorine Products Corporation.

The magnesite deposit near Llano, Tex., and a deposit reported in North Carolina were investigated by the Office of Production Management as possible emergency sources of magnesite. Authorization of a Federal loan of $300,000 to the Rademaker Chemical Corporation of Eastlake, Mich., for the construction of a plant to produce dead-burned magnesite was announced on April 23, 1941. The magnesia content of the natural brines of that area will be precipitated by the lime content of dolomite from Sturgeon Bay, Wis., resulting in recovery of the magnesia from both raw materials.

Producers of magnesite refractories were indicted for monopoly on January 20, 1941. Antitrust charges in connection with the production of magnesite were filed against the Harbison-Walker Refractories Co. and the General Refractories Co. (joint owners of Northwest Magnesite Co.), the American-Austrian Magnesite Co., and four foreign companies. The charges were denied.

Production of caustic-calcined magnesite, reaching its highest level since 1926, increased 60 percent to 16,261 short tons valued at $512,607 in 1940 from 10,157 short tons valued at $310,102 in 1939. This increase may be largely accounted for by the greater use of magnesium oxychloride cement for flooring purposes in defense projects, and of "soluble" magnesium oxide in fertilizers. The use of magnesium oxychloride cement for floors of explosives plants is especially valuable owing to its nonflashing properties. Caustic-calcined magnesite for magnesium oxychloride cement was produced largely from high-purity California magnesite, whereas "soluble" magnesium oxide for fertilizers was made from sea-water magnesia, which is more suitable owing to its small particle size.

Production of magnesite in Chosen may be expected to reach large proportions within a few years. The semiofficial concern, the Chosen Magnesite Development Co., which was organized in 1939, has undertaken to develop reserves of magnesite (estimated at about 3 billion tons) in Tansengun, South Kankyo Province, Chosen. No commercial shipments are expected until 1942 or 1943, however, owing to the necessity of building a railroad connection from the deposits to the Kankyo line of the Government Railway. Plans for developing magnesite deposits in Australia (at Bulong near Kalgoorlie, Western Australia), Kenya Colony, and Italy (in the Dolomite Mountains of northern Italy) were announced during 1940.

Price quotations of the Engineering and Mining Journal remained the same as in 1939, that is, at $22 and $25 a short ton for dead-burned magnesite f. o. b. Chewelah, Wash., and California shipping points, respectively. For other products, its quotations f. o. b.

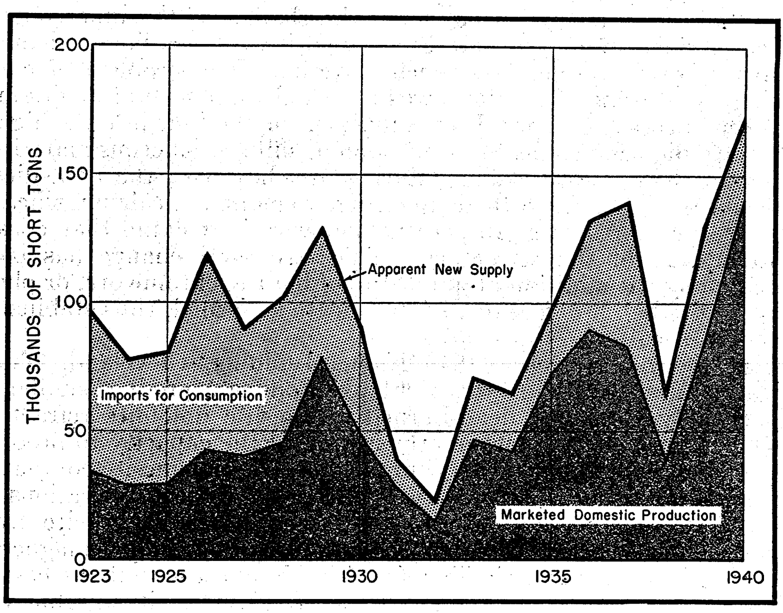

FIGURE 2.—Apparent new supplies of dead-burned magnesite in the United States from domestic and foreign sources, 1923–40.

California remained nominally as follows: Artificial periclase, 94 percent MgO, $65; 90 percent $35; caustic, 95 percent MgO, white color, $40; 85 percent MgO, no color standard, $37.50 a ton.

DOLOMITE

Sales of dead-burned dolomite by domestic producers, reflecting the increased activity of the steel industry, advanced to the record high of 867,909 short tons valued at $6,925,328 in 1940—a 29-percent increase in quantity and 27 percent in value compared with the 1939 production of 671,561 tons valued at $5,447,554. Imports of dead-burned dolomite, reaching the end of their steady and rapid decline from the high level of 13,928 tons in 1936, ceased in 1940.

Dead-burned dolomite sold in and imported into the United States, 1936–40

Year	Sales		Imports [1]		Year	Sales		Imports [1]	
	Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
1936	596,751	$4,887,243	13,928	$349,678	1939	671,561	$5,447,554	186	$4,260
1937	617,706	5,217,833	9,083	231,084	1940	867,909	6,925,328		
1938	366,626	3,095,355	2,875	67,340					

[1] Reported as "dead-burned basic refractory material."

War conditions have given impetus to research into and development of dolomite and magnesitic dolomite refractories. This field is particularly attractive owing to the enormous supplies of dolomite located conveniently as regards industries consuming basic refractories. The chief objections to the use of untreated dead-burned dolomite for refractory purposes are the slaking of the lime content during periods of disuse and the low orders of spalling resistance exhibited by the products of such material. The problem of overcoming the slaking of the lime was attacked from several angles and has been successfully solved by conversion of the lime into the highly refractory dicalcium silicate by addition of suitable siliceous materials. Owing to temperature changes during use, however, the beta dicalcium silicate first formed tends to change to gamma dicalcium silicate, with an accompanying 10-percent increase in volume that causes disintegration of the refractory. This structural change has been overcome by the addition of quantities of borate, chrome ore, or phosphate to the batch before dicalcium silicate is formed, thus stabilizing the beta form.

Basic Refractories, Inc. (845 Hanna Building, Cleveland, Ohio), which acquired United States rights to produce a product similar to the specially stabilized dead-burned magnesitic dolomite refractory developed in Canada, has greatly expanded the capacity to produce this product at its plant near Tiffin, Ohio. The magnesite content of the dolomite for this refractory is increased, in the operations of Basic Refractories, Inc., by substantial additions of brucite from Nevada. Consideration was given to the use of byproduct magnesite from the Eastern Magnesia Talc Co. for this purpose, but the cost of refining this material to a point that would make it suitable was prohibitive. The Standard Lime & Stone Co. (First National Bank Building, Baltimore, Md.) has begun to produce a similar magnesian dolomite refractory from dolomite as the only source of magnesia. The slightly soluble lime content of the calcined dolomite is reduced in the process of this company by leaching with large volumes of water. At least two other processes for reducing the lime content of burned dolomite are being investigated in pilot plants. One of these methods, which is under investigation in Pennsylvania, involves slaking of the calcined dolomite, treatment of the calcium hydroxide so formed with hydrogen sulfide to form calcium hydrosulfide, and subsequent extraction of the calcium hydrosulfide to leave a residue of high magnesia content. The hydrogen sulfide is regenerated from the calcium hydrosulfide by treatment of the solution with carbon dioxide to form calcium carbonate. In the other process, which is being developed in Ohio, calcined and slaked dolomite is treated with a sugar solution to form soluble calcium sucrate, which is removed from the residual magnesia afterward by filtration. The sugar solution is regenerated by treatment with carbon dioxide to form calcium carbonate and sugar.

TECHNOLOGIC TRENDS IN MAGNESIA REFRACTORIES

Recent estimates indicate that the 1940 consumption of magnesite by the steel industry per ton of steel produced reached a low level and no further reduction in consumption is expected. The recent decrease in the consumption of magnesite per ton of steel has resulted from at least two causes: (1) Improvement in the magnesite refractories so that replacements and repairs have been less frequent and (2) replacement of much magnesite brick by chrome and chrome-magnesite brick in many applications where magnesite brick formerly were used exclusively. Consumption of magnesite per ton of steel produced, however, is expected to increase somewhat in the near future. This will be caused by several factors, prominent among which are: (1) The operation of all-basic open-hearth furnaces, which has been made possible by improved magnesite and chrome-magnesite brick and changes and improvements in furnace design and (2) an increasing trend toward the replacement of chrome-containing brick by straight magnesite brick in furnaces for treating alloy steels in which contamination by chrome may be objectionable.

During recent years there has been a strong trend toward the use of chrome-magnesite refractories. It is found that for general purposes these refractory materials in combination are vastly superior to either component alone. The combination of chromite and burned magnesite may range from 80 to 20 percent magnesite and from 20 to 80 percent chrome ore, although a ratio of 60 to 75 percent chrome ore to 40 to 25 percent burned magnesite is preferred for general basic refractory purposes. These mixtures show greater refractoriness than straight chrome ore and have better physical and chemical properties than either material alone. The increased refractoriness results from formation of forsteritic materials by combination of the magnesite with the fusible gangue materials in the chrome ore. The volume stability of chrome-magnesite has been ascribed to the reaction between the added magnesium oxide and the gangue material, the solid solution of MgO in chromite, and the replacement of the FeO in the chrome by MgO.

Studies of the internal structure indicate that the relative size of the particles and the distribution of the various components is even more important than the percentage of chrome ore or magnesite. A substantial percentage of all basic refractory brick now being manufactured is formed from properly sized particles under high pressure without the conventional burning in kilns.[1] High resistance to thermal shock usually is obtained by keeping the chrome fraction coarse and the magnesia fraction considerably finer so that it may fill the interstices between the chrome particles. Suitable refractory bonds are added to the mix before molding. The brick so obtained are strong, resilient, and very resistant to spalling, which makes them preferable

[1] Opinion regarding the general merit of unburned brick is not unanimous. It is claimed that some residual shrinkage of the brick although small, remains and that the resistance of these brick to spalling is temporary, being lost after use at high temperature.

to silica in most, if not all, parts of open-hearth furnaces above the floor level.

Owing to their relatively low compressive strength at high temperatures, however, it is not practical to use magnesite or chrome-magnesite brick for arched roofs of large furnaces. However, they may be used to advantage in the construction of suspended roofs having iron plates between the bricks. Because they are more resistant to the action of iron oxide and are more refractory, properly constructed all-basic open-hearth furnaces permit higher working temperatures, reduce shut-down time, lower the slag bulk and the amount of fettling material required, and generally make possible increased production of superior quality metal. It is claimed that these advantages overbalance the additional cost of constructing suspended roofs on large installations and that there will be a definite trend toward all-basic open-hearth furnaces. This trend undoubtedly will be accelerated by the increasing demands for steel caused by the national defense program. Because of the smaller stresses involved, small basic arched roofs give satisfactory service without the need for external support.

Increased working temperatures in many metallurgical furnaces are requiring the replacement of silica brick with higher-melting refractories of the forsterite type for many processes. These are, in many instances, being produced by combination of olivine and talc or serpentine with magnesite. Work done by the Bureau of Mines [2] indicates that excellent refractories can be made from Pacific Northwest olivine by proper control of particle-size distribution and addition of suitable conversion agents, such as chromite and MgO.

OTHER MAGNESIUM COMPOUNDS

The output of magnesium compounds other than magnesite and dolomite produced from natural sources and sold or used in the United States rose to an all-time high of 108,266 tons valued at $2,452,814 during 1940 compared with 85,754 tons valued at $2,159,019 in 1939. The increased production of magnesium chloride, which placed it ahead of magnesium sulfate for the first time, reflected the rapidly growing demand for magnesium metal and the sharply increased use of magnesium oxychloride cement in national defense industries. The increased production of magnesium sulfate resulted partly from the cessation of imports of Epsom salts and calcined kieserite from Germany and partly from the general acceleration of business activity. Recovery of magnesium sulfate was undertaken during 1940 by the Arizona Chemical Co. as a joint product of its sodium sulfate operations in Texas.

The production of brucite from the deposit near Luning, Nev., increased further in 1940, but the Bureau of Mines is not at liberty to publish the figures separately, and the material is included under "Other magnesium compounds." Basic Ores, Inc.—a subsidiary of the principal consumer, Basic Refractories, Inc.—is the only domestic producer. Brucite is used by the parent company mainly to increase the magnesia content of dolomite in preparing stabilized magnesitic dolomite refractories.

[2] Wilson, Hewitt, and Skinner, K. G., Review of four years of research on refractory properties of Pacific Northwest olivine: Jour. Am. Ceram. Soc., vol. 23, No. 5, May 1940, pp. 136-8.

Magnesium compounds imported for consumption in the United States, 1936–40

Year	Magnesium chloride (anhydrous and n. s. p. f.)		Magnesium sulfate (Epsom salts)		Calcined magnesium sulfate or calcined kieserite (not fertilizer)		Oxide or calcined magnesia	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1936	16	$584	2,167	$25,008	2,720	$44,664	119	$39,098
1937	32	1,120	1,953	26,771	4,117	71,889	109	35,643
1938	41	1,572	799	12,328	3,193	66,470	46	15,947
1939	28	960	198	3,641	2,472	43,455	38	14,755
1940			6	898			18	5,672

Year	Magnesium carbonate, precipitated		Manufactures of carbonate of magnesia		Magnesium silicofluoride or fluosilicate		Magnesium salts and compounds, n. s. p. f.	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1936	377	$34,396			(1)	(1)	[1] 186	[1] $29,355
1937	521	51,684	7	$562	(1)	(1)	[1] 70	[1] 20,462
1938	470	53,151	3	209	(1)	(1)	[1] 48	[1] 17,146
1939	776	68,934			(1)	(1)	[1] 59	[1] 26,788
1940	754	82,764			(1)	(1)	[1] 92	[1] 44,492

[1] Magnesium silicofluoride or fluosilicate included under "Magnesium salts and compounds, n. s. p. f."

Although much larger requirements of metallic magnesium for airplane construction have stimulated research into the production of this metal from sources other than magnesium chloride, the capacity for producing magnesium chloride for use in the existing electrolytic process was considerably increased during 1940. The Dow Chemical Co. erected a large plant to recover magnesium compounds from sea water at Freeport, Tex., and an estimated 6,500 tons of magnesium metal will be produced annually. The output of this amount of magnesium metal involves precipitation of almost 16,000 tons of magnesium hydroxide as the primary form of the recovered material. Although this plant was not completed much before the end of 1940, its capacity is already being increased.

Magnesium oxide was suggested [3] as a water conditioner to remove silica. A product obtained by the calcination of dolomite in such a manner that magnesium oxide is produced and the calcium carbonate is not affected has been employed for several years in Germany to remove carbon dioxide and other acidic materials from water and thus prevent corrosion of pipes and conduits.

CALCIUM CHLORIDE

Production and sales of calcium chloride and mixed calcium-magnesium chloride, basis 75 percent $(Ca, Mg)Cl_2$, obtained directly from natural brines decreased to 94,238 short tons valued at $1,485,784 in 1940 compared with 108,441 tons valued at $1,307,717 in 1939. Sales of calcium chloride obtained as a byproduct of the ammonia-soda process for the production of sodium carbonate are nearly twice as large as those of material from natural brines. However, these sales

[3] Betz, L. D., Noll, C. A., and McGuire, J. J., Removal of Silica from Water by Hot Process: Ind. Eng. Chem., vol. 32, No. 10, October 1940, pp. 1323–1329.

are not included in the foregoing figures because the salt and limestone from which such calcium chloride is produced are reported with those discussed in the Salt and Stone chapters in this volume. Total sales of calcium chloride (both natural and byproduct) during 1940 are estimated at 266,000 short tons—an increase of a little more than 2 percent over 1939.

Calcium (calcium-magnesium) chloride from natural brines sold by producers in the United States, 1936–40

Year	Short tons	Value	Year	Short tons	Value
1936	125,911	$1,909,908	1939	[1] 108,441	$1,307,717
1937	[1] 97,142	1,295,403	1940	[1] 94,238	1,485,784
1938	[1] 96,470	1,218,938			

[1] Calculated to basis of 75 percent $CaCl_2$.

Calcium chloride imported for consumption in and exported from the United States, 1936–40

Year	Imports		Exports	
	Short tons	Value	Short tons	Value
1936	2,128	$25,678	27,831	$503,966
1937	2,205	24,908	21,732	415,309
1938	1,642	21,174	24,118	396,981
1939	996	12,314	19,382	318,199
1940	----------	----------	8,907	194,738

Owing to limited demand barely more than 5 percent of the total calcium chloride produced in the manufacture of sodium carbonate is recovered as a byproduct. Notwithstanding the fact that it is still largely a waste material, calcium chloride has attained considerable economic importance, as indicated by the afore-mentioned sales figures. Its greatest application is for the construction and maintenance of roads, where it is used to lay dust, and to aid in the consolidation and stabilization of dirt and gravel roads, in the curing of concrete, and ice control. Other uses are for dedusting and ice control of coal and coke, for dust control of private grounds, in refrigerating brines, in air-conditioning, and in numerous other smaller outlets. Recent estimates of the proportional utilization of calcium chloride are: Road stabilization, surface consolidation, and dust laying, 40 to 45 percent; highway ice control, about 15 percent; dust- and freeze-proofing of coal and dust-proofing of coke, 10 to 14 percent; refrigeration, 5 percent; concrete acceleration and conditioning, 5 percent; manufacture of other chemicals, 3 percent; and miscellaneous, 17 to 18 percent.

A vigorous campaign by the Solvay Sales Corporation and other manufacturers is under way in an attempt to develop the miscellaneous uses of calcium chloride as well as those that consume large tonnages. One of the more interesting applications is dehumidification of the air of private homes. Low-cost equipment in which flake calcium chloride can be used for this purpose has been placed on the market; and it is claimed that, under proper conditions, the humidity can be reduced sufficiently to prevent condensation of moisture on cold pipes and basement walls during humid weather and even to prevent the sensation of dampness and the formation of mold. A patented dehydrator of air known as Caloride has recently been placed on the market. This material consists of nonporous lumps of 72-percent calcium chloride into which activated carbon is dispersed. It is designed not only to dehydrate the air but also to absorb some odors. Equipment has been developed for applying it to dehydration of air both in residential and in industrial air-conditioning.

BROMINE

After advancing almost steadily since 1926, the production of bromine jumped 56 percent to another all-time high of 29,633 short tons valued at $11,772,515 in 1940, compared with 18,941 short tons valued at $7,611,400 in 1939. Despite the improvement in the quality of base gasolines the use of bromine in the production of tetraethyl lead again rose more rapidly than did the production of gasoline. This resulted, at least in part, from the fact that during the past few years even the so-called regular gasolines have been improved by larger additions of this knock-inhibiting compound.

Bromine and bromine in compounds sold or used by producers in the United States, 1936–40

Year	Pounds	Value	Year	Pounds	Value
1936	20,609,025	$4,038,438	1939	37,882,005	$7,611,400
1937	26,200,256	5,180,177	1940	59,266,275	11,772,515
1938	[1] 33,324,116	6,610,056			

[1] Revised figures.

Bromine and bromine compounds imported for consumption in the United States, 1938–40, by countries

Commodity and country	1938		1939		1940	
	Pounds	Value	Pounds	Value	Pounds	Value
Ethylene dibromide: Germany	1,210,005	$263,459				
Potassium bromide: Japan	42	30				
Other bromine compounds:						
France			4	$193	18	$732
Germany	733	5,110	2,011	9,518		
Italy					135	6,106
Switzerland	527	8,611	1,503	28,386	4,033	51,597
United Kingdom	10	317				
	1,270	14,038	3,518	38,097	4,186	58,435

The present abundant supplies of bromine, available at relatively low cost, have encouraged research into and development of new applications for this element by assuring the user of adequate supplies should large quantities be required. The use of bromine in the shrinkproofing of wool was described by Ericsson.[4] Advantages claimed were: Less chemically determinable damage to the wool fiber, easier control during application, and a reduction of fumes with a newly designed apparatus. A new, although not large, use of bromine compounds as a substitute for tincture of iodine has recently been reported

[4] Ericsson, Ralph L., Textile Chemists Told Army Needs: Oil, Paint, and Drug Reporter, vol. 138, No. 18, October 28, 1940, p. 56.

in Germany. This is a combined bromine preparation, the bacteriocidal power of which is said to be equal to that of tincture of iodine, and it is claimed to be superior to iodine in other respects. The importance of this development rests not so much upon the new outlet for bromine as upon the release of the medical and surgical requirements of relatively large quantities of iodine, of which there is a severe shortage in Germany.

On December 23, 1940, bromine and its compounds were added to the export-control list. The United States is the world's largest producer of bromine and, although figures are not available, exports are considerable. Germany and Palestine also are large producers, and appreciable amounts are produced in Japan, France, Tunisia, Italy, Russia, and the United Kingdom. Plants for recovering bromine from sea water are reported to be operating in France and in England.

Fourteen plants reported production of bromine or bromine compounds from natural sources during 1940. The Ethyl-Dow Co. produced the largest quantity, recovering bromine from raw sea water near Wilmington, N. C. The second largest producer was the Dow Chemical Co., which recovered bromine from natural brines in Michigan. This company has also begun to produce bromine at its Freeport (Tex.) plant where magnesium compounds are recovered from raw sea water. The American Potash & Chemical Corporation—a newcomer into the bromine field—also supplied an important quantity of bromine during 1940, having recovered this element from some of the more concentrated process liquors derived from Searles Lake brines. Equipment for producing bromine compounds as well as liquid bromine was being installed early in 1941, and actual output of these compounds was expected to begin by early summer.

IODINE

Domestic production of iodine during 1940 continued the increase begun in 1937; however, owing to the fact that output was reported by only two companies—the Dow Chemical Co. at its plant at Long Beach, Calif., and the Deepwater Chemical Co. at its plant at Compton, Calif.—the Bureau of Mines is not at liberty to publish the figures. The domestic production of iodine during 1937 (statistics for which are the last published by the Bureau of Mines) was 299,286 pounds valued at $242,422. Imports of iodine in 1940 (all crude) totaled 1,244,146 pounds valued at $1,296,181—a sixfold increase over the imports of iodine during 1939, which totaled 200,000 pounds valued at $168,233.

Crude iodine imported for consumption in the United States, 1936–40

Year	Pounds	Value	Year	Pounds	Value
1936	592,217	$558,326	1939	200,000	$168,238
1937	1,967,148	1,784,491	1940	1,244,146	1,296,181
1938	570,532	464,303			

On April 15, 1941, iodine was added to the export-control list. Supplies of iodine—an essential in medicine and photography—are ample but not overabundant in the United States. The recovery of iodine in this country depends on the market price more than on natural resources of this element. Should suspension of imports cause a sufficient increase in price, profitable recovery of iodine in the United States could be increased to an estimated 500 tons [5] annually, which is about equivalent to annual domestic consumption. Since 1932 the United States sales agency of the Chilean iodine producers has maintained a minimum stock on hand of 1,000 metric tons of iodine; as soon as stocks are depleted to this figure fresh shipments are imported. If imports of iodine should be cut off these stocks, which are equivalent to almost 2 years' normal supply, will be adequate to supply domestic requirements until new equipment for the recovery of iodine can be installed in this country.

The bulk of the world supply of iodine is produced as a byproduct of the nitrate industry in Chile. The greater part of the Chilean output is supplied by the two modern Guggenheim-process nitrate plants, Maria Elena and Pedro de Valdivia. France, the United Kingdom, Ireland, Norway, Japan, Netherlands Indies, and British India also contribute to the world iodine output. Germany depends on foreign sources for all of its iodine requirements; in consequence of a special trade agreement with Chile, net imports expanded markedly in 1935, to 252 short tons from 64 short tons in 1934, then contracted steadily, falling to 140 short tons in 1938 and an estimated 135 short tons in 1939. As a result of the British blockade, therefore, Germany is suffering from an acute shortage of iodine. Various measures have been taken to relieve the situation. Waste iodine from all possible sources is being recovered, one of the most outstanding being the photographic-chemical industry. Fixing baths at photograph-development establishments are an especially advantageous source of reclaimed iodine, inasmuch as they are invariably treated for the recovery of silver. Other sources of reclaimed iodine are residues, solutions, and other iodine-containing industrial wastes of the pharmaceutical industry and plants producing inorganic or organic iodine-bearing preparations. Germany has reduced the consumption of iodine by restricting its use and by developing substitutes. As noted under the foregoing discussion of bromine a new antiseptic agent recently developed in Germany, incorporating oxygen-bromine compounds, a metal salt, and weak acid thiocyanate solutions, has been found an effective substitute for tincture of iodine and is already in general use, having been accepted as standard by the German army. Iodine is now employed in Germany principally for industrial purposes, especially photography; consumption for photographic purposes has been greatly expanded in recent times by the extensive use of military photography. Recently the iodine situation in Germany has been somewhat relieved by supplies originating in France.

SODIUM SULFATES

Sales of natural sodium sulfates continued their upward trend of the last 6 years by jumping 36 percent to 187,233 short tons valued at $1,528,633 in 1940 compared with 137,479 short tons valued at $1,027,876 in 1939, the previous record year. This increase in production was caused (in part at least) by the sharp decrease in imports of salt cake during 1940, which—owing to war conditions—totaled only 73,027 short tons valued at $1,009,694 and represented a 51-percent decrease in quantity and a 28-percent decrease in value from the 1939 imports of 148,794 short tons valued at $1,394,484.

[5] Holstein, P. F., Fortunes and Misfortunes in Iodine: Chem. and Met. Eng., vol. 39, No. 8, 1932, p. 423.

Sodium sulfate imported for consumption in the United States, 1939–40, by countries

Country	Crude (salt cake)		Crystallized (Glauber's salt)		Anhydrous		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1939								
Belgium	25,607	$291,619					25,607	$291,619
Canada	9,518	66,477					9,518	66,477
Chile	1,503	10,575					1,503	10,575
France					444	$7,358	444	7,358
Germany [1]	103,259	931,553	468	$2,520	5,047	90,262	108,774	1,024,335
Netherlands	1,552	14,034					1,552	14,034
Poland and Danzig [1]	5,111	55,621					5,111	55,621
United Kingdom	2,244	24,605					2,244	24,605
	148,794	1,394,484	468	2,520	5,491	97,620	154,753	1,494,624
1940								
Belgium	14,202	209,394	1	53			14,203	209,447
Canada	16,444	241,982					16,444	241,982
Chile	8,444	146,798					8,444	146,798
France	9,290	113,452			32	741	9,322	114,193
Germany [1]	2,240	24,000					2,240	24,000
Italy	551	4,250					551	4,250
United Kingdom	21,856	269,818					21,856	269,818
	73,027	1,009,694	1	53	32	741	73,060	1,010,488

[1] For statistical purposes, after November 16, 1939, trade with Danzig and that part of Poland occupied by Germany has been included with Germany.

Crude sodium sulfate (salt cake) imported for consumption in the United States, 1939–40, by customs districts, in short tons

Customs district	1939	1940	Customs district	1939	1940
Atlantic ports:			Gulf ports—Continued.		
Georgia	27,533	9,893	Mobile	21,076	19,431
Maryland		47	New Orleans	2,844	541
New York	1,503	82	Pacific ports and Canadian border:		
South Carolina	33,672	19,542	Dakota	9,094	11,551
Virginia	901		Duluth and Superior	423	
Gulf ports:					
Florida	50,541	11,940			
Galveston	1,207			148,794	73,027

The Bureau of the Census reports that sales of salt cake from chemical works as well as from natural sources amounted to 224,749 short tons valued at $2,291,944 in 1939 (241,347 tons, $2,367,616 in 1937), sales of anhydrous (refined) sodium sulfate 42,489 tons, $689,599 in 1939 (21,797 tons, $312,285 in 1937), and sales of Glauber's salt 34,493 tons, $539,770 in 1939 (31,934 tons, $490,660 in 1937).

Responding to the demand for domestic salt cake (fig. 3) caused by the reduction of imports in consequence of war conditions, a large plant at Dale Lake, Calif., has been constructed by the Desert Chemical Co. to manufacture salt cake and anhydrous sodium sulfate. Owing to the use of solar evaporation for the recovery of both Glauber's salt and salt cake, operating costs at this plant are said to be very low. It is hoped that these low operating costs will offset the somewhat unfavorable situation of this plant with respect to the consuming areas. "Synthetic salt cake," a sintered mixture of soda ash and sulfur in proportions of about 3 parts of sulfur to 10 of soda ash, has become an important factor in the kraft-paper market for sodium sulfate. This product is not a satisfactory substitute for sodium sulfate in other applications, but the kraft pulp and paper industry is by far the

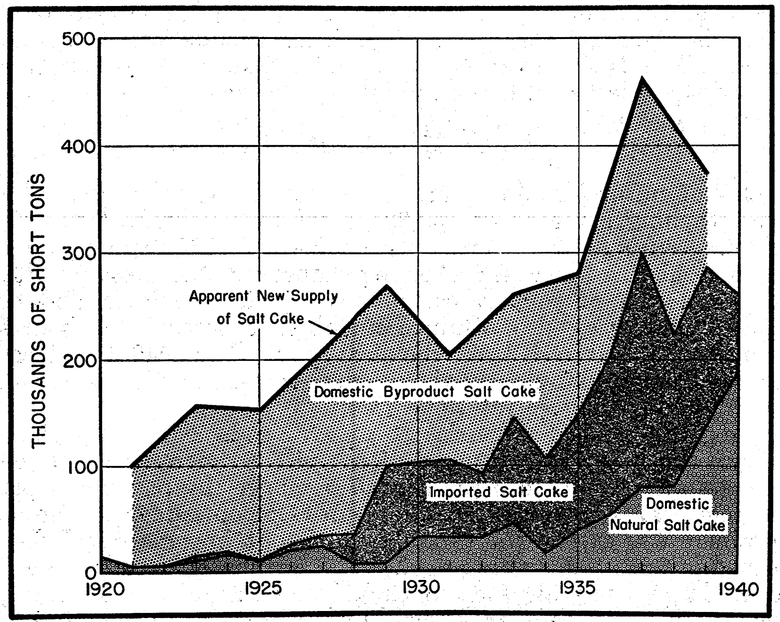

FIGURE 3.—Apparent new supplies of salt cake in the United States from domestic and foreign sources, 1920–40.

largest consumer of sodium sulfate and requires well over 70 percent of the entire output of this chemical. It is reported that the Mathieson Alkali Works at Lake Charles, La., is producing "synthetic salt cake" at the rate of about 400 tons a day, largely replacing the imported salt cake no longer available from Germany.

A number of sulfate-process pulp plants are using a combination of gypsum and sodium carbonate instead of salt cake. Sodium carbonate and gypsum are added to the black ash of the process, and sodium sulfide is obtained after the mass has been burned. Advantages claimed for this process are lower furnace losses and better control of the sulfidity of the digesting liquor.

Natural sodium sulfates and sodium carbonates sold or used by producers in the United States, 1934–40

Year	Sodium sulfates [1]		Sodium carbonates [2]	
	Short tons	Value	Short tons	Value
1934	16, 650	$148, 225	88, 325	$1, 254, 113
1935	38, 706	275, 943	93, 230	1, 173, 003
1936	51, 608	336, 559	102, 866	1, 106, 364
1937	80, 053	599, 266	104, 711	1, 191, 485
1938	80, 210	596, 812	100, 010	1, 235, 328
1939	137, 479	1, 027, 876	124, 743	1, 528, 810
1940	187, 233	1, 528, 633	130, 034	1, 629, 283

[1] Salt cake and Glauber's salt.
[2] Soda ash, bicarbonate, sesquicarbonate, and trona.

The price of imported salt cake, as quoted by the Oil, Paint, and Drug Reporter (assumed to be the price of salt cake on the southern market) rose from its pre-war level of $15 to $16 a ton to $18 a ton in

December 1939 and to $20 a ton in January 1940. The price remained at this latter figure during 1940 until the production of "synthetic salt cake" and the availability of salt cake from other sources reduced the price to $16.50 a ton late in December 1940.

SODIUM CARBONATES

Sales of natural sodium carbonates continued to increase during 1940, reaching a record of 130,034 short tons valued at $1,629,283 compared with 124,743 short tons valued at $1,528,810 in 1939—the previous high. Likewise reflecting improved business conditions, the production of sodium carbonates by the ammonia and other chemical processes also attained an all-time record. Estimates of the output of soda ash from chemical sources for 1940 are placed at 3,025,000 tons manufactured by the soda-ammonia process and 25,000 tons by the electrolytic process.

Owing to technical advances the use of soda ash in the glass industry—the greatest consumer of sodium carbonate—continued to grow despite inroads into the container market by paper and plastic products. It is predicted that difficulties in obtaining tin for metal containers will extend the production of container glass and thereby the use of soda ash in this field. The output of caustic soda—the second largest use for sodium carbonate—was placed at 1,095,000 tons during 1940 compared with 1,025,000 tons during 1939.[6] Of the 1940 production 46 percent was obtained from soda ash by the lime-soda process in 1940 and 52 percent in 1939. This decrease in the production of caustic soda by the lime-soda process in 1940 was caused in great measure by the increased demand for chlorine, which is largely obtained by electrolysis of sodium chloride, with caustic soda as an unavoidable coproduct. Many manufacturers of caustic soda by the lime-soda process also operate electrolytic cells for producing chlorine and sodium hydroxide; consequently they will reduce output of caustic soda by the lime-soda process when necessary to avoid accumulating large stocks of this material.

An interesting new use for sodium carbonate is in the manufacture of "synthetic salt cake," already described. This material is and probably will always be exclusively a product of the sodium carbonate produced by the ammonia-soda process, inasmuch as natural salt cake is economically available in areas where natural soda ash is largely used. The smelting of low-grade iron ores by the so-called acid process has become a newly important use for sodium carbonate in Germany. Owing to the great wartime requirements for steel in that country it has been necessary to resort to extensive use of low-grade iron ores locally available; consequently a new and very large demand for a special fused lump-form soda ash has arisen in that country. Such a product has been employed for some time in the United States for a similar purpose—usually in refining high-grade steels—but the demand for sodium carbonate for this use has never been very great.

Research into the applications of sodium carbonate continues; because of this, it is thought that the present importance of sodium carbonate in industry will continue or may even grow. Investigational work now in progress includes research on sodium carbonate

[6] Chemical and Metallurgical Engineering, Commodity Reviews and Forecasts, Alkalis and Chlorine: Vol. 48, No. 2, February 1941, pp. 92–94.

for improving the manufacture of clay products. Relatively small quantities of sodium carbonate are used, but excellent results are obtained by proper manufacturing control.

BORATES

Owing to extensions of the British blockade of exports from the United States to European countries falling under Axis control, domestic production of borate minerals declined slightly to 243,355 short tons valued at $5,643,390 during 1940 compared with 245,284 short tons valued at $5,689,797 (revised figures) in 1939. Exports dropped sharply to 64,313 short tons valued at $2,456,523 from 91,139 short tons valued at $3,230,304 during the preceding year and a record of 154,052 tons valued at $4,715,691 in 1937. Apparent consumption in the United States increased in 1940 owing to general business improvement rather than to any specific technical advances. Increased sales and lower prices of ovenware expanded somewhat the requirements for boric acid and borates of manufacturers of heat-resisting glass; and increased sales of vitreous enamelware, resulting from improvements in the products and from the scarcity of corrosion-resistant alloys for other than national defense purposes, were another favorable factor. Both industries are important consumers of borax.

Salient statistics of the boron-mineral industry in the United States, 1936–40

	1936	1937	1938	1939	1940
Sold or used by producers:[1]					
Short tons	313,759	358,898	[2] 215,662	[2] 245,284	243,355
Value	$6,156,123	$7,232,897	[2] $4,739,291	[2] $5,689,797	$5,643,390
Imports for consumption (refined):					
Pounds	1,887	724	631	[3] 774	752
Value	$457	$176	$131	[3] $170	$185
Exports:					
Short tons	102,021	154,052	77,519	91,139	64,313
Value	$3,119,850	$4,715,691	$2,642,446	$3,230,304	$2,456,523
Apparent consumption:					
Short tons	211,739	204,846	[2] 138,143	[2] 154,145	179,042

[1] 1936–37: Borax, colemanite, kernite, and boric acid (calculated as borax); 1938: Borax, kernite, and boric acid; 1939: Borax, colemanite, kernite, ulexite, and boric acid; 1940: Borax, kernite, boric acid, and colemanite.
[2] Revised figures.
[3] Also 348 pounds of crude valued at $3.

The use of boron in fertilizer, though not large as yet, is growing steadily and within a period of years may become a major outlet for this element. Active research has developed the fact that there is a different and a relatively narrow range of optimum concentration for each type of plant. Too little boron causes deficiency diseases in plants, and too much may prove toxic. The problem is complicated further by the fact that on some soils the very small quantities of boron compounds that can be employed may be made completely unavailable by other minerals contained in these soils.

Other uses of boron materials are being investigated. The Bureau of Mines has published a report[7] on the electrolytic production of calcium boride—an agent used to some extent in metallurgical work as a source of boron or as a deoxifier or degasifier of molten metals.

[7] Koster, J., Knickerbocker, R. G., and Fox, A. L., An Electrolytic Method for the Production of Calcium Boride: Bureau of Mines Rept. of Investigations 3500, 1940, 20 pp.

Research and development work has also been carried out in an attempt to improve the methods of recovering boron minerals from their ores. Another Bureau of Mines report [8] describes the recovery of a relatively high grade of crude boric acid by treatment of the ground crude ore with sulfur dioxide and water, followed by flotation of the precipitated boric acid. The same report also describes a method of recovering 94- to 95-percent calcium borate from a 70-percent colemanite concentrate by extraction with carbonic acid followed by precipitation of the resulting boric acid solution with lime.

Borax was placed on the export-control list on March 4, 1941. Inasmuch as over 90 percent of the world supply of boron materials is produced in this country this action affords the United States Government a means to ration most of the world supply of this important material.

[8] Knickerbocker, R. G., and Shelton, F. K., Beneficiation of Boron Minerals by Flotation as Boric Acid; Knickerbocker, R. G., Fox, A. L., and Yerkes, L. A., Production of Calcium Borate from Colemanite by Carbonic Acid Leach: Bureau of Mines Rept. of Investigations 3525, 1940, 18 pp.

GEM STONES

By Sidney H. Ball[1]

SUMMARY OUTLINE

The jewelry industry in 1940.—Retail sales of jewelry in 1940 totaled about $416,000,000—a 15-percent increase over sales of $361,564,000 in 1939, as reported by the Bureau of the Census. They were the most satisfactory since 1929, but the quantity sold exceeded that in 1929, as jewelry prices today are below those of that year. In 1939, 14,558 retail jewelry stores were operating in the United States. The Retail Business Census shows that in 1929, $1.11 out of the consumer's $100.00 was spent for jewelry, contrasted with only $0.86 in 1939. As compared to 1939, Michigan, Washington, Oregon, and Texas showed notable advance in retail sales in 1940. The gains were due largely to the increased sale of relatively inexpensive items, and although some high-priced articles were sold a colorless stock market exercised a restricting influence, particularly in New York. The volume of Christmas trade was at least 25 percent above that in 1939. Diamonds and watches were the leading items; sales of the former were augmented by the large number of engagement and wedding rings bought, especially after the passage of the Selective Service Act.

Jewelry manufacturers were unusually busy from May on, and overtime was common. The industry experienced some labor difficulties in 1940, the principal issue being the closed shop.

Retailers evidently believe wholeheartedly in the future of their trade. Tiffany's moved, for the fifth time in the 103 years of the corporation's life, to commodious quarters at 5th Avenue and 57th Street, New York City; two other important Fifth Avenue retailers thoroughly remodeled their stores; and, late in the year, at least two internationally known French jewelry houses opened shops on Fifth Avenue.

Fashions in jewels.—Colorful jewelry in large units characterized the 1940 mode. Gold, often in two or three colors, was more popular than platinum, although the latter was used in the finer diamond mountings. Patriotic, geometric, conventionalized floral, astronomic,

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

animalic (some few attractive), Egyptian, and East Indian motifs were seen. Styles were striking and individual. Jewelry ensembles set with similar stones continued to gain popularity, as did large pieces divisible into several ornaments. An abundance of bracelets and necklaces, hair ornaments (including tiaras), clips, rings, and earrings were worn. Wealthy refugee women wear their jewels, and American women are not to be outdone.

Large diamonds and colored gems set pavé with small diamonds were popular; but in the fall, the high price of small cut (owing to destruction of the cutting industry in the Low Countries) forced new styles requiring fewer melee. The finer gems—including the diamond (including fine yellow and some coffee-colored stones), ruby, and sapphire (not only blue but yellow)—were particularly popular, while the emerald was less so. The less-valuable colored stones—star sapphires, moonstone, and topaz, and, to a smaller extent, aquamarine and amethyst—were likewise much used. The appreciation of and demand for colored stones almost unknown to the earlier generation is evidence of the increasing knowledge of precious stones among the American people. Because of the insistent demand for diamonds, colorless stones were most popular; red, blue, green, and yellow stones followed in order.

Costume jewelry.—No costume is now considered complete without real or imitation jewelry, which is being used more and more. The black gowns so prevalent today form an excellent background for "gold" pins, clips, necklaces, and bracelets. The sales of costume jewelry in 1940 increased substantially, probably to a greater extent than sales of real jewelry. Designs are improving and either follow the lead of jewelry designers or in some instances precede them. Many foreign sources of supply were cut off by the war, but American industry has successfully made up the deficit. Plastics are effectively used, and lucite beads are a fair substitute for satin spar. The manufacture of costume jewelry centers in New York. The value at the factory of costume jewelry produced in 1939 was $33,921,990 (1937, $29,928,567), and over 12,000 people were employed in the industry.

Domestic production.—From the 1909 peak output of gem stones valued at $534,280, the domestic industry dwindled to only $3,000 in 1934. Since then production has increased markedly and in 1940 was valued at $340,000 to $750,000; the first figure is a rough estimate of the amount used in jewelry and the second an estimate of the total, including that treasured by collectors or sold to tourists, collectors, and rock gardeners. The rise is due largely to the growth of lapidary work as a hobby (particularly in the Pacific Northwest and notably in Oregon and Washington). Stones of the agate family comprise about 87 percent of the amount used in jewelry. Gems are produced largely by individuals or partnerships, and as there are no official returns exact figures are not available.

The war has shut off, at least in part, the country's normal sources of supply of colored gems; their place, to some extent, has been taken by gems of American origin.

In the Northwest, especially in Oregon (according to correspondence with H. C. Dake) mineral collectors and lapidaries, both professional and amateur, continue to increase. He estimates the value of the material (largely quartz minerals) collected and cut in 1940 as follows: Oregon (professional lapidaries—$150,000, amateurs—$225,000);

Washington, \$140,000; and Idaho, \$47,000—a total of \$562,000. A new agate-producing district in Harney County, Oreg., an opalized-wood locality in central Washington, nephrite in place in an aplite dike near Split Rock, Fremont County, Wyo., and nephrite boulders about 48 miles southeast of Lander, Wyo., are reported. Miss M. Barrie Berryman states that there are some 50 professional and amateur lapidaries in Utah; she estimates the total value of the rough and cut gems and mineral specimens produced in the State as \$25,000 in 1940 compared with \$8,000 in 1939.

With the exception of quartz gemstones, turquoise leads in total value—about \$20,000; Nevada ranks first in output and Colorado second. The Fox turquoise mine near Cortez, Lander County, Nev., produced 7,928 pounds of rough turquoise; of this the more desirable material was sold for \$11,405. The Tonopah district and mines at Austin, Nev., also produced some turquoise, as did the turquoise mine in the San Luis Valley near Villagrove, Colo. A little is reported to have been produced in New Mexico, and some Arizona turquoise was sold, although little or no mining was done in 1940. Sales of turquoise jewelry in the southwestern curio shops were large.

Arthur L. Crawford reported that three localities in Utah (5 miles west of Fairfield, Utah County; 9½ miles south of Grantsville, Tooele County; and 25 miles north of Lucin, Box Elder County) produced variscite in 1940, and the mineral was also discovered near Promontory Point, Box Elder County.

In 1940 Montana produced about 12,350 troy ounces of sapphires (1,029 pounds) valued at about \$17,000. The principal producers were the American Gem Mines at Philipsburg, owned by Charles H. Carp and J. W. Kaiser, and the Perry-Schroeder Mining Co. of Helena, dredge operators. The stones are used industrially, as few are suitable for jewelry. As difficulty is likely to arise in obtaining synthetic sapphires and rubies from Europe, Montana sapphire mining may well become an important cog in our national defense program, because jewels are essential in many instruments necessary for military purposes.

Austin F. Rogers [2] describes nephrite recently found in the western part of the Santa Lucia Range, southern Monterey County, Calif. It occurs not only in large and small boulders but also in place in serpentine in a region of Franciscan rocks. The nephrite ranges from light greenish gray to black in color, and some of it is suitable for cutting. According to reports, californite (a compact vesuvianite used as a substitute for jade) is being mined by the Curly Jack Mining Corporation on the South Fork of Indian Creek near Happy Camp, Siskiyou County, Calif.

Three operators produced tourmaline, kunzite, beryl, and rock crystal valued at about \$2,400 from the well-known gem-stone deposits of San Diego County, Calif.

In 1940 a number of mineral collectors visited Topaz Mountain in the Thomas Range, Juab County, Utah, according to Miss Berryman. By blasting they collected a quantity of sherry-color topaz, which had been bleached water-white at the surface. When cut this material forms attractive gems readily sold locally.

A considerable amount of moss agate was recovered from the gravels of the Yellowstone River in southeastern Montana. This

[2] Rogers, Austin F., Nephrite Jade from Monterey County, Calif.: Bull. Geol. Soc. America, vol. 51, No. 12, pt. 2, December 1940, p. 1941.

source has long furnished beautiful moss agate for jewelry, but fine material is becoming scarce. The deposit in the Granite Hills near Split Rock, Wyo., also supplied considerable moss agate, and some was produced in other Mountain States.

A few Sioux still dig pipestone at Pipestone, Minn., and cut it into pipes or ornaments for their own use or for sale.

In the fall of 1939 Carl M. Anderson found a deposit of lapis lazuli, some of rather fine quality, at an elevation of 12,500 feet on the slope of Italian Mountain, Gunnison County, Colo. The lapis occurs as three stringers in Paleozoic metamorphic limestone intruded by diorite, which reach a maximum width of 7 or 8 inches and are traceable for about 300 feet. Harold I. Rosencrans, a Longmont jeweler, controls the deposit, cuts the lapis, and sold some in the East and set the remainder in Indian-style silver jewelry for distribution in the West.

Some gem stones were produced as a byproduct of North Carolina feldspar and mica mining; C. C. West operated a ruby property near West Mills, Macon County, and sold the product to the tourist trade. A number of lapidaries also cut for sale to tourists.

A small amount of rose quartz was produced at Scott's mine near Custer, S. Dak. The total recorded production of rose quartz in the Black Hills from 1879 to date has been valued at about $55,000. A small amount was also produced at Albany, Maine, and asteriated rose quartz in North Carolina.

Other gem stones produced in the United States in 1940 included agate (Utah, South Dakota, New Mexico); agatized wood (private lands surrounding Petrified National Monument, Ariz., New Mexico, Utah); alabaster (New Mexico, Utah, Wyoming); amazonstone (Colorado); amethyst (Red Feather Lakes, Larimer County, Colo., Georgia, Maine, North Carolina); aquamarine (Colorado, Maine, North Carolina); azurite (Bingham, Utah); chalcedony (Utah); emerald matrix (North Carolina); garnet (Colorado, New Mexico, North Carolina); golden beryl (North Carolina); jasper (California, New Mexico, North Carolina, Utah); lazulite (Clubbs Mountain, N. C.); malachite (Bingham, Utah); moonstone (North Carolina); rock crystal (Arkansas); iridescent obsidian (California); rhodonite (Utah); rutilated quartz (North Carolina); topaz (Colorado, Maine, North Carolina); pink sapphire (Georgia); and tourmaline (Maine).

Imports.—Imports of precious and imitation stones (exclusive of industrial diamonds) into the United States in 1940 totaled $37,767,705—a 6.7-percent decrease as compared with 1939. Details are shown as follows:

	Carats	Value
Diamonds:		
Rough or uncut (suitable for cutting into gem stones), duty free	227,886	$11,595,703
Cut but unset, suitable for jewelry, dutiable:		
Less than 10 stones per carat	54,005	5,457,151
10 or more stones per carat	267,466	16,544,568
Emeralds:		
Rough or uncut, free	14,364	6,915
Cut but unset, dutiable	16,093	394,104
Pearls and parts, not strung or set, dutiable:		
Natural		224,101
Cultured or cultivated		355,595

	Value
Other precious and semiprecious stones:	
Rough or uncut, free	$153,858
Cut but unset, dutiable	2,191,513
Imitation, except opaque, dutiable:	
Not cut or faceted	4,127
Cut or faceted:	
Synthetic	359,672
Other	423,344
Imitation, opaque, including imitation pearls, dutiable	32,193
Marcasites, dutiable:	
Real	6,790
Imitation	18,071
	37,767,705

As compared with 1939 imports of rough diamonds, other precious and semiprecious stones, cultured and imitation pearls, and synthetic gems increased whereas imports of cut diamonds, uncut emeralds, natural pearls, and marcasites decreased. The number of watch jewels imported in 1940 totaled 98,771,042 valued at $1,831,007 compared with 43,712,840 valued at $913,245 in 1939.

Government regulations.—Owing to the war, Government regulations affecting the jewelry trade were legion in 1940. By Presidential proclamation, effective July 5, 1940, as a result of the Sheppard-May Bill, a license was required to export industrial diamonds and quartz crystals, and on December 20, 1940, the order was amplified to include all products that contain them.

The British embargo on the export of diamonds (to prevent industrial diamonds from reaching the enemy) promulgated at the beginning of the war is effective, except for a major leak of Brazilian stones to Germany. In 1940 the order was amended several times to increase the control of industrial diamonds. As of July 1, 1940, diamonds, precious stones, and jewelry were permitted to be carried out of Great Britain by license only to prevent the export of capital. Customs officials at British ports require the presentation of a license for all jewelry worn by travelers, even wedding rings if they appear to be new. The budget of July 1940 increased the British tax on jewelry to 33⅓ percent of the wholesale value.

Canada has classified industrial diamonds and piezoelectric quartz crystals as of indirect strategic value. To keep cash within the Dominion, in December 1940 Canada prohibited the importation of jewelry and uncut diamonds from the United States and placed a 25-percent excise tax on the sale of luxury articles. Canada was formerly this country's most important foreign market for jewelry. Severe regulations exist regarding the sale of military emblems that might be mistaken for official insignia.

In May the Union of South Africa decreed that all shipments of rough diamonds can thereafter be addressed and delivered only to parties in London.

For the period July-December 1940 New Zealand cut imports of precious stones from the United Kingdom and its Crown colonies by 75 percent. The export of precious stones, unset or in jewelry, from Australia is prohibited, except by consent of the Minister for Trade and Customs.

On June 3, 1940, France decreed that cut precious stones and jewelry could not be exported from the country; previous decrees had covered the export of rough stones.

In May 1940 Germany prohibited the sale in the Reich of gold objects weighing more than 50 grams (1.6 ounces) or of more than 14 carats gold content. Early in 1940 Hebrews in Bohemia and Moravia were required to register with the Government all precious stones and articles made of precious metals. In Occupied France the German military authorities required inspection of all private safety deposit boxes and official listing before January 10, 1941, of the gold and precious stones they contained.

Early in 1940 Japan appealed to its citizens to sell or give their gold jewelry to the Government. In June the sale of watches costing more than $12 and the manufacture and sale of rings and necklaces were prohibited. Stocks of such articles in stores were to be liquidated within 3 months. The export of gold, even that in one's teeth, is reported to be dutiable upon leaving Japan.

On March 24, 1940, French Indochina required all shipments of imitation precious stones imported into the colony to show clearly the country of origin. Many of the zircons cut in Bangkok, Siam, originate in Indochina and are smuggled across the border. To control the trade, the Indochinese Government on June 12, 1940, decreed (1) that only the Kha people could dig the gems; (2) that only licensed buyers could purchase them; and, (3) that buyers and lapidaries must keep an accurate and detailed account of the stones bought and sold.

On July 22, 1940, Switzerland placed the control of industrial diamonds under its War Industries and Labor Office, to regulate sales and insure more equitable distribution of the supply on hand.

On February 8, 1941, President Getulio Vargas of Brazil issued a decree prohibiting the export of 35 minerals (including industrial diamonds and rock crystal) without an export permit, except to American nations. Exports to Japan, either for Japanese consumption or for reexport, were relatively large in 1940.

Industrial gem stones and national defense.—Certain gem stones are essential to the United States armament program. Industrial diamonds are one of the critical [3] minerals being stocked by the Government to insure rapid and efficient motor- and airplane-engine production. Lapidaries should be trained to produce the smaller-gage diamond dies. As of June 30, 1940, the Procurement Division of the United States Treasury had purchased 11,800 pounds of rock crystal for $98,875, and early in 1941 it bought Brazilian industrial diamonds valued at $100,000. Piezoelectric quartz from Brazil is necessary in the manufacture of certain types of radios, telephones, telegraph instruments, and cables. Rock crystal is also essential for the lenses and prisms widely used in optical instruments and when fused is employed in the chemical and electrical trades. Limited quantities of fine fluorspar, also utilized in optical instruments, can be obtained in the Illinois-Kentucky fluorspar district, and a synthetic substitute is said to be satisfactory. Iceland spar is essential for Nicol prisms. A deposit found recently in the Copper Mountain mining district 30 miles southwest of Taos, N. Mex., promises to replace in the American optical industry the spar formerly imported from Helgustadir, Iceland. Tourmaline is used in the tourmaline tongs (a simple form of polariscope) and might have other value in military instruments. Watch

[3] Considered "critical" by the Army and Navy Munitions Board for purposes of procurement under the Reconstruction Finance Corporation.

and instrument jewels, essential for airplane instruments and time bombs, are normally cut in Switzerland from European-made synthetic sapphire. An adequate domestic supply of raw material is available in the Montana sapphire mines, but lapidaries should be trained in this country to cut the jewels.

Effect of war on jewelry trade.—The jewelry industry continues to feel the effects of war. Destruction of the cutting industry in the Low Countries doubled or even quadrupled the price of small-cut diamonds. The price of fine large stones, however, only increased about 20 percent, inasmuch as such goods can be profitably cut in this country, England, and South Africa. For the present prices should be firm, with possible increases in large-cut stones later. The limited supply of small-cut stones in this country will result in fashion changes, and pavé settings will be replaced by "sec" mountings (large stones set with a minimum of small stones).

The British embargo on the export of uncut gem and industrial diamonds has been administered broadly; in consequence, imports into the United States have been unusually large. New York has increased in importance as a diamond center but can scarcely, as some claim, become the locale of the world cutting industry.

The fine-precious-stone industry, with its center—Paris—in the hands of the Germans, has been in chaos; imports into the United States have been more or less normal, and although prices are firm no great increase is expected, as stocks in the United States are adequate. For the duration of the war India will be a more important—and Paris a much less important—center of fine-gem trading.

Most of the less-valuable stones were cut in Germany, Czechoslovakia, and France, and before the war the United States imported synthetic stones from Germany, France, and Switzerland. The stocks of the less-valuable stones were normal when war broke, but since then they have been replenished but meagerly; in consequence, shortages of certain stones already have occurred. Stocks of synthetic stones suitable for jewelry are not large.

An alleged shortage of iridium (used as an alloy in jewelry platinum) caused a marked increase in price in 1940 (from $175 to $275 an ounce), although the price of platinum itself was stable. The war can only increase the cost of most jewelry items.

DIAMOND

Notwithstanding world conditions the diamond industry in 1940 had a relatively satisfactory year. Production increased in total weight but decreased in total value. Total sales of rough stones by the Diamond Trading Co. were about the same as in 1939, but the war has largely limited retail purchases (with the exception of clandestine investment buying) to the American continents, India, and the East Indies. The invasion of the Low Countries disrupted the cutting industry. The Germans have the men, equipment, and plants but little rough stock; Great Britain has the stocks; and Great Britain and powers friendly to it have a few cutters of large stones.

Share dealings.—The shares of diamond-mining companies, virtually all of which are listed on the London Stock Exchange, had a limited and at times a nominal market in 1940. After a short spurt quotations declined until the French debacle in June, by which time they had been reduced almost 50 percent; prices then seesawed for 3 months and afterward rose rather sharply. During the year five representative stocks lost about 8 percent—better performance than that of most British and American stocks. At the end of the year quotations were 29 percent of their high (1927) and 285 percent of their low. Of the 11 leading diamond-mining companies, 8 paid dividends.

Market.—In 1940 the Diamond Trading Co., which controls the sale of about 95 percent of the world output of diamonds, sold rough stones valued at about £6,000,000. For the first 4 months of the year sales were large and reminiscent of the prosperous twenties. But with invasion of the Low Countries trade fell off markedly, and America remained the chief customer. Industrial diamonds were, however, sold in quantity throughout the year.

Sales of polished diamonds were also large until May, and during January and February small cut stones were in marked demand. After May, the United States was practically the only buyer of importance and since then has been building up its stock of small cut stones. Retail sales in the United States increased compared with those in 1939.

Stocks of rough stones held by the Diamond Corporation are large, although they include few fine, large gems. Stocks of rough gem-grade diamonds in the United States are believed to be adequate, but stocks of industrial grades are less so. Stocks of large cut stones are adequate; those of small cut stones are inadequate, and unless the latter can be replenished, jewelry styles must change.

Imports.—Diamond imports into the United States in 1940 by countries were as follows:

Diamonds imported into the United States in 1940, by countries

[Exclusive of industrial diamonds]

Country	Rough or uncut			Cut but not set		
	Carats	Value		Carats	Value	
		Total	Average		Total	Average
Belgium				242, 326	$15, 137, 583	$62. 47
Brazil	3, 436	$322, 773	$93. 94	1, 612	140, 058	86. 88
Cuba				131	10, 884	83. 08
France				6, 487	582, 519	89. 80
Mexico				40	3, 465	86. 63
Netherlands				34, 309	2, 306, 740	67. 23
Netherlands Indies	1, 789	45, 423	25. 39	501	18, 593	37. 11
Palestine				1, 123	92, 318	82. 21
Peru				18	933	51. 83
Switzerland				995	87, 894	88. 34
Union of South Africa	222, 615	11, 222, 372	50. 41	24, 571	2, 827, 942	115. 09
U. S. S. R				1, 017	39, 986	39. 32
United Kingdom				8, 341	752, 804	90. 25
Venezuela	46	5, 135	111. 63			
	227, 886	11, 595, 703	50. 88	321, 471	22, 001, 719	68. 44

Cutting.—The cutting industry was normal for the first 4 months of the year, but when the Germans invaded the Low Countries in May the centers of 90 percent of the industry became wholly disorganized. America, the principal market, must now depend on the 450 cutters in the United States, 300 in South Africa, and 200 in England to supply its needs, as Brazil, Borneo, India, and Palestine cater largely to local and Eastern markets. The cutters in the first three countries are paid such high wages that small stones cannot be cut profitably. Recent increases in America (the minimum weekly wage rose from $75 to $120) must increase prices; however, some observers claim that if the industry is mechanized further the United States can profitably cut small diamonds.

World production.—Owing to the war, actual production figures are not available but the estimates in the following table are believed to be fairly accurate. World production (gem and industrial) in 1940 is estimated to have been 14,140,200 carats (2.828 metric tons) valued at about $31,000,000—an all-time record as to quantity. Compared with 1939 total weight increased 13 percent; value decreased 24 percent. In other words, the production of bort increased markedly and that of gem stones decreased by about 22 percent. Belgian Congo was the leading world producer both in weight (77 percent) and in total value (24 percent). As only one pipe mine was operated—and that for but 8 months—the alluvial mines produced 96 percent of the world total by weight and 91 percent by value. Of the world total the British Empire produced 14 percent by weight and 37 percent by value. Industrials comprised 85 percent by weight of the world total.

The following table shows, as accurately as available statistics permit, world production for the past 5 years:

World production of diamonds, 1936–40, by countries, in metric carats

[Including industrial diamonds]

Country	1936	1937	1938	1939	1940
Africa:					
Angola	577,531	626,424	651,265	690,447	[1] 785,000
Belgian Congo	4,634,266	4,925,228	7,205,620	8,344,765	[1] 10,900,000
French Equatorial Africa	1,550	5,588	19,644	[1] 16,000	[1] 16,000
French West Africa	18,897	57,687	61,928	56,314	[1] 75,000
Gold Coast (exports)	1,414,677	1,577,661	1,296,763	1,087,652	[1] 825,000
Sierra Leone	616,200	913,401	689,621	[1] 600,000	[1] 600,000
South-West Africa	184,917	196,803	154,856	36,010	30,017
Tanganyika	2,704	3,234	3,576	3,445	[1] 2,250
Union of South Africa:					
Mines	339,719	820,284	979,460	[2] 1,089,144	[1] 351,400
Alluvial	284,204	207,359	259,148	160,684	[1] 172,000
Total Union of South Africa	623,923	[3] 1,030,434	1,238,608	[2] 1,249,828	[1] 523,400
Brazil	136,462	192,000	111,257	[1] 350,000	[1] 325,000
British Guiana	41,067	35,958	32,522	32,491	26,764
Other countries [4]	6,000	6,000	34,200	19,000	[1] 31,750
	8,258,200	9,570,400	11,499,900	12,486,000	14,140,200

[1] Estimated.
[2] Includes 1,009 metric carats recovered by debris washers.
[3] Includes 2,791 metric carats recovered from re-treatment of tailings.
[4] 1935: Borneo, India, Nigeria, and Venezuela; 1936: Borneo, India, New South Wales, Rhodesia, United States (California), and Venezuela; 1937: Borneo, India, Liberia, New South Wales, Rhodesia, and Venezuela; 1938–40: Borneo, India, New South Wales, U. S. S. R., and Venezuela.

The Belgian Congo increased its output, particularly from the Beceka mines, which produce mainly bort. Angola also increased its yield about 14 percent. The Gold Coast curtailed production drastically, and the pipe-mine output was about 37 percent of that in 1939. Venezuela—a minor producer— is increasing its output.

Age of African diamond deposits.—The more famous of the African diamond fields (South African kimberlite pipes) are of Cretaceous age. South African alluvial deposits and those of South-West Africa are derived from the break-down of such pipes. The Tanganyika pipes are contemporaneous, as are the noncommercial Belgian Congo pipes; strangely enough, the Arkansas kimberlite intrusives are approximately of the same age.

The Belgian Congo-Angola diamonds are known to be older than the Jura-Triassic and are presumably of pre-Cambrian age. Junner[3] believes that the Gold Coast deposits are also of pre-Cambrian age, and diamonds have been recovered from the clean-up of the Ashanti-Adowsena gold mine, whose ore bodies occur in the Banket series (Tarkwaian quartzites of pre-Cambrian age). An occasional diamond is found in the gold mines on the Witwatersrand, where the gold deposits also occur in pre-Cambrian rocks. The important Sierra Leone deposits and those of the French African colonies are likewise presumably of pre-Cambrian age.

In normal years the value of the production from the Cretaceous and pre-Cambrian deposits is more or less comparable; in 1940, owing to the small amount of activity in pipe mining, the older deposits represented 96 percent by weight and 72 percent by value of that part of the world production that can be allocated to deposits of these two types.

Industrial diamonds.—In 1940 American industries, working under the stress of the defense program, consumed more diamonds than ever, probably in excess of 2,000,000 carats, and in European munition plants the increased use was equally great. In the past 30 years the use of industrial diamonds has increased eightfold, and a decade hence the diamond mines of the world may have difficulty in satisfying the world demand. Industrial diamonds are one of the critical war materials to be stocked by the Procurement Division of the Treasury. During the last 2 years the American trade has accumulated a stock of industrial stones that may be adequate for 1 year's consumption. Naturally such a small stock is wholly inadequate for a highly industrialized country lacking local sources of supply. Features of the trade in 1940 were (1) the further expansion of the use of diamond-impregnated wheels and tools with a powdered-metal bond, (2) the increased use of mechanically set drill bits studded with small stones, and (3) the tendency to replace cleavages by fine crystals in diamond dies.

Throughout 1940 the demand for industrial diamonds was strong because of the high rate of industrial activity in the United States and in Great Britain. Prices were firm, with an upward trend.

Imports of industrial diamonds into the United States during the past 5 years were as follows:

Industrial diamonds (glaziers', engravers', and miners') imported into the United States, 1936–40

Year	Carats	Value		Year	Carats	Value	
		Total	Average			Total	Average
1936	1,166,094	$4,328,603	$3.71	1939	3,568,730	$9,725,683	$2.73
1937	1,885,970	6,542,365	3.47	1940	3,809,071	11,026,563	2.89
1938	1,396,247	4,213,412	3.02				

Imports from Brazil increased markedly and caused an advance of 16 cents a carat in the average value.

[3] Junner, N. R., Origin of Gold Coast Diamonds: Gold Coast Colony Report of Geol. Survey Dept. for financial year 1937–38, p. 6.

RUBY, SAPPHIRE, AND EMERALD

Sales of rubies, sapphires, and emeralds and of less-expensive colored gems were large in 1940. Particolored sapphires were popular, and one New York jeweler combined Montana sapphires and yellow gold attractively.

After the Burma Ruby Mines, Ltd., abandoned operations in 1931 local Burmese miners continued them. The production rose markedly from 1934 to 1937 (21,622 carats of rubies valued at £2,708 and 153 carats of sapphires valued at £25 in 1934 to 157,308 carats £6,841, and 4,392 carats, £228, in 1937, respectively). There was a further increase in 1938. A few spinels are a byproduct.

In 1939 the Anakie (Queensland) industry sold sapphires valued at £326; production was somewhat greater, as appreciable quantities of fancy stones and industrial corundum were exported but not sold.

The Kashmir sapphire output was nominally 18,344 carats valued at £41 in 1937 and 4,892 carats, £11 in 1938. Owing to its high altitude this deposit (at Soomjam in the Pedar district) can be worked only when the weather is favorable.

After 25 years of Indochinese sovereignty the sapphire deposits of Pailin were reincorporated into Thailand (Siam) toward the close of 1940.

In 1940 the United States imported 16,093 carats of cut emeralds valued at $394,104 (United Kingdom 58 percent, Russia 20 percent, Colombia 13 percent, France 2 percent, and Belgium 1 percent) and 14,364 carats of rough emeralds valued at $6,915. The Chivor Emerald Mines, Ltd., Colombia, was operated under lease in 1940, and some good material is reported to have been found. Dr. Thomas Clements (see following bibliography) considers that the Muzo (Colombia) emeralds were deposited by magmatic waters at relatively low temperatures. Although the mine has been closed since January 1, 1939, Dr. Clements states that the deposit is not exhausted, and he believes that there may be other deposits in the vicinity. Government reports indicate that emerald stocks valued at about $400,000 are in the Banco de la República. Brazil exports a few light-color emeralds obtained in the States of Minas Gerais and Bahia.

LESSER GEMS

A little opal was produced at Sheep Creek Station, Queensland, in 1939, but operations at Duck Creek were at a standstill.

Burma produced 1,303 hundredweight of jadeite valued at £4,320 in 1938 and 2,952 hundredweight valued at £13,030 in 1937; the cause of the decrease was attributed to the war in China.

Production of amber in Palmnicken, Prussia, increased consistently from 1936 to 1939 (estimated exports for 1939 were 26,860 kilograms valued at 138,000 reichsmarks); most of this output was shipped to Danzig for processing and re-export. The Myitkynia district produced 38.7 hundredweight of amber valued at £668 in 1937, but no production was recorded in 1938.

A rock crystal weighing 4,400 pounds and valued at $25,000 was found at Itamarandiba, Brazil, in 1940. The Swedish Geological Survey reports the discovery of rock crystal in the Province of Jamtland, northern Sweden. Preliminary tests suggest that this find may supply Sweden's small demand for piezoelectric rock crystal formerly obtained from Brazil.

Kornerupine of gem quality is reported to have been identified in concentrate from gem pits at Ratnapura, Ceylon.

Dr. A. L. Parsons reports that a little iolite was produced from the Great Slave Lake region, Canada. Some attractive gems have been cut from the material.

Agalmatolite is exploited on a small scale at the large deposit near Para de Minas, Minas Gerais, Brazil; it is used for church construction, ornamental purposes, and sculpture.

In 1939 Turkey produced less meerschaum than in 1938 (335 cases compared with 385 in 1938).

In the first half of 1940 Brazil exported 1,754,745 carats of gem stones—virtually all to the United States. Bahia and Rio de Janeiro were the principal shipping points.

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MINOR NONMETALS

By Paul M. Tyler and Leo J. O'Neill [1]

SUMMARY OUTLINE

CARBON DIOXIDE

According to preliminary figures of the Bureau of the Census, the production of dry ice in 1939 (the latest data available) amounted to 178,447 short tons valued at $5,532,315, and the output of liquid or gaseous CO_2 (including 15,000,000 pounds piped to dry-ice plants) was 51,104 short tons valued at $4,657,037. In 1937, the previous year for which statistics are available, the dry-ice output was 156,609 short tons valued at $4,618,937, and the production of liquid or gaseous CO_2 totaled 50,358 tons worth $4,939,508. The number of plants producing solid carbon dioxide increased from 42 in 1937 to 44 in 1939, whereas the number of plants producing liquid or gaseous CO_2 decreased from 61 in 1937 to 55 in 1939. The principal outlets for dry ice are in the ice-cream industry and for food refrigeration. Liquid CO_2 is used mainly in carbonating beverages. Imports of carbon dioxide for 1940, all of which came from the United Kingdom, amounted to 350 pounds (including weight of containers) and had a foreign market value of $197.

GRAPHITE

Although listed as a "critical" rather than a "strategic" material, graphite assumed considerable importance in plans for national defense and aid to Britain in 1940. Graphite crucibles are no longer used in making ingot steel and have been superseded in large part for melting steel and nonferrous metals in general foundry work. Nevertheless, they are still a wartime necessity, being employed for special castings and more especially in recent months in the manufacture of bronze and other copper-alloy castings for shipyards building naval as well as merchant vessels. Retorts for recovery of secondary zinc also are made from crucible-grade graphite admixed with clay and stoppers for ladles used in steel works from somewhat similar mixtures. Modern crucibles, which usually contain about 50 percent graphite,

[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.

withstand at least twice as many heats as those manufactured in 1914–18. With less melting to be done in crucibles and with more service obtainable from each crucible, the quantity demand pattern of the World War of 1914–18 has not been repeated. During the last war, moreover, crucible makers insisted on having Ceylon plumbago, whereas in recent years they have been just as insistent that Madagascar flake graphite is the only material that they can use, although several use admixtures of Ceylon graphite for certain products. One company utilizes a small quantity of Alabama flake for a special type of crucible.

Procurement of Madagascar flake afforded some difficulty even before the fall of France, and at the close of 1939 stocks were somewhat depleted. Madagascar recognized the Vichy Government, and although the French authorities were willing to do business with the United States the British blockade of the island effectively prevented shipments, except after major diplomatic maneuvers. Actual imports during 1940, including a small purchase for a Government stock pile, aggregated roughly three times the average quantities imported annually during the last 5 years, but estimated requirements were stepped up to at least 350 to 400 tons a month, or more than twice normal needs.

Graphite imported for consumption in the United States, 1936–40, by kinds

Year	Amorphous				Crystalline					
	Natural		Artificial		Lump and chip		Dust		Flake	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1936	20,160	$344,499	1,635	$63,804	251	$18,107	68	$4,090	2,057	$136,162
1937	25,354	512,162	802	31,562	482	41,499	321	17,600	2,634	149,492
1938	14,676	247,789	500	19,870	41	3,074	168	10,643	1,620	90,663
1939	18,675	269,046	413	15,383	(1)	(1)	[1] 602	[1] 30,421	2,260	110,476
1940	23,766	487,675	260	9,187	(1)	(1)	[1] 752	[1] 54,027	6,551	340,396

[1] Lump and chip included with dust.

Natural graphite exported from the United States, 1936–40

Year	Short tons	Value	Year	Short tons	Value
1936	816	$114,847	1939	976	$109,715
1937	1,514	163,331	1940	1,632	148,639
1938	983	112,443			

Prices of graphite in Madagascar were virtually unchanged during the year, and early in 1941 a cargo of several thousand tons was made up of various lots ranging in price (according to screen analysis and carbon content) from a minimum of $58 to a maximum of about $82 a metric ton, averaging $70 f. o. b. Tamatave. Freight rates, which for some time had remained unchanged at 90s. (say $18) a ton, were advanced to $25 a ton in November and later to $36. Import duty (30 percent or about $21) raised the total cost of the material to around $130 a metric ton or about 5⅞ cents a pound, delivered in New York, duty paid, in May 1941. Prices of amorphous graphite remained virtually the same as in 1939. In fact, almost the only substantial change in graphite quotations, apart from the advances due to increased ocean freight, was in Ceylon crucible grades, which were jumped to around 10 cents a pound f. o. b. mines compared with 5 or 6 cents a year earlier.

Notwithstanding the increase in imports a little more interest was evidenced in domestic graphite mining. The Long Valley Ore Co. mine at Pope Mills and the milling plant at Morristown, St. Lawrence County, N. Y., changed hands late in 1940 and were closed for extensive alterations which are expected to improve quality of the concentrate and to maintain a steady production rate of around 12 tons a day. The ore contains fine flake graphite disseminated in a sheared, thick-bedded quartzite or quartzose schist. Reserves are considered to be more than ample for several years' operations at least and may prove fairly large. Abandoned mines in the eastern and southeastern Adirondacks, previously described by Alling,[2] were examined by the Federal Geological Survey, which reports by letter that some of them may warrant further investigation, in the light of modern milling practice. A virgin prospect near Suffern, N. Y., yielded promising samples and was being investigated during the late fall in the hope that graded crushing and proper beneficiation might yield larger flake than hitherto has been obtainable commercially from domestic deposits.

The Alabama graphite industry was revived after 10 years of virtual inactivity. The Ceylon Graphite Co. near Goodwater, Coosa County, which rebuilt its mill late in 1939, began producing flotation concentrates comprising about 75 percent No. 1 flake, 20 percent No. 2 flake, and 5 percent dust. A small tonnage of amorphous graphite for paint was mined at Carson City, Nev., by the Carson Black Lead Co. Efforts were made to revive production of graphite in California, Georgia, Montana, Texas, Virginia, and perhaps other States, but the Bureau of Mines has no knowledge of any substantial production of natural graphite in 1940 except by the three companies mentioned. Artificial graphite was manufactured and sold by the Acheson Graphite Co. (30 East 42d Street, New York, N. Y.) at Niagara Falls and by the Exolon Co. at Blasdell, N. Y.

World production.—Owing to the absence of figures for the Soviet output, which in 1935 approximated 84,000 metric tons, world production statistics for graphite are incomplete. With the possible exception of the U. S. S. R. the largest producing area in recent years has comprised Bavaria, Moravia, and Austria, which produces mostly low-grade material suitable only for local consumption. The movement of this material in international trade has been confined virtually to transactions across the central European frontiers established by the Versailles treaty and wiped out by the expansion of Germany under Hitler. The principal source of overseas shipments is Chosen, which in recent years has become a large exporter of amorphous graphite and a by no means insignificant source of flake graphite. Next in order as regards tonnage but far more important as regards value of product is Ceylon. Although in recent years a substantial portion of Ceylon's exports, especially those to the United States, has been classified as "amorphous," the average price per ton f. o. b.

[2] Alling, H. L., The Adirondack Graphite Deposits: New York State Mus. Bull. 199, Albany, 1918.

mines is many times greater than that of material mined in any other important producing country, including even Madagascar, which is the only other large source of crystalline graphite worth more than about $50 a ton f. o. b. mines. Mexico, the only other country furnishing as much as 10,000 tons a year, produces amorphous graphite, all of which is exported to the United States and worth about $10 a ton, or roughly the same as the Chosen graphite f. o. b. mines.

Brazil.[3]—Graphite schists occur in the basal complex of Minas Geraes but usually are low-grade, although workable graphite (87 percent) is reported at Itabira. The best deposits—at Fortaleza, Arassuai, and Jequitinhonha—are veins in gneiss. Most important is that at Arassuai, which yielded only 8 metric tons from 1930 to 1937.

World production of natural graphite, 1915–34 (5-year averages), 1935–37 (3-year average), 1938, and 1939, in metric tons

[Compiled by L. P. Lounsbery]

Country	1915–19 (average)	1920–24 (average)	1925–29 (average)	1930–34 (average)	1935–37 (average)	1938	1939
Argentina					14	28	
Australia:							
New South Wales	100	18	12	18	10		(1)
Queensland					16	10	(1)
South Australia				15	(2)		
Brazil [3]	13	10	4	4	4	(1)	(1)
Bulgaria							23
Canada	2,481	1,172	1,756	790	(4)	(4)	(4)
Ceylon [3]	21,042	9,088	13,618	8,677	15,174	11,972	22,756
Chosen [3]	7,679	15,034	18,484	23,721	42,937	50,348	78,501
Czechoslovakia	[5] 26,841	13,751	29,276	4,187	3,313	(1)	(1)
France	886	415	734	46		(1)	(1)
Germany:							
Austria	[6] 19,657	11,557	19,083	14,653	19,786	16,852	(1)
Bavaria	31,308	21,696	17,548	21,333	23,166	28,106	(1)
Greenland		753			20	(1)	(1)
India, British	349	29	8	71	509	465	951
Indochina [3]	6,160		[7] 289		3	1	(1)
Italy	9,151	5,722	8,487	3,997	5,255	5,485	(1)
Japan	1,380	778	578	572	[8] 1,389	(1)	(1)
Madagascar [3]	16,776	9,929	14,141	6,111	9,668	13,433	(1)
Mexico	3,059	4,340	5,699	3,521	9,480	9,611	9,815
Morocco:							
French [3]	(1)		21	108	324	406	(1)
Spanish						73	(1)
Norway		2		1,206	2,485	3,802	(1)
Spain	1,184	1,923	580				(1)
Sweden	101	1			52	48	165
Union of South Africa	64	50	51	53	63	54	59
U. S. S. R.	(1)	(1)	3,992	[9] 32,333	(1)	(1)	(1)
United States:							
Amorphous	3,999	3,059	2,840	(10)	(10)	(10)	(10)
Crystalline	4,494	1,672	2,133	(10)	(10)	(10)	(10)
Total [11]	156,724	100,999	139,334	121,416	133,668	140,694	112,270

1 Data not available. 2 Less than 1 ton. 3 Exports.
4 Quantity not available; value reported as follows: 1935, $79,781; 1936, $88,812; 1937, $125,343; 1938, $41,590; 1939, data not available.
5 Average based upon production of Bohemia and Moravia, which before 1918 formed part of Austria.
6 Average based upon production of Lower Austria and Styria only. Data covering production of Bohemia and Moravia shown under Czechoslovakia.
7 Concentrates.
8 Average for 1935–36; data for 1937 not available.
9 Average for 1932–34; data for 1930–31 not available.
10 Bureau of Mines not at liberty to publish figures.
11 Sum of figures given in table only; probably incomplete.

3 Leonardos, O. H. (Graphite in Minas Geraes): Service fomento produccao mineral, Brasil, Avulso 26, 1938; Chem. Abs., vol. 34, No. 12, June 20, 1940, p. 4024.

Ceylon.—Japan continued to be the principal buyer of Ceylon graphite throughout 1940, and it was not until after the close of the year that the British Government placed an embargo on shipments to that country. A joint marketing scheme for Madagascar and Ceylon graphite was projected in April, presumably to gain political control of world supplies of high-grade graphite, but this plan was not popular in Ceylon and collapsed after the Battle of Flanders.

The total graphite shipped from Ceylon in 1940, according to preliminary reports, was 24,028 long tons valued at 5,750,144 rupees compared with 22,396 tons valued at 3,407,135 rupees in 1939 (Rs. 1 equaled $0.3003 in January 1941). Of the 1940 exports the United Kingdom purchased about 11,000 tons, and the United States and Japan about 6,000 tons each; smaller quantities were shipped to other countries. Whereas exports to the United States consist principally of relatively low priced amorphous or crystalline dust, Japan's purchases have been principally of high-grade crystalline.

According to Consul George M. Graves (Colombo):[4]

Increased orders for graphite have caused prices to rise. In fact, as one mine owner explained it to the Consulate, prices are rising with demand. There is, of course, another explanation of rising prices in that mining equipment has more than doubled in price and both freight and insurance rates are up.

Presumably the United Kingdom is cut off from the Madagascar market and therefore looks more to Ceylon for its requirements. Supplies on hand, particularly of the crystalline grades, are small. However, normal demand of the United States trade for amorphous grade should be met easily in 1941. Whether the United States will be able to obtain all its needs of crystalline graphite from Ceylon will depend on orders received from the United Kingdom, willingness of American importers to pay prevailing prices, and restrictions placed upon the shipment of graphite to Japan.

Crystalline graphite is relatively scarce, and neither mine owners nor shippers will enter into long-term future contracts for crystalline grades. One important producer of amorphous graphite informed the Consulate that no large mines in Ceylon are producing the crystalline grade, and that shippers of the commodity therefore are dependent on small mine owners, from whom they purchase stocks in 3- to 5-ton lots. Except at the few large mines, which produce chiefly amorphous grades, the mineral is mined by old-fashioned methods.

The Consulate has been supplied with the following current prices per long ton c. a. f., New York, of various grades of Ceylon graphite:

Percent	Grade	Price per long ton
88	"XB" flaky crucible O. L	$257.00
85	"B" flaky crucible O. L	234.00
98	Hard large lumps	193.00
97	Carbon ordinary lumps	178 00
95	do	171.00
93	do	164.00
90	do	155.00
90	Carbon chips	155.00
85	do	146.00
88	Flaky crucible chips	226.00
85	do	203.00
85	Carbon dust	153.00
80	do	143.00
90	do	163.00
65	do	99.00
55	do	83.00
85	Carbon F. D	145.00
90	do	155.00
65	do	99.00
60	do	90.00
55	do	83.00

[4] Graves, George M., Bureau of Mines Mineral Trade Notes: Vol. 12, No. 4, April 19, 1941, pp. 25–26.

The Administration Report of the Government mineralogist for 1939 (published May 1940) contains the following optimistic statement regarding possible extensions of graphite deposits:

Geological examination of the country north and northeast of Kurunegala and extending roughly in the quadrangle of territory enclosed between the lines Nikaweratiya to Vavuniya and Dambulla to Horowpotuna has proved a strike continuation of rocks belonging to the series that may be regarded as the carrier of the valuable graphite deposits of Ceylon. A fairly promising lode of graphite in the form of intersecting veins of graphite in the acid granulites and quartzleptynites, with charnockite dikes and sills, which was examined near Horowpotuna, reveals the possibilities of a large area of similar petrological composition and structural relations. Since then crystalline graphite has been observed as a rock constituent at several intermediate localities along the strike of rocks to south of Anuradhapura.

The chief mining areas for plumbago are centered in the southwestern half of the Island, to which alone prospecting has been directed hitherto. So far very little attention has been given to parts of similar composition and structure lying outside this area, where the country rocks are concealed under superficial deposits, soils, etc., for wide stretches. Detailed prospecting in this ground by private agencies is strongly recommended and is likely to reveal workable areas with promising contents of graphite.

Chosen.—Official statistics on exports of graphite from Chosen were discontinued after March 1940, but production of both flake and amorphous varieties undoubtedly increased, although shipments to non-yen-bloc countries declined. According to advices from Vice Consul Arthur B. Emmons, 3d, at Keijo, flake graphite prices, in terms of United States currency, ranged during the third quarter from \$21.09 a long ton for crude Grade C, No. 2, to \$107.81 for Grade A, while those of crude amorphous fluctuated between \$7.93 (Yen 30) and \$9.38 (Yen 40) a ton.

The local press announced on January 25, 1941, that the Government General of Chosen would publish new control regulations for the graphite industry in February. According to these regulations as reported, the Chosen Mining Development Co. (Chosen Kogyo Shinko Kaisha) will be designated a sole controlling agency, will purchase all graphite produced, and, in turn, will supply it to consumers. This monopoly company will fix prices and exercise arbitrary control over all phases of the graphite industry.

Madagascar.—According to a recent report,[5] the average yield at the oldest works in Madagascar, operated at Tsarazafy by Société Génerale des Graphites, is 1 ton of rough concentrates ("débourbé," about 50 percent carbon) to 3 tons of ore; 4½ tons of rough concentrates yield 1 ton of standard flake graphite containing 90 percent carbon and 1 ton of dust containing 80 to 86 percent carbon. Thus almost 7 tons of crude ore are treated for each ton of salable product, half of which is dust.

Production in Madagascar reached an all-time peak of 27,000 metric tons in 1917. Exports declined in 1932 to only 2,146 tons and jumped to 13,433 tons in 1938 under the stimulus of rearmament in Europe. Elimination of German purchases doubtless reduced shipments to some extent in 1939 and drastically later. At the end of 1940 considerable stocks had accumulated on the docks at Tamatave, the only port of shipment. Normally, however, production does not keep much ahead of shipments, and frequently partial payments on orders have to be made to finance mining and treatment, as many operators cannot finance themselves.

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[5] Van Slaars, Sidney, Bureau of Mines Mineral Trade Notes: Vol. 10, No. 5, May 20, 1940, p. 11.

Mexico.—Exports of graphite from Sonora to the United States, as reported by Vice Consul Henry T. Dwyer at Guaymas, jumped to 14,551 short tons valued at $140,590, which represents a 60-percent increase over the 1939 shipments of 9,070 tons valued at $92,181, and prices for the 80- to 82-percent product were advanced from $10 to $10.60 (United States currency) f. o. b. Mexican shipping point.

A general review of the Mexican graphite industry was prepared by Assistant Trade Commissioner John Bankhead.[6]

GREENSAND

In recent years the only commercial production of greensand has been in New Jersey, and this has been consumed almost exclusively in water-softening compounds. A brief survey of the industry was published in Bureau of Mines Mineral Trade Notes (vol. 9, No. 5, November 20, 1939, pp. 14–17). Shipments of refined greensand in 1940 totaled about 6,481 short tons valued at about $209,938 compared with 6,466 tons worth $150,500 in 1939 and an annual average of 12,715 tons valued at $197,200 for the 1925–29 period. Valuation figures are partly estimated.

Refined greensand produced in New Jersey, 1936–40

Year	Short tons	Value	Year	Short tons	Value
1936	8,368	$177,835	1939	6,466	$150,500
1937	9,734	210,974	1940	[1] 6,481	[1] 209,938
1938	6,576	152,000			

[1] Estimated.

ICELAND SPAR

By far the most important use for perfectly crystallized, waterclear, flawless calcite of optical grade is for the manufacture of Nicol prisms, which are an essential part of every polarizing microscope and of saccharimeters, dichroscopes, photometers, colorimeters, and polariscopes.[7] For many years this material was produced extensively in Iceland from deposits now apparently exhausted; later it came in meager amounts from South Africa and Spain. Domestic production has been negligible until about a year ago, when Ed. M. Stanton and associates of Santa Fe opened up a new deposit about 30 miles southwest of Taos, N. Mex. Users of this material report that it is of satisfactory quality, and high-grade rhombs up to 17 pounds in weight have been obtained.

KYANITE, ANDALUSITE, AND DUMORTIERITE

The increased use of kyanite for refractories is revealed by record domestic shipments for 1940 of 4,241 short tons valued at slightly less than $94,000 f. o. b. mines compared with 2,950 short tons valued at $69,000 f. o. b. mines in 1939. California and Virginia are the leading producing States. Imports of kyanite, all from British India, jumped

[6] Bankhead, John, Bureau of Mines Mineral Trade Notes: Vol. 12, No. 1, January 20, 1941, pp. 16–18.
[7] Hughes, H. H., Iceland Spar and Optical Fluorite: Bureau of Mines Inf. Circ. 6468R, 1941, 19 pp.

to 7,658 short tons having a foreign market value of $92,159 compared with 3,381 tons (revised) valued at $38,137 in 1939 and 3,964 tons valued at $32,458 in 1938.

The average price of all domestic kyanite sales as reported to the Bureau of Mines by producers was $22.10 a short ton f. o. b. mines. One of the largest producers, Kyanite Products Corporation, quotes raw 94-percent flotation concentrates (35-mesh) at $15 a ton in bulk and $17.50 in bags. Grinding through 100-mesh adds an extra $2 a ton, and calcining adds $5 a ton. Extra-low-iron grades carry a substantial premium, and a special product (under 0.1 percent Fe_2O_3, 98 percent kyanite) calcined and ground to 325-mesh has been offered by Celo Mines at $78 a ton f. o. b. Burnsville, N. C. Freight rates to northern and midwestern consuming points average $5 to $6 a ton on carload shipments.

The Phosphate Recovery Corporation remodeled and added calcining equipment to its plant at Darlington Heights in Prince Edward County near Pamplin, Va. This operation was taken over in September 1940 by the Kyanite Products Corporation, which also acquired the lease on the Knob Hill (S. C.) property. No production was reported at the latter property during the year, but plans were announced to drill the deposit in 1941. At Clarkesville, Ga., kyanite was produced by the A. P. Greene Fire Brick Co. and at the No. 3 plant of the Southern Mining & Milling Co. Celo Mines, Inc., Burnsville, N. C., produced kyanite and byproduct garnet. The kyanite deposit owned by the Vitrefrax Corporation at Ogilby, Imperial County, Calif., was operated by the Western Nonmetallic Co., which also does the milling. The product is used principally for making mullite grain.

Domestic production of andalusite and dumortierite has ranged from 400 to 2,000 tons per year; it is used mainly in the manufacture of spark plugs. The Tillotson Clay Products Co. has mines in California and Nevada but produced andalusite at the Nevada property only. Champion Sillimanite, Inc., produced dumortierite at Oreana, Nev., all of which was shipped for use by the parent company in the manufacture of spark-plug cores. The andalusite mine at Laws, Calif., owned by the company was not operated during 1940.

According to Boyd,[8] several useful minerals may be recovered from a north Georgia kyanite schist, which contains 4 to 8 percent kyanite, about 25 percent commercial mica, small quantities of commercial graphite, and impurities of silica, iron minerals, and slimes. The kyanite is separated from the gangue by mulling in patented mullers, screening, and jigging. The mica is recovered by settling, screening, and tabling and the graphite by flotation.

Tests of North Carolina kyanite showed that the rate of inversion to mullite and silica varies with the degree of shattering of the grains. Grains passing 325-mesh decomposed about twice as rapidly as coarser grains at certain temperatures, but above 1,500° C. all samples decomposed rapidly.[9]

Kyanite is mentioned as a cheap source of alumina for commercial glasses.[10] Finely powdered material containing less than 0.1 percent Fe_2O_3 can be produced upon a commercial basis and may afford a cheap and efficient source of alumina for improving the strength, vis-

[8] Boyd, Walter B.: Bull. Am. Ceram. Soc., vol. 19, No. 12, December 1940, pp. 461-463.
[9] Bartlett, Helen B., Rate of Decomposition of Kyanite at Various Temperatures: Jour. Am. Ceram. Soc., vol. 23, No. 9, September 1940, pp. 249-256.
[10] Scholes, Samuel R.: Ceram. Abs., vol. 19, No. 3, March 3, 1940, p. 64.

cosity, chemical durability, and thermal endurance of the glass. Inasmuch as kyanite contains approximately three times as much alumina as feldspar the tolerable content of iron oxide might be three times as great.

Consideration is being given to proposals to erect a plant in Sweden to produce aluminum from andalusite, which is reported to contain 35 to 40 percent Al_2O_3. Before the war, bauxite for the Swedish aluminum industry was imported from Norway.[11]

LITHIUM MINERALS

Shipments of lithium minerals and compounds by producers decreased to 1,961 short tons valued at $79,679 in 1940 as against 1,990 tons worth $97,000 in 1939 but compared favorably with the record of any previous year for which figures can be published. The decline in tonnage resulted from a drop in lithium compound shipped from the brine-refining operations at Searles Lake, Calif., which more than offset a slight increase in mine production. Consumption, on the other hand, continued to increase, causing stocks to be lower than for several years.

Although the quantities of lithium compounds consumed directly for war purposes are rather small, lithium is considered essential for certain uses by the American and British Governments. Increasingly large quantities of lepidolite were shipped to glassmakers in 1940, and the consumption of spodumene in ceramic work continued to grow. In enamels the addition of spodumene, a powerful fluxing agent, lowers the maturing temperature, thus reducing wear and tear on refractories. Small quantities of lithium chloride and lithium fluoride are used in welding-rod coatings and are said to give an exceptionally fine finish to the weld. Lithium-calcium alloys are effective in removing the nitrogen and oxygen gas from molten copper, thereby increasing its conductivity. The amount of lithium required in this process is only 0.001 percent. Small quantities of lithium hydroxide are used in Edison batteries, which are employed mainly in mine locomotives.

Spodumene was shipped by the Tennessee Mineral Products Corporation, Spruce Pine, N. C.; Lawrence Judson, Keystone, S. Dak., who leased the Ralph A. Smith property; and the Maywood Chemical Works from its Etta mine at Keystone, S. Dak. Amblygonite also was shipped from the Ralph A. Smith property. Only lepidolite was shipped from the Ingersoll mine of the Black Hills Keystone Corporation, although amblygonite and spodumene were also produced. The Black Hills Tin Co. produced spodumene from its recently installed flotation unit; the product is scheduled for shipment early in 1941. The mine at Hill City, S. Dak., formerly operated by H. Taylor, was idle in 1940 but shipped a small tonnage of spodumene mined the previous year.

Lithium compounds shipped from mines in the United States, 1936–40

Year	Producers	Short tons	Value	Year	Producers	Short tons	Value
1936	6	1,241	$34,273	1939	4	1,990	$97,000
1937	7	1,357	36,206	1940	6	1,961	79,679
1938	4	892	47,088				

[11] Bureau of Foreign and Domestic Commerce, Foreign Commerce Weekly: Vol. 1, No. 6, November 9, 1940, p. 278.

MEERSCHAUM

No meerschaum has been produced in the United States since about 1914. World supplies of the mineral, which is used almost exclusively in pipes and other smokers' articles, come from Eskishehir, Turkey. Imports into the United States in 1940 exceeded the total for the preceding 3 years, amounting to 18,431 pounds valued at $18,804. The average import value dropped to a new low of $1.02, the previous minimum being $1.36 in 1924.

MINERAL WOOL

The Bureau of Mines does not collect statistics on mineral wool, and those obtained by the Bureau of the Census are upon a biennial basis. In 1939, according to the latter Bureau, 58 plants produced mineral wool, vermiculite, and certain allied products valued at $8,237,553, a 10.4-percent increase over the value of products of 32 establishments reporting in 1937. Production of rock wool, shaped or in bulk, was reported as 139,455 short tons valued at $3,771,110 (141,262 tons, $5,525,628) and that of slag wool as 163,135 tons valued at $4,758,910 (55,180 tons, $2,514,854) in 1939 (revised figures for 1937 in parentheses). Under the sponsorship of the National Mineral Wool Association (Wharton Clay, secretary, 1270 Sixth Avenue, New York, N. Y.) the mineral-wool industry held a centennial celebration in Chicago on May 16, 1940. Most of the growth in the industry, however, has occurred during the last 10 years; it was not used extensively for home insulation until 1927, and the pneumatic method of installing it in dwellings already built was not perfected until 1930. Recent trends are toward full, thick insulation and increased use of batts and strips rather than loose wool. During 1940 the latter trend offset a substantial price reduction, with the result that compared with 1939 figures the total value of sales increased somewhat more than the increase of about 25 percent in tonnage sold.

MONAZITE

Monazite is a monoclinic phosphate of cerium metals, essentially $(Ce,La,Di)PO_4$, but it contains 0 to 18 percent thoria (ThO_2). Formerly monazite was valued principally for its thoria content, and even though the demand at present seems to be principally for the ceria, quotations are still based upon a minimum thoria content of 8 percent. The 1940 price—$60 to $65 a short ton—compares with $60 to $70 or $75 quoted in 1939 and earlier years.

After electricity supplanted gas for general lighting in this country, the consumption of monazite decreased sharply. As world production dwindled to about 23 tons in 1925, monazite seemed destined to be dropped from the list of useful minerals. However, the downward trend was reversed, and since 1932 production and consumption have increased owing to the increased use of pyrophoric alloys; of ceria and other rare earths in glass; of cerium fluoride and oxide in cores of searchlight, motion-picture, and therapy-lamp carbons; and (relatively new) of cerium acetate as a water- and mildew-proofing compound. Thoria is now considered a byproduct. Formerly gas-mantle manufacturers accumulated great quantities of residues carrying cerium, lanthanum, and other rare earths, but a processor of monazite stated in a recent interview that he could not fill the demand for cerium, whereas the demand for thorium was so small relatively that thoria was being stock-piled. Domestic manufacturers of incandescent mantles, however, continue to do a good export business; and fairly large quantities of thorium nitrate, although subject to export control, are exported to Japan and China.

Monazite was mined in the United States from 1893 to 1910 and again in the war years 1915–17. About 1 ton was produced in Florida in 1925. At the present price for imported monazite containing 8 percent thoria, domestic mines cannot operate at a profit. Even after concentration most domestic monazite contains less than 6 percent thoria and thus falls below commercial grade under present specifications. Hess [12] has stated that 15 cents a pound seemed to be about the minimum price at which domestic monazite could be mined in the Carolinas. The dominant position of British India as a producer of monazite is due chiefly to the high-grade beach sands of the State of Travancore, where some of the deposits contain as much as 50 percent monazite and yield after concentration a product containing 95 percent. In both Brazil and India monazite may be considered a byproduct from the mining of beach deposits for their ilmenite, rutile, and zircon content. Domestic deposits in the Carolinas do not contain similar associated minerals. Florida beach sands, on the other hand, do yield ilmenite, rutile, and zircon as joint products with monazite, and in 1940 mining of these sands was resumed. No figures as to the output of monazite (probably small) are available for publication.

OLIVINE

North Carolina olivine mines were operated intermittently, and shipments and consumption in 1940 probably did not exceed those of earlier years. Although commercial developments appear to be marking time, research is active, particularly at Norris and Knoxville, Tenn. At its Norris Electrotechnical Laboratory the Bureau of Mines has removed detrimental iron (from fayalite) as ferrosilicon in laboratory electric furnaces, the purified magnesium-silicate melt being either cast directly into blocks or granulated and then molded into refractory products. Various processes are proposed for obtaining magnesium salts and other compounds from this material, which contains more magnesium than any other common mineral except brucite. A preliminary report of studies of Pacific Northwest olivine was issued by the Bureau of Mines.[13]

QUARTZ CRYSTAL

Quartz crystal is a mineral of great strategic importance, as it is essential to radio communication and other military purposes. Japan, the United Kingdom, Germany, and the United States consume over 95 percent of the world total, which amounted in 1940 to about 1,000 short tons valued at $1,115,000 and which is supplied almost entirely by Brazil. No mineral is more abundant in nature than quartz, and hundreds of millions of tons of quartz worth only 50 cents to a maximum of about $2 a ton are produced annually in the United States and sold as sand, gravel, or stone. Even quartz crystal is so abundant that many hundreds of tons a year are thrown away as waste at feld-

[12] Hess, F. L., Monazite (chapter): Am. Inst. Min. and Met. Eng., Ind. Minerals and Rocks, New York, 1937, pp. 523–526.
[13] Ralston, O. C., and Conley, J. E., Annual Report of the Nonmetals Division, Fiscal Year 1940: Bureau of Mines Rept. of Investigations 3538, 1940, pp. 11–12.

spar quarries. It seems amazing, therefore, that the world must needs turn to only one country for its supply of crystals of the quality that can be used in radio work and that the price of these crystals should range from $2 to $20 or more a pound, or several times as much as ordinary quartz crystals are worth a ton.

In midsummer 1940 the Bureau of Mines surveyed stocks of quartz crystal suitable for radio-frequency control and found that stocks in private hands were adequate to supply immediate needs but that these should be supplemented by a Government stock pile that has been accumulating gradually in consequence of purchases by the Procurement Division of the United States Treasury Department. Japan was currently buying about 40 percent of all crystal produced in Brazil, and England's purchases have been expanded so that they virtually equaled the quantity bought by Japan and probably comprised a larger quantity of strategic quartz. United States purchases in recent years have represented about 5 percent of the quantity and about 15 percent of the value of exports from Brazil.

Before 1939 only a minor portion of Brazilian quartz, probably not over one-fourth, was usable for radio work. Quartz crystals vary greatly in perfection and size. For cutting into commercial piezo-electrical plates, resonators, or oscillators certain large users prefer crystals weighing 3 to 8 pounds and having at least two crystal faces. Such crystals cost $5 to $15 a pound delivered in New York and are difficult to get in quantity, so a considerable portion of the finished plates is made in relatively small shops where individual craftsmen can use economically crystals weighing only a half-pound or less, provided they are reasonably free from twinning, cracks, ghosts, veils, phantoms, needles, and bubbles. Most of these imperfections can be seen with the naked eye except twinning, which is one of the commonest and most serious defects.

Up to 1925 quartz crystals were used principally for ornamental purposes and to a minor extent for lenses and prisms for optical instruments or for making clear fused quartz. Their wide use for radio-frequency control is of relatively recent date, and not until 1937 were they employed extensively in telephony. Miscellaneous uses of strategic interest are in range finders, in instruments used for measuring pressures or detonation in gun barrels or airplane engines, in depth-sounding and direction-finding apparatus, and for sundry precision instruments, including chronometers, seismographs, periscopes, gun sights, and polariscopes.

Quartz crystal (Brazilian pebble) imported for consumption in the United States, 1932–40

Year	Quantity	Value	Value a pound	Year	Quantity	Value	Value a pound
	Pounds				*Pounds*		
1932	374	$86	$0.23	1937	32,821	$62,076	$1.89
1933	9,100	1,000	.11	1938	56,171	144,968	2.58
1934	8,219	2,477	.30	1939	67,052	138,695	2.07
1935	7,155	1,722	.24	1940	126,521	264,436	2.09
1936	22,766	9,645	.42				

SERPENTINE

Attention has been drawn to the possibility of utilizing the serpentine resources of Georgia as a source of magnesium and its salts.[14] A large deposit in Columbia County, Ga., is shown upon the new (1939) geologic map of the State. Analyses of several samples indicate a content of 36 to 38 percent MgO. Sulfuric acid for extracting the magnesium could be produced from the large pyrite deposits of Paulding and Lumpkin Counties, some of which were operated during the last war. The serpentine contains 2 to 5 percent chrome ore, which (it is reported) would be readily separable.

STRONTIUM MINERALS

Important changes characterized the strontium industry in 1940. Imports from Germany, the sole source of strontium salts in past years, were completely cut off, domestic mines resumed production on a small scale, and in December 1940 strontium metal and salts were added to the list of commodities that may not be exported except under license. The Mudrite Products Co. of Houston, Tex., has produced a small tonnage of impure celestite for several years; but this was ground for use as an oil-well drilling-mud admix, and no domestic production of minerals for their strontium content has been previously reported since 1918. Domestic requirements for strontium minerals and salts have hitherto been met by imports, principally from England and Germany; the former supplied virtually all requirements for strontium minerals.

The minerals celestite and strontianite are employed principally in the manufacture of strontium chemicals; however, ground celestite is used in fairly large quantities for purifying caustic soda for the rayon industry and strontianite on a semicommercial scale in Europe for desulfurizing and dephosphorizing steel. Although a few tons of strontianite mined in the United States in 1940 were shipped to a manufacturer of ferrous alloys, employment of strontium in steel making affords less promise in the United States than in Europe owing to the higher quality of domestic iron ores. Strontium nitrate is used in peace time in railroad flares and signals and is considered essential for military flares and rockets. Other strontium compounds are necessary constituents of tracer bullets and shells. In the past the greatest demand for strontium minerals has been from the German beet-sugar industry, where strontium hydrate is used in desaccharizing beet-sugar molasses. The use of strontium chloride in gas refrigeration, which appeared to promise wide application a few years ago, has failed to develop.

Excluding a considerable tonnage of celestite ground for use in oil-well drilling fluid as a weighting agent (displacing barite), domestic production, as reported by a total of six producers in California, Ohio, Texas, and Washington, was less than 350 tons in 1940. Imports of strontium minerals in 1940 amounted to 5,502,029 pounds and were mostly celestite from England, although 44,800 pounds of strontianite originated in Tunisia. Imports of strontium nitrate and the precipitated carbonate, previously supplied by Germany, ceased in 1940. Apparently the decrease in imports was more than compensated for by domestic production. A deposit of high-grade celestite in Mexico

[14] Fulcron, A. S. Magnesium and Magnesium Salts in Columbia County, Ga. Manufacturers Record, vol. 110, No. 2, February 1941, p. 19.

was developed in 1940, and exports of the material to the United States began in January 1941.

Quotations for finely powdered celestite containing 90 percent strontium sulfate remained unchanged at $37 a short ton from August 1939 to September 1940, when they were nominally advanced to $45 a ton concurrent with an advance in specifications to 92 percent minimum $SrSO_4$. The nominal quotation for powdered strontium carbonate remained unchanged at $55 a ton for material containing 84 to 86 percent $SrCO_3$. The price of technical carbonate was advanced 2 cents to 25 cents a pound in November, and supplies were reported limited. Mineral prices, however, are upon a basis of negotiation between buyer and seller, and the price for crude domestic material ranged between $15 and $20 a ton, f. o. b. mines.

The manufacture of strontium nitrate and strontium chloride from celestite is described in Research Series 67, Purdue University Engineering Experiment Station.

An important new source of strontium, discovered during the year at Utatur, is the first known commercial deposit of strontium minerals in South India.[15]

A discovery of strontianite associated with barytes in Newfoundland has been reported by A. O. Hayes and H. Johnson in a special bulletin referred to by A. K. Snelgrove in Information Circular 4 (1938, p. 126) issued by the Newfoundland Geological Survey.

Strontium minerals and chemicals imported for consumption in the United States, 1936–40

Year	Minerals		Nitrate		Carbonate and oxide	
	Pounds	Value	Pounds	Value	Pounds	Value
1936	3,880,302	$14,537	694,696	$39,820	52,311	$6,056
1937	5,636,570	20,877	609,488	40,243	44,579	4,610
1938	552,868	2,824	364,362	23,921	82,859	8,502
1939	5,645,935	23,136	479,933	32,060	23,148	2,811
1940	5,502,029	28,686				

VERMICULITE

Sales of vermiculite increased in 1940 to 22,209 short tons valued at $148,723 compared with 21,174 tons worth $174,587 in 1939 and exceeded the quantity sold in any previous year except 1937, when total shipments of 26,556 tons having the high value of $260,664 were reported by producers. By far the bulk of the 1940 output was mined by the Universal Zonolite Insulation Co. of America (2601 West 107th Street, Chicago, Ill.) at Libby, Mont. However, there were at least four producers in North Carolina and one each in Colorado and Wyoming. Recent developments have been reported elsewhere.[16] Annual sales since the beginning of the industry in 1924 were tabulated in Minerals Yearbook 1940 (p. 1480).

[15] Bureau of Mines Mineral Trade Notes: Vol. 10, No. 5, May 20, 1940, pp. 18–19.

[16] Tyler, Paul M., Vermiculite—North Carolina: Bureau of Mines Mineral Trade Notes, vol. 11, No. 3, September 20, 1940, pp. 25–26. Vermiculite—United States: Bureau of Mines Mineral Trade Notes, vol. 11, No. 6, December 20, 1940, p. 25.

PART IV. MINE SAFETY

EMPLOYMENT AND ACCIDENTS IN THE MINERAL INDUSTRIES

By W. W. Adams

SUMMARY OUTLINE

Increased employment and a more favorable accident-frequency rate in proportion to the number of man-hours of work performed were the outstanding facts revealed by reports from operators in the various mineral industries of the United States for 1940. Although data covering many operations had not been received when this was written, those available so far show upward trends in the number of employees, the number of man-days and man-hours worked, and the average number of workdays and workhours per employee during the year. Injuries, both fatal and nonfatal, caused by accidents to the employees, were more numerous in 1940 than in 1939, but the increase was proportionately smaller than the gain in man-hours worked, so that from the viewpoint of number of accidents among any given number of workers, the year's record as a whole was favorable. Virtually no change appears to have been made in the fatality rate, which was 1.14 per million man-hours worked in 1939 and continued at about the same level throughout 1940, as far as may be judged from the incomplete reports now available. On the other hand, the nonfatal-injury rate of 64.56 per million man-hours worked in 1939 apparently was lowered to 60.28 in 1940.

During the decade ended in 1940 employment in the mineral industries attained a maximum in number of workers in 1937, having increased by 188,608 men over the low point reached in the depression year 1932. The estimate of 812,000 employees for 1940 is within 6 percent of the peak year 1937. The highest accident-frequency rate (fatal plus nonfatal) was for 1931—the first year of the decade; since that time the trend of the yearly rates has been downward, apparently reaching its most favorable level in 1940, according to information now available.

Number of men employed in the mineral industries of the United States, 1938–40

	1938	1939	1940[1]
Coal mines:			
Bituminous	445,246	445,044	450,000
Pennsylvania anthracite	96,282	94,331	93,200
	541,528	539,375	543,200
Metal mines:			
Iron	18,006	19,769	22,100
Lead-zinc (Mississippi Valley)	6,436	7,237	7,800
Copper	17,582	18,436	19,300
Gold, silver (including lead, zinc, copper)	47,534	53,214	56,200
Miscellaneous (tungsten, manganese, etc.)	3,943	3,623	5,200
	93,501	102,279	110,600
Nonmetallic-mineral mines	9,526	9,630	10,600
Quarries:			
Cement	25,520	26,045	26,700
Marble	3,414	3,697	3,200
Slate	2,615	2,833	2,800
Traprock	3,141	2,771	2,900
Granite	8,395	8,390	8,000
Sandstone	2,907	3,113	3,400
Limestone	22,352	22,968	23,200
Lime	9,153	9,632	10,400
	77,497	79,449	80,600
Coke ovens:			
Byproduct	12,750	14,852	17,500
Beehive	1,049	1,757	2,000
	13,799	16,609	19,500
Metallurgical plants:			
Mills	11,657	12,476	13,200
Smelters	14,623	15,905	20,000
Auxiliary works	12,763	13,202	14,400
	39,043	41,583	47,600
Grand total	774,894	788,925	812,000

[1] Subject to revision.

The following table shows the number of employees, the number of man-days and man-hours worked, and the number of men killed and injured by accidents, as well as the yearly fatality and injury rate for mines, quarries, coke ovens, ore-dressing plants, smelters, and auxiliary works connected with ore-dressing plants and smelters.

Employment and accident record of mineral industries of the United States, 1931–40

Year	Men employed	Man-days of employment	Man-hours of employment	Number		Rate per million man-hours	
				Killed	Injured	Killed	Injured
1931	784,347	147,602,799	1,209,270,036	1,707	96,412	1.41	79.73
1932	671,343	110,655,616	900,211,723	1,368	68,717	1.52	76.33
1933	677,722	122,787,658	984,570,160	1,242	72,342	1.26	73.48
1934	739,817	144,566,133	1,081,694,716	1,429	81,660	1.32	75.49
1935	783,139	152,354,170	1,128,808,465	1,495	82,219	1.32	72.84
1936	824,514	177,920,334	1,326,347,029	1,686	92,644	1.27	69.85
1937	859,951	186,790,283	1,381,261,415	1,759	96,484	1.27	69.85
1938	774,894	145,056,875	1,069,729,725	1,369	71,618	1.28	66.95
1939	788,925	159,388,490	1,169,351,497	1,334	75,495	1.14	64.56
1940[1]	812,000	175,400,000	1,303,000,000	1,690	78,550	1.30	60.28

[1] Subject to revision.

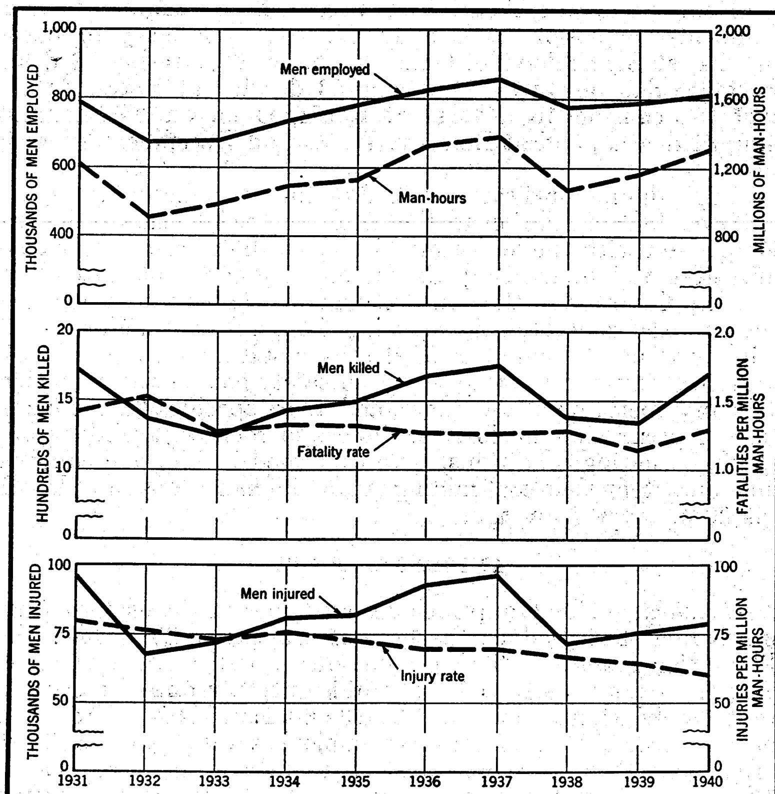

FIGURE 1.—Trend of employment and fatal and nonfatal accidents in the mineral industries of the United States, 1931–40.

EMPLOYMENT AND ACCIDENTS

BITUMINOUS-COAL MINES

Employment.—About 630 million man-hours of work were required to supply the United States with bituminous coal in 1940. This amount of labor, performed by approximately 450,000 employees in and about the mines, represented an increase of about 14 percent over 1939. According to present estimates, the output in 1940 was 453,200,000 tons—an increase of 57 million tons over 1939. The average employee was employed about 19 more days than in 1939.

Accidents.—Although accidents increased in number in 1940, along with the increase in the number of hours worked, the greater volume of employment or exposure to occupational hazards did not cause a rise in the accident-frequency rate per million man-hours of exposure; in fact, the accident rate apparently declined, as it was estimated at 69.81 compared with a rate of 71.01 in 1939 shown by final reports from the operating companies. This estimated accident-frequency rate for 1940 included a fatality rate of 1.93 compared with 1.56 for the previous year; the unfavorable showing for 1940 was due chiefly and almost entirely to the occurrence of six major disasters, with a total of 276 deaths in 1940, whereas only one major disaster, with a total of only 28 deaths, occurred in 1939. The six major disasters in 1940 included explosions at Bartley, W. Va., on January 10, causing 91 deaths; at St. Clairsville, Ohio, on March 16, causing 72 deaths; at Portage, Pa., on July 15, causing 63 deaths; at Bates, Ark., on August 27, causing 10 deaths; at Cadiz, Ohio, on November 29, causing 31 deaths; and at Beckley, W. Va., on December 17, causing 9 deaths.

Although the major-disaster record of 1940 was distinctly unfavorable, it was bad in relation to that of other recent years rather than in comparison with the long-time history of the industry. Even the six disasters and their heavy death toll in 1940 should not obscure the creditable progress that the bituminous-coal industry has made during the past generation in reducing the number of major disasters and in lowering the number of deaths resulting from them. The general awakening to the importance of safety as a factor in efficiency in the daily operation of the mines, and, more specifically, the increasing use of permissible explosives, the use of rock dust, and improvement in ventilating conditions, have combined to improve conditions to such an extent that coal mining is not the hazardous industry that it was 30 or more years ago.

ANTHRACITE MINES

Employment.—This group includes all mines in the eastern part of Pennsylvania that produce the type of coal generally termed "hard coal" or "anthracite." The production of anthracite during 1940 amounted to about 50,100,000 tons; this output required the work of approximately 93,200 men for 122,493,000 man-hours. Preliminary reports indicate that the number of employees was slightly under that for 1939 and that there was also apparently a slight reduction in man-hours worked during the year. No material change occurred in the total number of work days or work hours of the average employee during 1940.

Accidents.—Accidents to the men working in and about the Pennsylvania anthracite mines caused 184 deaths. In addition, 13,156 (estimated) men received injuries that resulted in at least 1 day of disability. Reports available thus far suggest that final records for 1940 will show a fatality rate of 1.50 and an injury rate of 107.40 per million man-hours worked; both of these rates were more favorable than the corresponding rates for the previous year.

Since June 2, 1938, when 10 men were killed in a mine explosion in Luzerne County, the anthracite-mining industry of Pennsylvania has been operated without an accident in which as many as 5 lives were lost.

IRON-ORE MINES

Employment.—Substantial gains in employment in iron-ore mining in 1940 were indicated by reports from the mining companies to the Bureau of Mines. Increases in number of employees amounted to approximately 12 percent, in man-days worked to 19 percent, and in man-hours worked to 21 percent. Incomplete returns indicate that employees at all iron-ore mines in 1940 totaled 22,100 and the man-hours worked 43,200,000. The average employee appears to have worked a little longer each day than he did in 1939, although the increase was only a fraction of an hour a man. The number of workdays per employee also increased in 1940.

Accidents.—For some years the iron-mining industry has conducted its operations with a greater measure of safety than most other branches of the mineral industry. This condition was maintained throughout 1940, although the accident-frequency rate for that year was not as favorable as for 1939. According to available reports from the operators of the mines the accident-frequency rate per million man-hours worked was 18.75 compared with the 17.51 shown by final reports for 1939.

COPPER MINES

Employment.—This group of mines covers all those operated chiefly for the copper content of their ores, although one or more metals other than copper may have been contained therein. Reports from operators of the mines showed that approximately 19,300 men were employed in 1940—a gain of between 4 and 5 percent over the 18,436 men who worked in 1939. A larger increase, amounting to about 16 percent, was made in the total man-hours of work performed, which was estimated at 48,800,000. Reports from the companies also showed that the period of employment per worker was substantially greater than in 1939, when the average employee had 285 days of work.

Accidents.—The accident situation at copper mines improved. Accidents occurred at the rate of 53.38 per million man-hours worked, which represented progress in accident prevention compared with the previous year's rate of 59.83. These figures included a fatality rate of 0.90 for 1939 and an estimated fatality rate of 1.00 for 1940.

LEAD AND ZINC MINES (MISSISSIPPI VALLEY STATES)

Employment.—This group includes all lead- and zinc-producing mines in the Mississippi Valley States, chiefly Oklahoma, Missouri, and Kansas; it also includes mines in Illinois and Kentucky producing fluorspar. Fluorspar mines in the two States mentioned are included for two reasons—because it is desirable to maintain unbroken a statistical series in the Bureau of Mines accident records that extends back to 1911 and because natural conditions regarding safety are not materially dissimilar in the two classes of mines in the States named and therefore permit separate figures to be published for Illinois and Kentucky. With this explanation as to the coverage of the figures, it may be stated that mines in the Mississippi Valley States employed about 7,800 men in 1940—an increase of more than 500 over the previous year. Man-hours of work totaled nearly 14 million—a gain of approximately 12 percent over 1939. The average employee gained about 10 workdays over the preceding year, when the average was 216 days of employment per man.

Accidents.—From reports now available the accident-frequency rate in 1940 seems to have been 59.29 per million man-hours worked. This rate was almost the same as that of 59.52 for 1939; however, the fatality rate, which is included in the frequency rate, appears to have been reduced somewhat from that for 1939—1.20 per million man-hours worked.

GOLD AND SILVER MINES

Employment.—This group includes gold and silver lode and placer mines in all States, lead and zinc mines elsewhere than in the Mississippi Valley region, and mines that produced some copper but that were operated chiefly because the ore contained metal other than copper.

The group as a whole employed about 56,200 men in 1940; 40,800 represented the number of employees at lode mines and 15,400 those at placer operations. Employment at each of the two classes of mines gained in 1940. Lode mines were in operation nearly 77 million man-hours, and placers were active about 21 million man-hours. The number of workdays of the average employee in 1940 apparently increased slightly at placer mines, but there appears to have been no change at lode mines.

Accidents.—As estimated for 1940, the accident-frequency rate was slightly more favorable than that revealed by final figures for 1939. This comparison applies both to lode and placer mines. The improvement was not great, and final reports from the operators may indicate that the rate was virtually the same in 1940 as in 1939. The tentative rate for lode mines for 1940, covering fatal and nonfatal injuries, was 106.44 per million man-hours worked, compared with a final rate of 110.51 for 1939; the rate for placer mines was 33.71, compared with 35.31 for 1939.

MISCELLANEOUS METAL MINES

Employment.—This group covers all operations that mine any kind of metallic ores except those produced chiefly for their gold, silver, copper, lead, zinc, or iron; therefore it includes mines that produce certain strategic minerals, such as tungsten, mercury, manganese, bauxite, and molybdenum. According to tentative figures now available, reflecting the intense demand for these strategic metals occasioned by national defense preparations, the number of employees in 1940 rose to approximately 5,200—a relative increase of 44 percent over the 3,623 employed in 1939. The man-hours of employment rose from 6.6 million in 1939 to 11.5 million in 1940—a relative increase of approximately 74 percent.

Accidents.—The safety record for miscellaneous metal mines was less favorable than in 1939. The accident-frequency rate per million man-hours of employment was approximately 80.18, compared with 76.19 in 1939.

NONMETALLIC-MINERAL MINES

Employment.—This group covers mines that yield all kinds of nonmetallics except stone, sand, gravel, and clay; therefore it includes those that produce phosphate rock, rock salt, sulfur, gypsum, and many other minerals. About 10,600 men were employed in 1940—a 10-percent increase, compared with the average working force of 9,630 men in 1939. During 1940, 21.2 million man-hours of work were performed; the corresponding figure for 1939 was 17.3 million.

Accidents.—From reports received so far the nonmetallic-mineral mines had an accident-frequency rate of 36.84 per million man-hours worked, which compares favorably with the rate of 42.19 shown by final reports for 1939.

CEMENT MILLS AND QUARRIES

Employment.—A gain in employment was reported for cement quarries and mills in 1940, compared with 1939; the number of men working increased 3 percent and the total number of man-hours 6 percent. The total estimated number of workers was 26,700 and man-hours worked 55.2 million. Reports for 1940 also showed an average increase of about 6 workdays in the period of employment per man.

Accidents.—The number of accidents in the cement industry increased in 1940, along with an increase in the number of workers and in man-hours of employment. Five hundred and thirty-six men were killed or injured in 1940. These figures represent a fatality rate of 0.27 and an injury rate of 9.44 per million man-hours of employment in the cement industry, compared with 0.23 for fatalities and 8.79 for injuries in 1939; thus the injury rate for 1940 was less favorable.

MARBLE QUARRIES

Employment.—Fewer men were employed and fewer man-hours of employment reported for marble quarries in 1940 than in 1939. The average number of men working at quarries and finishing plants was estimated at 3,200, and the total man-hours worked during the year was 6 million—a 13-percent decrease in the number of men employed and a 16-percent decrease in the number of man-hours of employment.

Accidents.—A far greater proportionate decrease occurred in 1940 in the number of men injured than in the volume of employment. All told, 239 men were injured, 3 fatally, compared with no fatalities and 429 nonfatal injuries in 1939, resulting in a 33-percent decrease in the accident rate in 1940, compared with 1939. The combined rate for 1940 was 40.58 per million man-hours worked; for 1939 it was 60.91.

SLATE QUARRIES

Employment.—The number of men working in the slate-quarrying industry was almost identical with that in 1939, although the man-hours worked decreased 6.1 percent. Final figures for 1940 show 2,800 employees and 5.0 million man-hours of employment, as well as a slight loss in the average amount of employment per worker.

Accidents.—Three hundred and fifty-six men were injured by accidents at slate quarries during 1940; 1 injury resulted fatally. The rate for 1940 was 71.03 injuries and fatalities per million man-hours worked compared with 70.98 for 1939.

TRAPROCK QUARRIES

Employment.—Reports from traprock quarries in 1940 indicated a gain in employment over 1939, when 2,771 men were reported employed. The total number of man-hours worked is estimated at 4.5 million for all operations, representing a gain of about 7 percent over the 4.2 million man-hours worked in 1939.

Accidents.—Although final figures are not available injuries during 1940 totaled 280 and included 3 fatal injuries. The frequency rate, covering both fatal and nonfatal injuries, was 62.09 compared with 65.95 in 1939.

GRANITE QUARRIES

Employment.—Fewer men were employed in and about granite quarries in 1940 than in 1939—approximately 8,000 compared to 8,390. The aggregate number of man-hours worked in the industry as a whole decreased about 8 percent. The period of employment averaged somewhat less than the 222 workdays per man shown by final reports for 1939.

Accidents.—Preliminary data indicate that the accident-frequency rate in 1940 was 44.77 per million man-hours of exposure to risk. The rate for 1939 was 42.98. The fatality rate was somewhat higher in 1940 than in 1939.

SANDSTONE QUARRIES

Employment.—About 3,400 men were employed at sandstone quarries—an increase over the 3,113 employed in 1939. Approximately 5.6 million man-hours of work were performed compared with 4.8 million in 1939—an advance of about 17 percent.

Accidents.—The number of accidents increased in 1940; fatal and nonfatal injuries are estimated at 355, representing an accident-frequency rate of 63.39—a tentative figure that compares with a final rate of 65.31 for 1939. No fatal accidents occurred in 1939, but preliminary reports indicate that 5 men were killed in 1940.

LIMESTONE QUARRIES

Employment.—Limestone quarries (not including those whose product was used chiefly for the manufacture of lime or cement) in the United States employed approximately 23,200 men in 1940—a slight gain over the 22,968 employed in 1939. The man-hours of employment also increased—from 35.7 million in 1939 to an estimated 37.2 million in 1940; moreover, a slight gain was also made in the number of workdays per employee in 1940.

Accidents.—A decrease in accidents, both in number and in relation to man-hours of employment, was shown by operators' reports for 1940. Tentative figures indicate a reduction in the accident-frequency rate from 49.16 in 1939 to 45.71 in 1940.

LIMEKILNS AND QUARRIES

Employment.—Gains in the number of workers and man-hours worked in 1940 compared with 1939 were reported by the lime industry. Tentative figures showed that 10,400 men were employed compared with 9,632 in the previous year; they also showed 22.7 millions of man-hours worked—an increase of 12 percent. The average employee also had more days of work than he had in 1939.

Accidents.—Tentative figures show an accident-frequency rate of 44.95 per million man-hours worked in 1940 compared with 49.59 for 1939.

BYPRODUCT COKE OVENS

Employment.—Increased employment in 1940 raised the total number of employees at byproduct coke ovens to 17,500—an 18-percent gain over 1939. The volume of employment was the equivalent of 50.4 million man-hours compared with 42.2 million in 1939—a 19-percent gain.

Accidents.—Complete reports for 1940 show that 415 fatal and nonfatal injuries occurred. The combined accident-frequency rate covering fatal and nonfatal injuries was 8.24 compared with 8.15 in 1939—a slight advantage in favor of 1939.

BEEHIVE COKE OVENS

Employment.—Although the number of men working at beehive coke ovens in the United States has been small in recent years it increased greatly in 1939 and again in 1940. It is estimated that 2,000 men worked at the ovens in 1940—a gain of nearly 14 percent over 1939, when 1,757 were employed. Man-hours of work also increased, being 2.8 million in 1940 and 1.5 million in 1939—an increase of 79 percent.

Accidents.—Operators' reports showed no fatal accidents in 1940 but revealed that the nonfatal injuries resulted in an accident-frequency rate of 48.29 per million man-hours worked; this rate did not compare favorably with the safety record of 1939, which was represented by a frequency of 40.25.

ORE-DRESSING PLANTS

Employment.—Ore dressing and beneficiating plants or mills employed approximately 13,200 men in 1940 compared with 12,476 in the previous year and were in operation 29.9 million man-hours; the latter figure revealed a 9-percent gain over the 27.5 million man-hours worked in 1939.

Accidents.—Accidents to men employed at the mills occurred at the rate of 28.56 per million man-hours worked in 1940. When compared with a frequency rate of 31.87 in 1939 the safety record for 1940 is seen to have been favorable.

SMELTERS

Employment.—As classified herein, the smelting industry covers the smelting and refining of all metallic ores except iron ore. Accident and employment statistics covering the smelting of iron ore and the manufacture of steel are not included in Bureau of Mines figures because such statistics are collected and compiled by the United States Department of Labor. The smelter industry employed approximately 20,000 men in 1940—a 26-percent increase over the 15,905 men employed in 1939. The man-hours of employment in 1940 reached 46.5 million compared to 37.7 million in 1939—a 23-percent increase.

Accidents.—In face of the intense production effort, accident prevention suffered a set-back in 1940. The accident-frequency rate increased from 16.35 in 1939 to 19.90 in 1940.

AUXILIARY WORKS AT ORE-DRESSING PLANTS AND SMELTERS

Employment.—Auxiliary works cover all operations at mills and smelters not directly connected with milling and smelting processes.

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About 14,400 men were so employed in 1940, indicating a material gain over the 13,202 men working in 1939. Man-hours worked likewise increased in 1940, as the estimated number totaled 35.6 million, a 13-percent increase over the 31.5 million man-hours worked in 1939.

Accidents.—Preliminary figures indicate an accident-frequency rate of 18.93 per million man-hours worked—a gratifying improvement over that of 22.28 for the previous year.

SUMMARY, 1931–40

Accident and employment data of the Bureau of Mines, except those covering nonfatal injuries at coal mines, first became available for 1911; these figures covered the mining and quarrying industries only. Beginning with 1913 statistics also became available for coke ovens and for ore-dressing plants and smelters, although the early records did not show the number of man-hours worked. After a few years some companies operating metal mines and stone quarries supplied special information, including man-hours worked, and tables based upon these data were prepared from time to time. Nationwide coverage of accidents and employment, including the number of man-hours worked, first became available for coal mines in 1930 and for quarries, coke ovens, metallurgical plants, and all other mines in 1931. Beginning with 1931, therefore, the yearly records of the Bureau of Mines are complete as to fatal and nonfatal injuries, men employed, and man-days and man-hours worked.

As this review of accidents and employment in the mineral industries of the United States for 1940 was necessarily prepared before many operating companies had sent their reports to the Bureau of Mines, it has not been practicable, in some of the brief reviews of each of the separate mineral-commodity groups, to state the actual number of deaths that occurred during 1940, although the combined number of deaths and injuries has been given, either specifically or by indicating the accident-frequency rate per million man-hours worked. Except in the larger groups or in groups for which nearly complete returns have been received, the number of deaths is usually too small to be estimated accurately.

When the record covering all branches of the mineral industries covered by the Bureau of Mines accident reports is reviewed, preliminary reports indicate that final reports for 1940 probably will show approximately 1,690 men killed and 78,550 injured. Should final reports from operating companies confirm this statement, 1940 will have been the best year, from the standpoint of the employees exposed to occupational risk, of any during the decade that began with 1931; that is to say the accident-frequency rate, estimated at 61.58, was lower than in any previous year of the period from 1931 to 1940. The estimated rate for nonfatal injuries was 60.28, which is lower than that for other years of the decade and compares most favorably with the rate of 79.73 for 1931. The estimated fatality rate for 1940—1.30—was lower than the corresponding rates that prevailed during most of the early years of the decade but did not compare favorably with the latter part of that period.

Employment figures for 1940 showed that the number of employees probably increased at 17 out of the 21 groups of mineral operations for which separate figures were compiled. A similar comparison was revealed for the number of man-hours worked. The number of accidents increased in only 14 of the 21 groups, explaining in large measure why the over-all accident-frequency rate for all 21 groups was more favorable in 1940 than in 1939 and, in fact, than in any other year of the decade 1931–40.

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